EUROPEAN ORGANISATION FOR THE SAFETY OF AIR NAVIGATION

EUROCONTROL

Guidelines for the Production of Computer Based Training

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EUROPEAN AIR TRAFFIC CONTROL HARMONISATION AND INTEGRATION PROGRAMME

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Abstract

These guidelines describe principles and technologies to be used to develop harmonised teachware They have been designed to be independent of the authoring tool used for development However, the developments will greatly benefit of the use of "EUROCONTROL templates"

Keywords

Computer Based Training	CBT Principles and Technologies	Production Methodology	Teachware development
CBT Phases	Part-Task training	Training Tools	Teaching Objectives

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The following table identifies all management authorities who have successively approved the present issue of this document

AUTHORITY	NAME AND SIGNATURE	DATE
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DOCUMENT CHANGE RECORD

The following table records the complete history of the successive editions of the present document

EDITION	DATE	REASON FOR CHANGE	SECTIONS PAGES AFFECTED
0.1	21/03/96	Working Draft	all
0.2	03/07/96	Draft (reviewed by TSG)	all
0 3	23/09/97	Proposed issue from TSG to HRT	all
1 0	14/11/97	Released issue by HRT No 8	all

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The purpose of these guidelines is to facilitate the efficient and useful creation of harmonised TEACHing softWARE, software teachware - specially used to provide Computer Based Training (CBT) to a student

The first chapter "Introduction" explains in further details this aim, defines the respective responsibilities and refers to a complementary document on the particular aspect of shared developments

Chapter 2 "Equipment" defines the equipment as described in the supplement that will have to be frequently amended due to the rapid development of computer technology

Chapter 3 "Computers and Training Tools" presents the various uses of computers as training tools, differentiate Computer Based Training (CBT) from simulation and defines the different types of CBT

Chapter 4 "Use of Computer Based Training" explains when CBT is useful and when it is inadequate and refers to further European Air Traffic Control Harmonisation and Integration Programme (EATCHIP) deliverable on the matter

The components of a CBT course are defined and analysed in Chap. 5 "Components of a CBT Course" and the structure is detailed in Chap 6 "Teachware - Structure".

The terminology of personnel involved and of their roles (Chapter 7 "Terminology - Personnel" is followed by a description of the production methodology (Chapter 8 "Production Methodology", from the training analysis phase to release procedures

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1. INTRODUCTION

1.1 Guidelines

1.1.1 Aim of Guidelines

These guidelines will assist EUROCONTROL Member States in the design and development of CBT along common principles and technologies

Specifically this will

- Facilitate the exchange of CBT between Member States,
- Facilitate the economical development of CBT by Member States;
- Facilitate a common Human Machine Interface (HMI) for teachware

The standards, provisions and information of these guidelines should be considered as the ideal provision for the production of Air Traffic Services (ATS) CBT programs In the sense of harmonization, it is recommended that member states should follow them

The contents of this manual are designed to assist organisations in the production of teachware If followed by all developers, they will facilitate the harmonised development of teachware

Where a particular topic is considered important for harmonisation it will be classified as a *Recommendation* and annotated accordingly

1.1.2 Responsibilities

The Training Subgroup (TSG) is the body responsible for the upgrading of these guidelines

The EUROCONTROL Institute of Air Navigation Services (IANS) at Luxembourg, is responsible for the production and maintenance of these guidelines This will be done according to the mechanisms recommended by the TSG

1.2 Co-ordination in the production of CBT courseware

The aim of the Co-ordination in the production of CBT courseware is to avoid the duplication of effort and expenses

To achieve the above aim, the EATCHIP Support Bureau should carry out the following actions

- Maintain a database of relevant available teachware,
- Provide a quarterly newsletter on teachware development,
- Provide a confidential service to assist in the co-ordination of teachware development,
- Provide technical advice and training on CBT related topics,
- Maintain a pool of authoring tools, images and other software related items,
- Provide a training course entitled "Designing CBT Modules for ATS Training",
- To provide ATS training personnel with an overview of the capabilities of CBT within the air traffic training environment,
- To provide an outline of the production methodology required

1.2.1 Procedures for Co-ordination

Purpose of these procedures is to help the course manager in the first phases of a CBT project

Where an organisation requires a specific teachware package or is considering the development of a teachware package, the EATCHIP Support Bureau should be advised

The procedures to follow are

- Notify the EATCHIP Support Bureau at Luxembourg of the intention to produce, or the desire to obtain, a CBT course in a particular subject The following items of information should be specified
  - subject to be covered,
  - whether joint venture production is acceptable,
  - whether confidentiality is required (confidentiality means that where requested all information will be kept confidential and details of the proposed development will not be revealed to other parties until other notification)
- The EATCHIP Support Bureau will advise, subject to confidentiality, on available packages or other organisations requiring similar teachware courses

1.2.2 Procedures for Sharing of Teachware

Purpose of these procedures is to share the effort and expenses required for the development of new teachware

The recommended procedure will be described in the document entitled "Recommendations for the Co-operative Procurement of CBT"

2. EQUIPMENT

To facilitate the aims of this document it is important that the teachware developed is capable of use over the widest range of equipment possible.

It is recognised that some specialist requirements will require equipment not falling into a common specification

In addition, the rapid development of computer technology make settings of a common long-term specification difficult This is why this specification is attached to these guidelines as a supplement "EQUIPMENT" valid for a period 1996-1999.

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3. COMPUTERS AND TRAINING TOOLS

3.1 General

3.1.1 Introduction

Computers are used extensively in many types of training which can be broadly divided into the following categories (note that these categories may not encompass all options but they appear to fit the majority of training carried out in air traffic training)

- simulation,
- time controlled simulation;
- part-task trainer,
- CBT and its various subdomains,
- Computer based presentation

The boundaries between some of these tasks are not fixed and they frequently merge into the categories on either side

This section will detail the various categories, their functions and the differences between them

It should be noted that the adoption of these terms assists experts from various countries in talking on the same level

3.2 Simulation

3.2.1 Definition

The practical application, under the tutelage and supervision of an instructor, of knowledge and skills previously acquired in the classroom or through the use of CBT packages During simulation the students should also develop judgement

3.2.2 Explanation

During simulation, there is neither real time analysis of the student performance by the software, neither is there a defined scenario of the presumed student action nor any type of guidance from the software to the learner Simulation is also associated with the presence of one instructor (at least before refresher or transition phases)

Real-time simulation is the traditional method of teaching operational Air Traffic Control (ATC) procedures It is labour and time intensive

It is probably still an essential part of training for new radar display equipment

The simulator **MUST accurately represent** the operational equipment if it is to be of the greatest value

3.2.3 Uses

- Acquisition of mental process and integration of knowledge and skills during ab initio training
- Practise of live ATC situations following training in new tasks and equipment
- Pre-On-the-Job-Training (OJT) simulations (refer to "Air Traffic Controller Training at Operational Units" - HUM ET1 ST05 4000-GUI 01 - Edition 1 0)

3.2.4 Advantages

- Allows risk free practice of all required skills in real time

3.2.5 Disadvantages

- Cost
- Resources such as pseudo pilots and controllers for feed sectors may be required
- May teach incorrect procedures and actions if it does not exactly replicate the operational equipment

3.3 Time Controlled Simulation

3.3.1 Definition

A time controlled simulation presents significant situations, in simple stages, in the correct sequence The situation is handled, in real time, until an event triggers a shift in time to the next significant situation

3.3.2 Explanation

Time controlled simulation

- Normally contains questions and feedback to reinforce the learning points to be covered,
- Is an interim stage between CBT and a simulator It enables the teaching of ATC procedures in pseudo time,
- Provides a method of combining ATC theory and procedures in a practical training device,
- Provides a method a gradually increasing a controllers knowledge without overloading the controller with information

Training on a time-controlled simulator should reduce the amount of training required on a full simulation device It should also enhance the standard as it provides a programmed training method

A time-controlled simulation

- Presents problems to student in simple stages in the correct sequence,
- Removes time periods which are not significant to the problem;
- Checks by questioning and feedback to ensure student understanding,
- Displays visual representations of radar displays as closely as possible to reality,
- Displays replicas of strip displays and/or Flight Plan data display where appropriate,
- Shows accelerated display of radar picture during rapid time advances,
- Provides audio where it would be used in reality i e aircraft Radio/Telephony (R/T) calls, etc

3.3.3 Uses

Teaching of new "tasks" Where a "task" is an action or series of actions which a controller is required to perform to carry out their role

3.3.3.1 Example

It is required to teach a radar controller a task on a new sector they are training on.

This task is the handling of an aircraft from transfer from adjacent sector AAA until transfer to approach control

Using time controlled simulation the trainee is provided with a computer display consisting of a reproduction of the radar display and a dialogue area

The trainee is led through the procedure step by step

Where long periods exist with no significant events occurring time is compressed, the radar display is updated in fast time, and the student is presented with teaching points covering the next significant event

3.3.4 Advantages

- One-to-one tuition,
- Student proceeds at own pace and can review the problem as often as required;
- The information is presented in small easily understood pieces;
- All the senses used in the real thing are employed,
- May be designed as part of the CBT,
- Requires no additional personnel to run the simulation

3.3.5 Disadvantages

- May require additional equipment,
- Requires necessary software,
- Requires development of problem scenarios

3.4 Part-Task Trainer or Emulation

3.4.1 Introduction

There are various terminologies that can be used under this title Basically, this is a method of teaching part of a task on equipment that represents, or closely represents, the actual equipment Terminology used to describe this includes

3.4.1.1 Interactive Demonstration - Definition

Interactive demonstration provides the opportunity for the student to practise operational functions in a free mode

3.4.1.2 Emulation - Definition

Methods giving priority to a representation of functional characteristics (stimulus and response) over fidelity to physical characteristics

3.4.1.3 Part-Task Training - Definition

A method in which the operation to be learnt is broken down into separate sections, each of which is taught and practised separately before bringing the parts together and practising in appropriate combinations until the whole operation has been mastered

3.4.2 Explanation

These devices allow the student to practice some operational functions independently from other functions which are not represented in the device

It should provide a replica of the actual equipment to be used Very often this will be in the form of a physical mock up and/or a reproduction of the display on a Personal Computer (PC) based training device There may be restrictions to some of the functions, particularly where interaction is required with other items of equipment

Such a device is intended to allow the student "free play" with the various functions

Limited feedback may be incorporated but generally this is provided in a CBT unit that would precede the use of this training aid

CBT provides knowledge acquisition whilst an emulation provides the opportunity for the student to practice all the functions in a free mode

3.4.3 Uses

- Provides a "free play" package to enable the student to explore the various equipment functions,
- Emulates a software package on a PC prior to the finished software being available on the actual equipment

3.4.3.1 Examples

- Software package emulating Flight Plan (FPL) workstation enabling practice of entry and handling of FPL and message data,
- An actual communications panel connected to a device to enable the various functions to be practised.

3.4.4 Advantages

- Allows the student to explore the functions of the equipment in a relatively free manner without the requirement of the main system,
- May be designed to be part of the CBT;
- Where new equipment is being installed may provide people with practice before the real equipment is delivered.

3.4.5 Disadvantages

- Needs to be designed and produced, which takes time and effort

3.5 Computer Based Training

3.5.1 Definition

Provision of knowledge and skills)by means of a computer with numerous interactions, student responses, analysis and free individual rythm of learning (self-paced manner) This encompasses interactive guided learning and interactive exploration

Good CBT should provide feedback and guidance to students as they progress through the course.

The term **"teachware"** is used to denote training material presented to a student through the use of a computer It is derived from **TEACH**ing soft**WARE**.

CBT is a generic term which encompasses the following subdivisions·

3.5.2 Types of Computer Based Training

3.5.2.1 Page Turning

An electronic book

No interaction between student and computer other than "the turning of pages"

3.5.2.2 Interactive Guided Learning

Training method used in CBT where the student has to follow a predetermined path through the training material There is extensive interaction between the student and the computer in the form of questions, feedback and participation

3.5.2.3 Interactive Exploration

Training method used in CBT where the student is allowed to follow their own path through the training material There is extensive interaction between the student and the computer in the form of questions, feedback and participation

3.5.2.4 Computer Based Examination

Use of the computer to give and assess examinations Usually consisting of randomly selected multi-choice or similar question types

3.5.3 Uses

- May be used as a training tool for most subjects The major exception is where human/human interaction is required,
- Is particularly suitable for training people in the use of new computer equipment and software

3.5.3.1 Example

- Use of new Human/Machine Interface (HMI) on radar and other air traffic displays

3.5.4 Advantages

- CBT provides a method of training people without the need for classroom sessions This has advantages if you are unable to release operational staff for classroom training sessions There are examples of CBT being used for system upgrade training where rearrangement of the operational rosters provided sufficient time within the normal working period for staff to carry out CBT training;
- Where training for computerised displays and equipment is being carried out **CBT provides an excellent training medium** It is possible to replicate actual equipment displays and provide interactive learning,
- The training is self-paced Students can redo any section as often as they like Sections can be reviewed for revision as required,
- There may be cost advantages over conventional training Although the initial cost of CBT is high the release of operational staff for traditional training requiring extensive instructional staff may be considerably more expensive,
- Sound and video can be incorporated if required

3.5.5 Disadvantages

- Not a good method where human/human interactions are to be taught;
- Initial cost of production The cost of producing CBT is quite high. However, when compared to conventional training, it may well show a significant cost advantage Modern authoring tools enable more efficient production.

3.6 Computer Based Presentation

3.6.1 Definition

Computer based classroom presentation

Use of a computer by an instructorto provide audio-visual aids in the classroom There is no direct interaction between the student and the computer

3.6.2 Explanation

Computer display projection devices or large screen monitors or televisions allow an instructor to present CBT to students in the classroom

This can include any or all of the following (note this list is not a complete list):

- simple sequential display of "overhead" slides,
- use as an electronic white board,
- display of diagrams, animation's or video,
- display of actual radar data or simulation exercises

The use of such devices in classroom training can greatly enhance the effectiveness by allowing display of interactive graphics

3.6.3 Uses

- Imparting knowledge to a group of people.
- Briefing groups of people prior to and after a simulator exercise

3.6.3.1 Example

- Showing a group of controllers a new method of strip marking

3.6.4 Advantages

- Provides excellent medium for display of interactive graphics, animation's and video.
- The advantages of using the classroom as an instruction method apply

3.6.5 Disadvantages

- May require extensive work developing the display material
- May require expert knowledge to produce animations, etc
- The disadvantages of using the classroom as an instruction method apply

4. USE OF COMPUTER BASED TRAINING

4.1 General

4.1.1 Introduction

CBTis just one of the many training tools that are available to the educator This chapter aims to give some guidance as to when CBT might prove a useful tool

The chapter will

- Detail reasons for the choice of CBT (Why use CBT?) as a teaching methodology,
- Cover some of the factors that need consideration when deciding whether or not to use CBT,
- Provide some practical examples where CBT has been considered

– A more general guidance on how to select the appropriate media is to be found in the EATCHIP deliverable entitled "Specification on Training Methods and Tools"

4.2 Why Use Computer Based Training? The Pedagogical Choice

4.2.1 Introduction

CBT is but one of many tools that are available to the educator to provide training to students For any training it is necessary to select the appropriate training method This section aims to show some of the pedagogical reasons for the choice, or not, of CBT for any particular subject

Practical considerations concerning the selection of CBT will be covered later in this chapter

4.2.2 One-to-one Training

The major advantages offered by one to one training are

– students can proceed at their own pace,
– students can go over points as often as they want,
– it is non threatening

4.2.3 Flexibility

Within limits the training can be carried out at any time and place

Specific advantages are

– you do not have to go away for a course, the course comes to you,
– you may be able to fit study into otherwise dead periods

4.2.4 Helps Provide a Standard

Enables training to be carried out to the same standard where ever the training is carried out

4.2.5 Shortens Training Time

Takes between 50 to 60% of the time of conventional training

Generally speaking, if it takes an instructor1 hour to cover the subject in the classroom, a CBT course will bring the student to the same level of understanding in 50 to 60 % of the time

As a disadvantage time may be needed with an instructor to clarify points which are not understood

4.2.6 Provides Active Teaching

Combines visual, hearing and touching (accepting some transfers we touch through the mouse cursor)

Interactivity puts the student in the position of learning by doing we learn more by doing things

A picture/action/demonstration saves a thousand words Where necessary an animated interactive picture probably saves 10,000 words

4.2.7 Reduces Instructor Workforce

May reduce the total number of instructors required

4.2.8 Distance Learning

May be used to facilitate the use of distance learning Interaction between an instructor and remote students may take place through specifically designed CBT packages.

4.3 Practical Factors Affecting Choice of Computer Based Training

4.3.1 Introduction

This section details the factors to be contemplated when the use of CBT is under consideration They are not presented in any order of significance In fact, as will be shown later in this chapter, many of them are closely related

In general, all these factors have one main point of origin - COST!

4.3.2 Stability of Subject

Generally speaking, the more stable the subject the more suitable it is for CBT Subjects that change often require considerable resource to keep the courseware up to date

4.3.3 Number of Students

The higher the number of students the more suitable the subject is for CBT

4.3.4 Location of Students

CBT lends itself to the distance learning concept where a student can learn whilst being geographically remote from the trainer

4.3.5 Availability of Students

CBT shows a number of advantages where individual training is required For example, it might not be possible to get 10 people together at the same time for a classroom training session CBT would offer a way of providing individual training on a flexible timetable

4.3.6 Course Lifetime

The longer the course lifetime the more suitable the subject is for CBT

4.3.7 Existing Course

If the course already exists in a structured form it may be relatively easy to produce a CBT course from it

If the existing course is successful are there significant benefits in changing the teaching method

4.3.8 Equipment

Does equipment already exist to present the CBT or will additional equipment have to be acquired?

4.3.9 Task/Course Analysis

Is the task the student is going to carry out going to benefit from this training method?

4.3.10 Computer Based Training (CBT) Benefits

- Is the course suitable for delivery by CBT? Generally speaking, most courses can benefit from CBT techniques but there are some subjects that are not suitable
- Where people are being trained to use computer displays then training using CBT may be particularly advantageous
- Courses where human contact is essential are generally not suitable
- Other teaching techniques may be more effective
- In some cases, the benefits given by CBT may outweigh the cost advantages of another teaching method

4.3.11 Cost

The cost of the development of the CBT must be taken into account. This factor is inextricably linked with several of the factors detailed above

4.4 Combinations of Factors

4.4.1 Introduction

This section gives several examples of the relationship between many of the above factors

4.4.2 Example 1

The subject is not stable but 500 people must be trained in the task within a three month period

Here the lack of subject stability is not a problem as the projected lifetime of the course is so short It is assumed that the subject will remain stable for the lifetime of the course

500 people should justify the use of CBT However, the task, location and availability of students needs to be looked at If, for example, it is possible to provide the training by running ten 2 hour training sessions for 50 people and the people are available for this then CBT would not be cost effective However, if training has to be provided on an individual basis, due to location, availability, etc , then CBT may be suitable

Example 2

The subject is stable and 20 people must be trained per year for the foreseeable future

Assuming that the subject is a suitable one for CBT the question, here is what is most cost effective

Does CBT training fit into the training plan?

Example 3

Training is required for 100 people initially and then 10 a year for about 5 years The subject matter is stable but annual changes may be made

The task is to train people to use a new Flight Data Input terminal

Training people to use computer terminals is an excellent use for CBT The initial 100 people provides a reasonable base

Questions to consider are

- How easy is it to modify the CBT for subsequent years ?
- Even though it might be cheaper to use classroom training, does CBT offer significant training advantages ?

4.5 Case History

4.5.1 Introduction

The following case history details a training task that was originally considered for CBT and then rejected in favour of other training methods

4.5.1.1 Training Task

To train controllers in the new METAR codes (around 1993)

4.5.1.2 Target Audience

Approximately 100 qualified controllers in 15 geographically separate locations, currently delivering hourly Met reports using the old METAR codes

4.5.1.3 Training Options

- CBT,
- Conventional training methods

4.5.1.4 Factors Considered for Computer Based Training (CBT)

Stability - METAR codes can be expected to remain stable for at least 10 to 15 years

Number of students - Initially 100 but for ab initio training at least 300 over the next 15 years

Location of students - First 100 geographically remote Ab initio students probably on a formal course

Availability of students (initial 100) - Not possible to get small groups together without extra expense of moving people around the country

Suitability - The course material lends itself nicely to the use of visual materials

4 5.1.5 Reasons for Rejection of Computer Based Training (CBT)

Visual material for the course would have been expensive to produce, would have required more sophisticated computers than were available and would have resulted in large file sizes

The ab initio training role - The art of meteorological observation is very subjective and the presence of a human teacher to facilitate discussion and interpretation is essential

Task analysis The task involves observing the weather and converting the observed weather into a code describing it

The METAR codes are comprehensive and cannot be expected to be committed, in total, to memory In practice, except for regularly used codes, reference will be made to some documentation to ensure that the code used is correct

Provision of a learning method aimed at improving retention of learning is thus unnecessary

4 5.1.6 Conclusions

CBT would have fulfilled this task on many of the factors but was rejected after consideration of the task analysis

4.5.1.7 Selected Training Method

Book detailing new METAR coding system with changes highlighted

Chart, for display at point where Met observations made, detailing ALL the METAR codes.

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5. COMPONENTS OF A CBT COURSE

5.1 General

5.1.1 Introduction

A CBT course is a collection of objects designed to convey information to the students in a manner that makes it easy for them to learn

This section deals with the basic component parts that make up a CBT course These components range from the "tools" that allow the student to move through the course to the simple text boxes that are used to contain text

The student tools are covered in their own chapter

This chapter is concerned with the objects or components that can be used as building blocks to construct a CBT course

Components to be covered are

- text,
- sound,
- interactions,
- graphics,
- animation,
- video,
- smart objects

5.2 Text

5.2.1 Introduction

Text is one of the basic methods of conveying information to the student. However, it should be remembered that a book carries out this function very efficiently and CBT does not aim to provide books in an electronic format

There are a number of software tools that specifically aim at "electronic publishing" CBT differs from electronic books in providing feedback and guidance to the student

The following guidelines should be considered when using text on a screen

5.2.2 Function

- Conveys information on the subject matter,
- Provides instructions for using other components of the teachware

5.2.3 Quantity

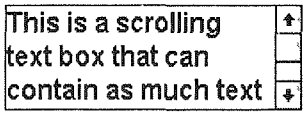
Generally speaking, text should be used in the form of short statements stating facts.

Understanding of the facts should be conveyed by graphics, animations, sound or video

One quarter of the screen should normally be the maximum space devoted to text

5.2.4 Scrolling Text Boxes

Scrolling text boxes provide a way of inserting a large amount of text in a limited space



This should be avoided as much as possible as the tendency is for the student to skip anything not directly displayed It also violates the principle of keeping text to the minimum and using other components for conveying understanding

5.2.5 Size

Text should be easily readable on the smallest screen size that the CBT will be used on

10 - 12 pt text is a reasonable size for a normal block of text

Text size provides one method of emphasising or de emphasising a teaching point Larger text can be used to draw attention to a particular point. Smaller text can be used to provide information that the majority of students will probably not need but may still be required by a few

It is recommended that standard text sizes be established and that these be used throughout the CBT

The EATCHIP templates will use

- 16 pt for titles, and
- 12 pt for most other text

5.2.6 Fonts

An easily readable font such as the types "Arial" or "Times Roman" is recommended The names of these vary according to the producer of the font

When operating under Windows™ it is an advantage to use one of the standard fonts supplied with Windows™ This ensures compatibility when courseware is used on other Windows™ machines

The EATCHIP templates use the "Arial true type" font exclusively These copyright free fonts are systematically installed during the procedure of installation of the templates Please note that display setting may allow the user to choose between small fonts and large fonts templates are designed for small fonts

The substitution of a different font can be used to give emphasis but a more likely method is to use the same font but in bold or italic format

NOTE - The use of more than one form of emphasis can result in "overkill" Thus **bold** or *italic* or underline may be used but ***bold/underlined/italic*** together is not recommended

Where font styles are used for emphasis this should be consistent throughout the application

NOTE - As an example, italic may be used for notes that are included as part of the teachware

5.2.7 Colours

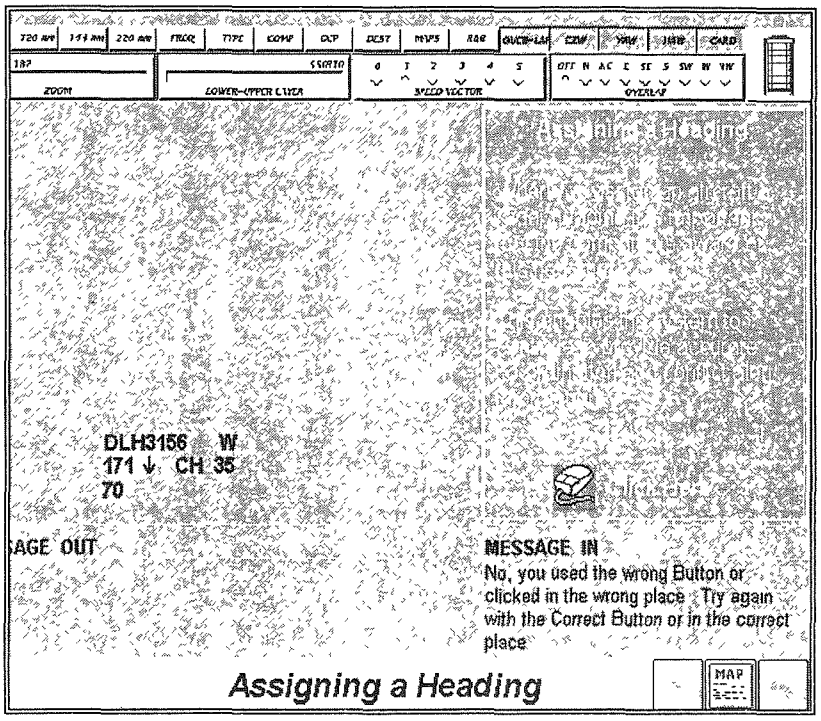
Much has been written about the choice and number of colours used on computer screens. The following observations may be of use.

- There are several colour combinations that are difficult to read The use, or rather abuse, of these is fairly obvious,
- Colours should be consistent throughout the teachware,
- Use colour coding where possible As examples
  - negative feedback to questions could be shown in red,
  - positive feedback could be shown in green,
  - titles could always be in the same colour,
- If you are developing using a palette of 256 colours or more, remember that all these colours will not be available in 16 colour mode,
- The use of pastel or light colours for backgrounds is more restful to the eyes,
- Avoid using too many colours as this can make the screen look confusing. Simple is best

5.2.8 Layout

Text can be displayed anywhere on the screen but it is useful to the student if the majority of textual explanations are contained in one area of the screen while covering one topic

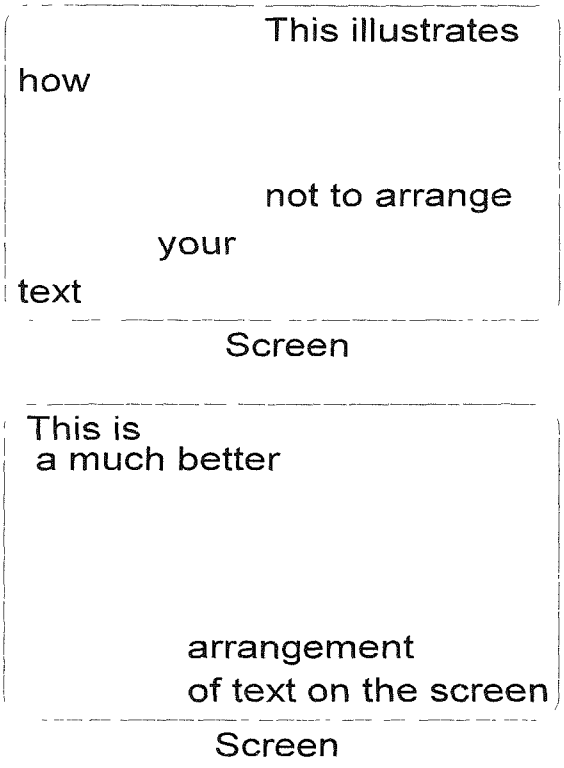
For example the following screen dump is taken from a CBT course on ODID This particular topic occupies 5 screens or pages Within this topic the text on each page was displayed on the right hand side



The student then knows where to expect the text whilst reviewing this topic

Text can also be associated with graphics and in this case may be located on various parts of the screen

Remember that, in the Western world, we read from left to right, top to bottom Thus if you have more than one text box on the screen try and arrange that they are readable in this logical manner



5.3 Sound

5.3.1 Introduction

Sound provides an excellent medium for giving explanations to the student It is able to provide much more information than text on the screen

Sound can also accompany animation's and interactions giving a full explanation of the teaching points

Sound should form an integral part of every teachware package.

The use of sound greatly increases the amount of disk storage space a CBT package will require

5.3.2 Function

Conveys explanations of the subject matter

5.3.3 Integration in the Teachware

Where sound is used the facility should ALWAYS exist for the student to replay any particular sound on request

5.3.4 Production

Speech should be clear, concise and easily understandable It should also be consistent throughout the teachware. The use of a professional sound actor may be considered or there may be a suitable person available in house Achieving high quality consistent sound is NOT an easy task

An alternative method is to use a "text to speech" software program It is anticipated that the quality of these will improve significantly in the next couple of years

The use of a text to speech converter has the following advantages

- Production costs fall dramatically as no recording is required, the require text is simply typed into the appropriate box,
- A person skilled in speaking is no longer required,
- Disk storage space falls dramatically if the storage of large amounts of digitised sound is not required

5.3.5 Copyright

The use of ANY commercially pre-recorded material will almost certainly require clearance from a copyright angle It is perhaps safer NOT to use commercially recorded sounds

5.4 Interactions

5.4.1 Introduction

Interactions provide a means by which the student can learn by taking part in the process They form an essential component of a CBT course

Learning by doing is an important action

The development of interactions is not always an easy task but can be achieved for the majority of subjects In some cases interactions will be limited to question and feedback

5.4.2 Function

Aids learning by involving the student in doing

5.4.3 Types of Interaction - Question

The easiest type of interaction to implement is that of question and feedback This technique can be used in all teachware

5.4.3.1 Types of Question

Computers are best at handling limited answer questions such as multiple choice or true/false

They are also capable of handling short answer questions but there are a number of problems associated with this

These include

- checking of incorrect spelling,
- use of words with similar meaning,
- the order of words,
- use of superfluous words

Although many CBT authoring systems include functions to analyse short answer questions many problems still exist If the short answer type question is used it should be worded such that the range of answers is very limited

e g What do the letters "ILS" stand for? (answer with three words only)

5.4.3.2 Answering Methods

Modern Windows ™ based authoring systems provide many methods for question interaction These include

- Typing the answer,
- Clicking on an object,
- Dragging an object and dropping (drag and drop) it on a particular space,
- You should try and use variety of methods within the teachware package.

5.4.3.3 Post-teaching Questioning

In the majority of cases, questioning will be used to enable the student to test themselves on the knowledge gained during study

Such questioning can either take place soon after the teaching point that it covers where it serves the function of reinforcement, or it can take place at the end of the subject or topic where it takes the function of a self-test to determine which teaching points have been achieved and which require more study

5.4.3.4 Pre-teaching Questioning

Questioning can also take place before a particular item of knowledge is given to the student

As an example a course on the "ILS" could ask the student what the letters "ILS" stand for before giving an explanation of what they stand for.

Such questioning forces the student to think and draw on their previous knowledge

This is a valuable teaching method but has a major drawback many students do not like to be asked questions before they have been taught the answers The fear is not they will not get the question correct !

If this technique is used it is strongly recommended that the student is told that the questioning technique is being used to promote thought and that no record is kept of the student answers Wording such as *"throughout this course you may be asked questions before you cover the answers in the teachware To answer these questions use your*

existing knowledge and see how successful you are. Note that no record will be kept of your answers "

5.4.4 Types of Interaction - Simulation of Human/Machine Interface Functions

Where the teachware is being used to teach the HMI of a computer program the use of interaction in the form of simulation of the functions will be valuable

Within the teachware the individual components of the HMI can be reproduced and the student can interact with them in the same manner that they would interact with the real HMI

Feedback is provided by

- Graphic displays emulating the actual functions,
- Text or sound detailing what the student has done correctly or incorrectly

5.4.5 Types of Interaction - Graphical Display of Equipment

Where the teachware is being used to teach the operation of items of equipment interaction can be made with graphical display of the equipment functions

As an example The student is required to operate a nuclear power station The teachware displays a diagram of the operating system The student is lead through the procedures to be followed in the event of a melt down The student is required to select the correct operating position for the various valves to prevent the meltdown

Feedback is given after each interaction and can be provided by text, sound or by changes to the operating diagram indicating the result of the action

5.5 Graphics

5.5.1 Introduction

Graphics provide a way of giving a visual representation of a task or object

5.5.2 Function

Aids learning by providing the student with visual images

5.5.3 Use

Graphics should be used where ever possible to illustrate a teaching point

In many cases, the use of a graphic will provide a visual stimulus to the student aiding the retention, in long-term memory, of the topic material

5.5.4 Production

Development of complicated graphics can be time consuming and thus expensive Very often a quick and simple graphic will suffice

During development strict control over graphic development must be made and the **degree of development of complicated graphics should be considered against the learning value** the student will get from the graphic

5.5.5 Copyright

Graphics may be acquired from a number of sources Where this is the case the rights to the use of the material should be carefully checked

5.5.6 Graphics Pool

The establishment of a pool of graphics, by Member States, would provide a useful source of copyright free graphics and reduce overall development cost for graphics drastically.

5.6 Animation

5.6.1 Introduction

Animation provide a way of giving a visual representation of a task or object

5.6.2 Function

- Aids learning by providing the student with visual images,
- Allows display of dynamic processes

5.6.3 Use

- Animations are an extension of the use of graphics They should be used where ever an understanding of a dynamic process is required,
- As an example an animation could be usefully used to show the life cycle of a thunderstorm

5.6.4 Production

- Development of animations can be very time consuming,
- Simple animations can be created from a range of still images, while more complex ones will require the use of a specialist animation software package

5.6.5 Copyright

Animations may be acquired from a number of sources Where this is the case the rights to the use of the material should be carefully checked

5.6.6 Animation Pool

The establishment of a pool of animations, by member states, would provide a useful source of copyright free animations and reduce overall development cost for animations drastically

5.7 Video

5.7.1 Introduction

Video may be included in CBT where it can fulfil a number of teaching functions Development of digital video is progressing rapidly and technical advances mean that full screen "video recorder" quality display is now available

Digital video takes large amounts of disk storage space and distribution will require CD-ROM or video compatible network

5.7.2 Brief details on video technology can be found later in this chapter.

5.7.3 Function

- Can be used to give an overview of a subject,
- Can be used to show Human/Human interactions,
- Can be used to provide reinforcement by showing actual events

5.7.4 Integration in the Teachware

Where video is used the facility should ALWAYS exist for the student to replay any particular clip on request

5.7.5 Production

The cost of video production is high Before deciding on the use of video it is necessary to compare the production cost with the teaching benefits to be gained.

5.7.6 Copyright

Video may be acquired from a number of sources Where this is the case the rights to the use of the material should be carefully checked.

5.7.7 Video Pool

The establishment of a pool of video clips by Member States would provide a useful source of copyright free video clips and reduce overall development cost for video drastically

5.8 Video Compression

5.8.1 *Introduction*

Video requires the display of individual frames at rates up to 30 frames per sec An individual frame would require 600 KB of disc space, thus 1 second of video would require 15 MB of disc space Obviously this would preclude the use of video as the average hard disk could contain only a few seconds of video and even a CD-ROM could contain only 40 seconds worth of video

Compression of the video is thus required and a number of systems exist for doing this

Compression rates of around 100 1 allow 1 minute of video to be stored in 10 MB of storage (1 hour = 600 MB)

The following outlines the current (02/05/1995) video compression techniques in common use

5.8.2 Joint Photographic Expert Group

Strictly speaking, this a compression technique for still photographs only It uses a symmetric algorithm (i e the same algorithm for compression and decompression) Compression ratios of around 10 1 are normal, i e a PCX file would be 10 times smaller in Joint Photographic Expert Group (JPEG) format

Although in computing terms this is a compression system for stills it has been included because it is used by some professional video suites for digital editing of video Effectively, each video frame is JPEG compressed The relatively low compression ratio means that this method is not suitable for use in CBT packages

5.8.3 Moving Pictures Expert Group

The Moving Pictures Expert Group (MPEG) system has been designed and accepted as a worldwide standard It comes in two main formats MPEG 1 and MPEG 2

MPEG 1 was designed for CD-ROM based applications whilst MPEG 2 was designed for the compression of TV signals for digital transmission MPEG 2 decoders will be capable of decoding MPEG 1 compressed material

Note that MPEG 3 does not exist (being incorporated in MPEG 2) and MPEG 4 is designed for video conferencing and video phone applications

For some time MPEG 1 will be the system most commonly used for the storage and playback of video from CD

5 8.3 1 MPEG 1

MPEG 1 uses a symmetric algorithm giving a better compression ratio than JPEG (approximately 3 x better)

Compression requires a specialised board (cost circa US$ 20,000) Owing to the high cost of these boards agencies exist that will compress video into MPEG 1 format Note

that the cost of compression boards is falling rapidly and reliable boards costing around US$ 2,000 should be common towards the end of 1995

Decompression was originally envisaged using a specialised board These are currently available at a cost of around US$ 500 Increasingly software only decompression is becoming available and may be a viable alternative on Pentium™ and faster processor types

MPEG 1 is a lossy compression system Some quality will be lost as the system does not store all of each frame

Rather it attempts to store only those portions of each frame which change This is a gross oversimplification of the task but is sufficient to explain how it is possible to obtain a higher compression ratio than with JPEG.

5.8.3.2 Usage of MPEG 1

Used to compress video for storage on CD-ROM

With hardware decoding able to display full screen video on a modest PC

Useful for showing complete videos or the display of short video clips within a CBT package

5.8.4 Video for Windows

Video for Windows™ (VFW) was developed by Microsoft and is one of the most common formats for displaying video under the Windows™ system

Capture and compression is via an add on board These are cheap and readily available (circa US$ 400)

Playback is by software although add on boards are available and can improve the quality of playback Dedicated chips to carry out this function may be incorporated on PC motherboards in the near future

The size of the playback image depends largely on the processor power Typically for a playback window of 320 x 240 at 15 frames per second, a high end 486 would be required

The file format is AVI and this is supported by a number of systems

5.8.4.1 Equipment Required

For capture a suitable capture card

When capturing video the speed of the target machine should be considered as optimum playback rates and size are a function of the capture settings

Software only playback provides an acceptable picture on high end 486's although picture size may be small The addition of hardware decoding will enhance performance although capture will have had to have been carried out at a suitable resolution if full screen playback is to be acceptable

5.8.4.2 Usage of Video for Windows

Used to capture video for storage on CD-ROM or hard disk

Useful for showing short video clips within a CBT package

5.9 Smart Objects

5.9.1 Introduction

Smart objects are reusable objects which contain all necessary program code to make them function and can be simply copied into a CBT application

Normally the interchange of such objects will be restricted to applications constructed using the particular authoring language that the smart object was created in

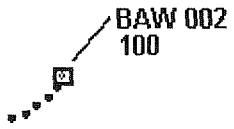
However it is possible to develop library of objects accessible from several languages under windows environment (such as visual basic VBX and more recent OCX objects)

5.9.2 Function

- Aids development by providing reusable components

5.9.3 Example

It is easiest to give an example of a smart object In this case, one constructed for the toolbook environment



The example above shows a radar target for a typical radar display system As a graphic it would form part of your resources and could be cut and pasted to any Windows™ application

As a smart object it contains program code that allows it to "fly" according to the headings, level and performance that you give it

In practice this object can be pasted anywhere into your CBT application and it will "fly" A simple line of code passes it your required headings

The graphics can be modified without affecting the code and thus the object can very quickly be made to look like a specific target from a specific system

5.9.4 Object Pool

The establishment of a pool of objects by member states would provide a useful source of copyright free objects and reduce overall development cost

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6. TEACHWARE - STRUCTURE

6.1 Introduction

6.1.1 General

A common understanding of CBT terminology and the structure of teachware is essential in the development of harmonised packages

This section of the manual will detail a common structure and the associated terminology

Note that the glossary of this manual provides a comprehensive summary of the terminology contained in this manual.

6.1.2 Authoring Tools

To a certain extent, the structure of a teachware will depend on the authoring system used to produce the course Many tools provide built in facilities for grouping sections of the course together and displaying the structure as groups of icons

The structure depicted in this section is based on teachware development carried out using the toolbook authoring system It will be applicable to many other development tools

6.1.3 Structural Concepts

An ideal teachware should provide branches based on student response i e questioning shows that student does not understand, the student is given additional material to aid comprehension

A simply linear course allows progression backwards or forwards through the teachware in a similar manner to a book It is possible to divide this up into "chapters" thus allowing access to a specific topic It is also possible to restrict access to subsequent topics until success has been achieved in the current topic

Development time increases as the number and complexity of the branches increase so a compromise is often necessary It is frequently necessary to construct a flow diagram in order that the developer can manage the development of such branches

One major disadvantage of a heavily branched teachware is that the student may become "lost"

6.1.4 Hyper Links

Hyper links are words or pictures that you can select that move you to additional information on a particular word or picture

Hyper links in teachware should be used with care, or the student can rapidly lose track of their position and their original learning objective This is particularly the case in interactive unguided learning In fact, extensive hyper links are more suited to reference systems such as encyclopaedias, etc

The provision of extensive hyper links in a teachware greatly increases the development time

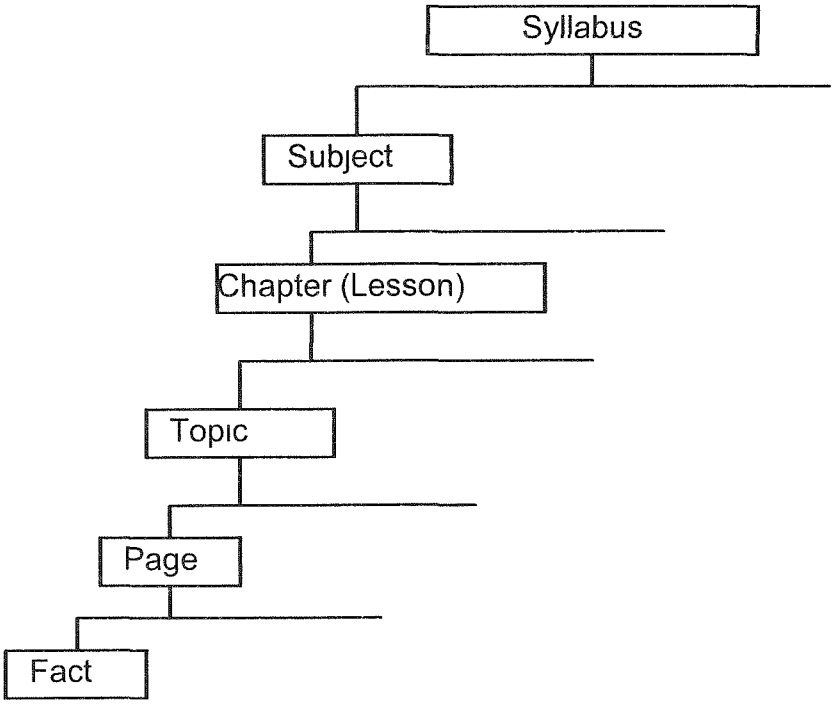
One interesting example of hyper linking is in the World Wide Web (WWW) In this system, clicking on a link displayed on a page in a computer in the USA switches you to a computer elsewhere in the world Using the web you can traverse many countries without even realising

6.2 Teachware Structure - General

6.2.1 Global View

It is possible to structure a course in many ways

The following structure is recommended for standardisation purposes



The main area of concern to the teachware author is the "fact" that exists on a page which is part of a topic in a chapter

6.3 Teachware Structure - Terminology

6.3.1 Syllabus

Generally, a syllabus is a listing of subjects, topics, elements and items showing the training necessary to fill the training gap and achieve the course aim It indicates time to be devoted to each part but usually neither methods nor order

Here, we will understand it as a generic term referring to the total training requirements needed to produce a trained person in on particular field Typically, a syllabus for CBT would contain many definable areas for which training is required

Each of these definable areas is known as a SUBJECT

Average time devoted to each part cannot be planned because we are in individualised training but an indication of a rough "guess-average" can help during training design phases

6.3.2 Subject

Part of a syllabus corresponding to a particular area of knowledge within the syllabus

Within CBT, a SUBJECT would correspond to a **teachware shell**

Within each SUBJECT it is again possible to break the required training into further smaller areas known as Lessons

6.3.3 Chapter (Lesson)

A section of a SUBJECT referring to a particular theme One or more chapters/lessons grouped together comprise a SUBJECT

A chapter would represent the amount of training that the average student would undergo in the period of approximately an hour *Note Teachware developers should not be too concerned if this time period varies between 10 and 90 minutes*

A chapter would be one module of a **teachware shell** In PC terminology, the teachware for a chapter would probably be contained in one basic file

To facilitate the assimilation of knowledge each chapter can be further broken down into a series of topics

6.3.4 Topics

A sub-section of a chapter/lesson of interrelated facts One or more topics grouped together comprise a chapter

Within each topic facts are conveyed to the student by individual pages of information

6.3.5 Page

Information displayed on a computer screen at any one time designed to convey a fact or facts to the student There should be a maximum of four NEW facts per page

Each page should include animation or interactions designed to enhance or reinforce the student understanding of the associated facts

6.3.6 Fact

An individual item of knowledge the assimilation of which is essential for the student

A maximum of four NEW facts should be given per page of information

Facts should be presented in an interactive manner

6.3.7 Links between Teachware Structure and Training Objectives

Teachware Structure	Training Objectives
Syllabus	General Objective
Subject	General Objective
Chapter (Lesson)	General Objective Terminal Objective
Topics	Terminal Objective Intermediate Objective
Page	Terminal Objective Intermediate Objective
Fact (Item)	Terminal Objective Intermediate Objective

6.4 Teachware Structure - Constructional

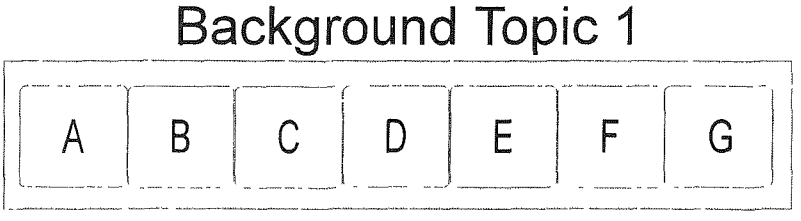
6.4.1 Introduction

The majority of teachware appears to a student as a series of screen displays or pages of information, interactions, etc For all practical purposes, this appears in a linear method i e "C" follows B, "D" follows "C", etc

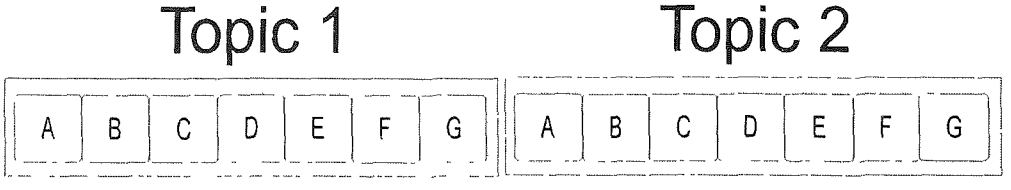
Such an organisation is readily understood by both course designer and student

6.4.2 Linear Organisation

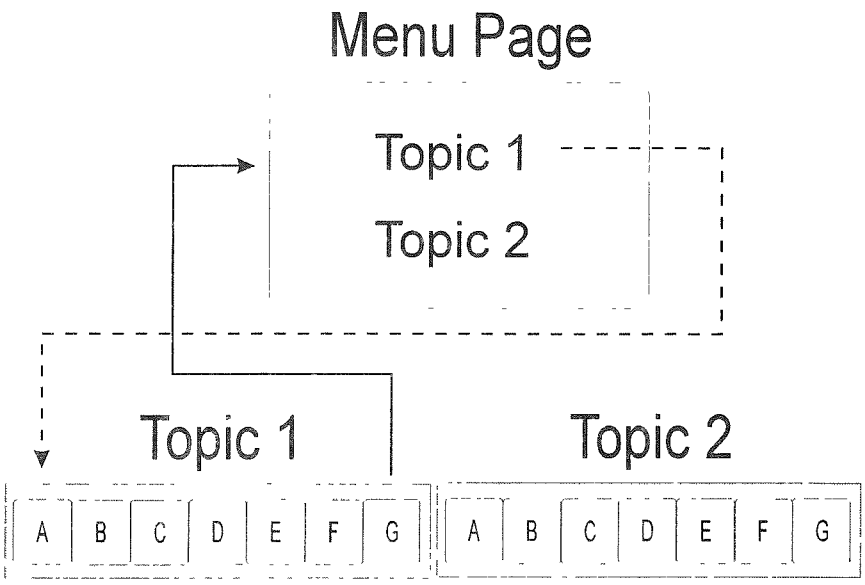
A course is divided into a series of topics which will each consist of a number of screen displays/pages Using the toolbook system, it is possible to discriminate between the various topics by allocating the pages of each particular topic to one background Thus·



Each topic would follow the next in a linear manner



In the toolbook environment, links have to be manually inserted to create the structure required



In fact, this is done automatically if the EUROCONTROL templates are being used.

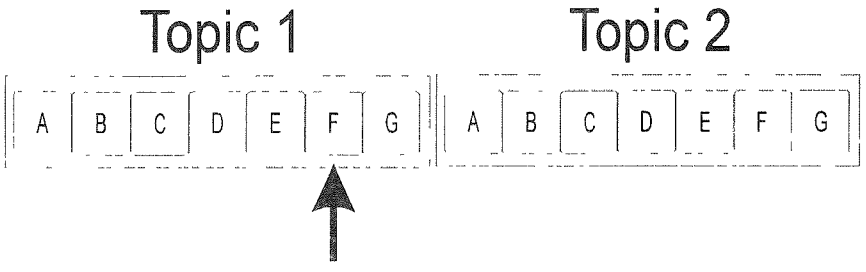
Such linear construction is relatively simple but some method is required to implement the teachware features that allow the student to be "re-routed" according to their progress i e branching

This facility is implemented by means of a thread

6.4.3 Threads

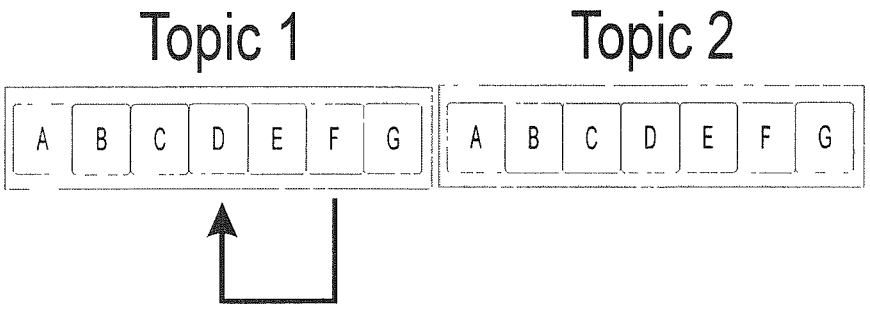
A thread is a section of teachware designed to provide a link from one section of the teachware to another

It is easiest to understand this with an example

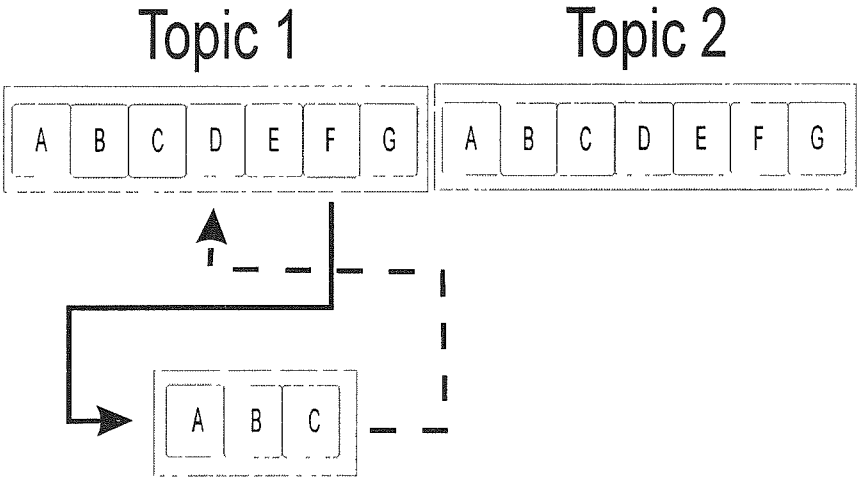


The student has reached page F of Topic 1 There is a question on this page that checks understanding of the subject material on pages D and E If the student fails this question they have not understood the material and should study it again

In its simplest form a thread would take the student back to page D

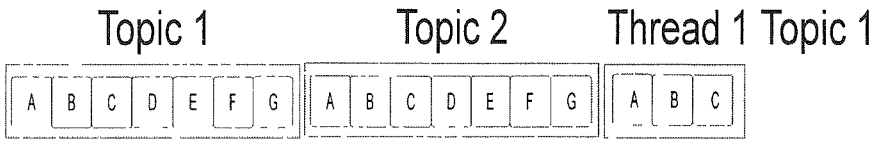


In a more complex form it would require the student to study additional pages of information



In this case, the student is returned to page D of Topic 1 but they could just have easily been sent to a different page in a different topic

The final linear version of the above teachware (without links) will physically be

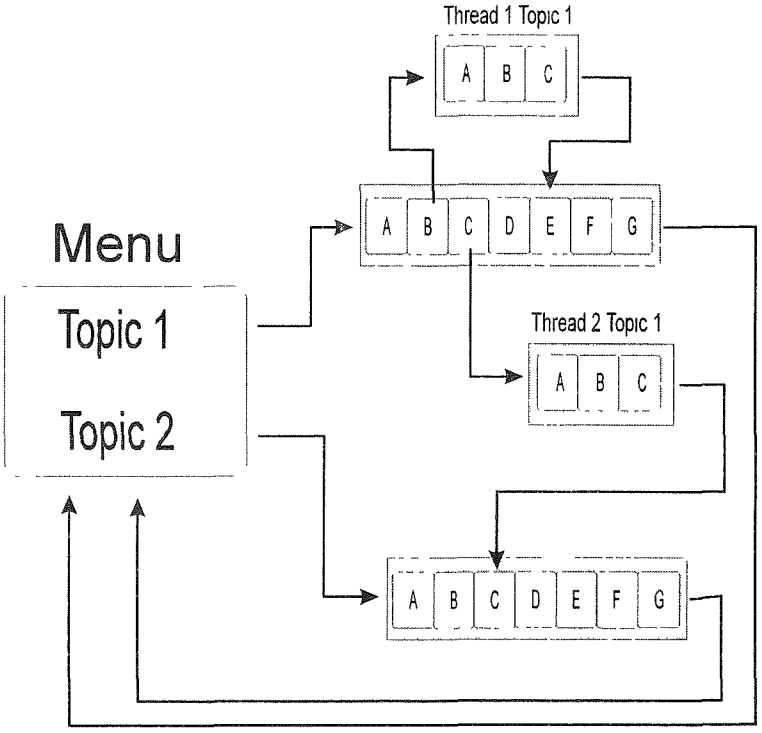


Threads provide a way of including branching into a linear programming system The EUROCONTROL templates provide facilities to allow the easy inclusion of threads

6.4.4 Models

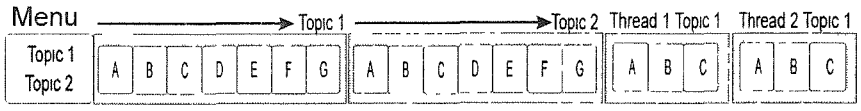
6.4.4.1 Mental Model

This diagram illustrates a possible mental model for a student using a teachware



6.4.4.2 Actual Structure

The actual structure is somewhat different



In fact, physically the topics and threads can appear in any order and it is even possible that the individual pages appear in a different

7. TERMINOLOGY - PERSONNEL

7.1 Terminology - Personnel

7.1.1 General

It is of benefit if all organisations developing teachware use the same or similar terminology when referring to persons responsible for development and production

The following terms are therefore recommended

Course development requires the following people It is possible some of these roles could be carried out by the same person There are, however, several advantages in keeping them divided

The following titles should be used for personnel developing teachware

7.1.2 Course Owner

Person or department requiring a teachware course.

7.1.3 Course Developer

Responsible for managing the development of the course from inception to final delivery. It is possible that the course developer could be undertaking this role for a number of courses at a time

7.1.4 Subject Matter Expert (SME)

This person has an expert knowledge of the subject matter She is responsible for the technical accuracy of the contents of the course.

7.1.5 Author

Responsible for taking the technical knowledge and converting it to a suitable format for use in teachware The author will produce, in paper form, the structure and contents of the course (storyboard)

7.1.6 Coder

Responsible for taking the storyboard and entering the information into the computer.

7.2 Responsibilities

7.2.1 Course Owner

- Identifies requirement for course,
- Provides resources to develop course,
- Co-ordinates with course developer;
- Determines cost / quality ratio with course developer,
- Distributes course;
- Responsible for maintenance of completed course

7.2.2 Course Developer

- Provides resources to develop course,
- Co-ordinates with course owner,
- Makes the final decisions on all aspects of the course development;
- Determines cost /quality ratio with course owner,
- Co-ordinates between SMEs and author,
- Co-ordinates between author and coder;
- Distributes course,
- Responsible for maintenance of completed course,
- In co-ordination with course owner, establishes subject matter to be covered;
- Establishes development timetable,
- Ensures development timetable is adhered to,
- Arranges trialing,
- Monitors trialing,
- Arranges quality audit,
- Ensures coding carried out to required standard,

7.2.3 Subject Matter Expert

- Provides expert technical knowledge;
- Checks technical knowledge after storyboarding.

7.2.4 Author

- Analyses subject matter to be covered,
- Establishes course structure,
- Liases with course developer,
- Liases with SME to ensure technical accuracy,
- Produces course flowchart,
- Produces storyboard,
- Produces Help File in Word format;
- Specifies indexing, definitions, glossary entries for Help File,
- Liases with coder as required,
- Checks completed teachware for accuracy against storyboard

7.2.5 Coder

- Converts storyboard into computer based material,
- Suggests options for improving storyboard,
- Converts Word Help File into Windows™ style Help File,
- Produces code for management functions,
- Documents code (Code Documentation) produced to standards laid down by course manager

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8. PRODUCTION METHODOLOGY

8.1 Choice of Development Method

8.1.1 General

The teachware development process can be carried out internally within the organisation or by an outside contractor

This section will cover the advantages and disadvantages of these options

There are a number of factors to consider when making this choice. In the majority of cases, cost will play a major role in the decision

In many cases, it will also be possible to split the development between internal and external resources

8.2 Factors Affecting Choice of Development Method

8.2.1 Expertise

Expertise is probably one of the biggest influences in the choice of development method

Teachware development is a highly specialised task and an organisation may well not have suitably qualified people in house

The expertise may exist for part of the task For example, the analysis of the subject matter and initial course design could be carried out in house with the storyboarding and coding being carried out by a contractor

This could be taken a stage further with only the coding being undertaken by an outside contractor

This later option is probably viable for most organisations. Course design is a process which any trainer is familiar with, whilst storyboarding is merely an extension of this design process The coding is probably the most time consuming part of the process and the one for which the highest technical knowledge is required Coding is also a process that is most efficiently carried out by a person who is using the software development package on a regular basis

8.2.2 Frequency of Development

Where teachware is infrequently developed it may not be cost effective to maintain expertise in-house One factor affecting this is the rapidly changing technology that requires the upkeep of the expertise

8.2.3 Cost

- Ultimately cost plays a large part in the decision,
- Most factors can effectively be traced back to the cost

8.2.4 Risk

It is frequently perceived that the use of an external contractor reduces the risk of the failure of the project

There is no doubt that contractors can be highly motivated to successfully complete a task After all, they do not get paid if they do not deliver

However, remember that contractors can fail

There is also risk involved with internal development There are a number of factors that can cause this However, accurate assessment of the task and the available skills will, with good project management, reduce this risk

8.2.5 Advantages of in-house Development

This decision is frequently a political choice as the establishment of the necessary in-house expertise, is in most cases, in a long-term decision

Factors in favour of in-house development are

- Developers are likely to be more familiar with the companies product or service Over time they will become more familiar,
- Can be easier to manage a project that is liable to change during development,
- Minor upgrades can be more easily undertaken,
- Location - communications problems should not exist,
- Where continuous teachware development is anticipated can be more cost effective

8.2.6 Disadvantages of in-house Development

- The main factor against in-house development is it requires skilled people with specialised abilities

8.2.7 Advantages of External Development

Factors in favour of external development are

- specialist company should be more efficient,
- little in-house resource required

8.2.8 Disadvantages of External Development

Factors against external development are

- easy to lose control of the project,
- risk of the contractor going out of business,
- location - the contractor may be remote

8.3 Selection of a Contractor

Selection of the correct contractor is an important stage in external development The following points should be looked at.

Have they done similar work

The design process and communication of ideas is much easier if there is an existing similar teachware package that can be used as a discussion point

Success in one project reduces the risk of failure in another similar project.

What is the experience level of their staff

Are their staff sufficiently experienced? It is difficult to recruit people experienced in teachware development skills Is your project being used to train unskilled people?

How many staff do they have

Is this a one-man band? If one person goes sick, will the project be in jeopardy?

Do they assign a member of staff to your project? How many other projects is this person working on at the same time?

Communications

Communications is vitally important How far away from you are they? Distance need not be a problem but do they have E-Mail communication?

How do they propose to keep you informed of progress?

8.3.1 Financial Stability

Is the company experiencing financial difficulties?

8.3.2 Visit the Offices

Many of these areas of concern can be answered by a visit to the offices of a prospective contractor

8.4 Obtaining a Quotation

8.4.1 Initial Design Analysis

Where external development is to be used, it should be noted that development companies will seldom be able to quote directly for complete development

They must have a good understanding of the work involved before they can accurately decide the development task

There are two methods of achieving this

- an in-house initial design analysis,
- contracting an initial design analysis

The in-house method has the advantage that the people will be more familiar with the subject On the other hand, they may not be training experts and thus might not fully understand the task required

Where the initial design analysis is contracted out it should be made clear that the product of this will be given to other companies to enable them to quote

In many cases, companies will carry out their own design analysis without cost in order to try to secure the contract

8.4.2 Project Management

Multimedia teachware is a hybrid of several fairly immature disciplines·

- instructional design,
- interactive multimedia design,
- film/video/animation production,
- software design and coding

A project manager is thus required who is knowledgeable in these disciplines as well as being able to manage team members and course owners

In particular there should be

- rigorous application of task based development,
- quantification of everything,
- frequent and regular communications,
- individual ownership of tasks,
- team ownership of project

8.4.3 Personnel

It is important that people are identified to carry out the functions detailed in the previous chapter on personnel

Note that contracting out development still leaves an internal staffing requirement and it is important to ensure that all personnel are fully aware of the roles that they are to undertake

8.5 Subject Analysis

8.5.1 Introduction

The analysis of the subject is important It is not the purpose of this chapter to detail extensive methods for carrying out such an analysis

The following points should be remembered when performing the analysis

A CBT course should consist of a number of small units logically connected

The terminology associated with a course structure is covered in detail in the chapter on terminology and structure

Briefly, a course is provided for each subject Within each subject chapters/lessons are provided that cover connected topics Ideally, each chapter/lesson should be of around 1 hour duration. Within each chapter, there will be a number of individual topics Topics will be of varying length, generally from 5 to 20 minutes duration

Teachware provides a self study course which the student may be fitting in around other tasks Breaking the teachware into small units assists the students in planning their study time

Initial analysis is thus required to

- Establish training objectives,
- Group objectives into topics and the topics into chapters,
- Establish any prerequisites for each unit (interactive guided learning)

8.5.2 Course Structure

Establishment of the basic course structure is the first task

The example below shows how a typical subject could be structured as a teachware course

Subject - Radio Navigation Aids - Can be broken down into **chapters/lessons** thus (*note: not all included in this example*)

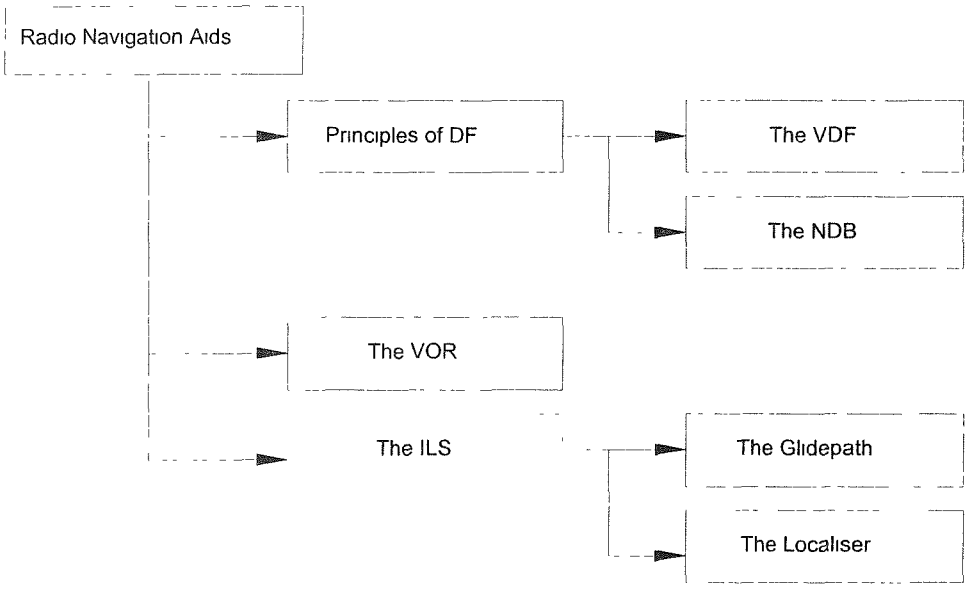
- basic principles of radio,
- principles of DF,
- the VDF,
- the NDB,
- the VOR,
- the ILS, etc

Each **chapter** can then be further subdivided into **topics**, e g

- the ILS,
- the localiser,
- the glidepath, etc

The result of the initial analysis will be a flowchart containing the basic course structure

Basic Course Structure



Well structured teachware will

- allow the student to find their way around easily,
- provide material in easily assimilated chunks (units),
- provide a logical flow through the subject matter

8.5.3 Establishment of Teaching Objectives

Once the basic structure of the course has been produced individual teaching objectives can be set for each topic that has been identified

It is of course possible to carry out this process in the reverse, i e establish teaching objectives for the whole course and then group the objectives into topics

8.5.4 Establishment of Prerequisites

8.5.4.1 External

With any teachware course it is important that people undertaking the course have the necessary knowledge to study the course.

Pre-requisites for the course should thus be established

8.5.4 2 Internal

Where teachware is going to follow the "interactive guided learning" principals prerequisites should be established for each chapter/topic of the course

In the example above you may decide that the topic on the localiser cannot be taken until the topic on the glidepath has been completed

8.5.5 Type of Teachware

Establish which type of CBT the teachware will be See chapter on computers as training tools

8.5.6 Student Tools

Establish the facilities that are to be made available to the student

Examples

- Help Files,
- message capability,
- searching tools,
- navigation tools

8.5.7 Instructor Tools

Establish which facilities or tools are to be available for the instructor

Examples include

- analyses of student progress,
- management of students

8.6 Establish a Development Schedule

8.6.1 General

Once the structure and teaching objectives have been established it is essential to plan a development schedule

8.6.2 Outline

A development schedule will normally compose the following major stages.

- produce the storyboard,
- code the course,
- carry out Beta testing,
- production,
- distribution

- These topics will be covered in detail in the following sections of this chapter.

8.7 Storyboarding

8.7.1 General

Storyboarding is a vital phase of teachware production

This is the stage where the teaching material designed to achieve the teaching objectives is designed and produced in a format that the coder can use

8.7.2 Personnel

Two personnel groups are involved in this task

8.7.2.1 The Author

Responsible for the production of the storyboard.

8.7.2.2 The Subject Matter Experts

Subject Matter Experts (S M E s), responsible for providing expert technical knowledge to the author

8.7.2.3 Additionally

The author must also be closely aware of what the coder is capable of, i.e

- what components can the authoring system use,
- what components is the coder capable of producing

This is also closely tied into costs as the production of complex expensive components must be weighed against their teaching value

8.7.3 Method

The most common method of story boarding is to produce on paper

- representations of the individual computer screens;
- flowchart showing the linkages through out the course

There are also software tools available that can be used for this task and at least one authoring system includes a storyboarding system within it

8.7.3.1 EUROCONTROL Templates

The EUROCONTROL templates encourage storyboarding as an integral part of the coding

The author is trained to use the template to produce the storyboard. This will contain the required text in the correct structure Where other components are required the author places a note in the appropriate location for the coder to produce the component.

Thus the storyboard is used as the basis for the teachware with the coder being used for development of the complex components within the course

8.7.4 Interactive Design

Following production of the storyboard it is submitted to the SME for checking for subject accuracy

Note that this procedure can be very modular with individual topics being submitted rather than submission of the complete course at the end of storyboarding

8.8 Coding

8.8.1 General

Coding is the generic term given to the conversion of the storyboard into the teachware

Coding can thus involve different disciplines including video and sound as well as graphic design and programming

The degree of programming skills depend on the authoring package being used In all cases, however, expert knowledge of the authoring package is essential for efficient production

8.8.2 Time Required

It is difficult to give firm time for the coding of teachware This difficulty arises because there are a variety of authoring systems, a variety of teachware components and no firm measure of what is produced at the end

It is easy to say that 1 hour of teachware takes 120 hours to code but the possibly options are so great that this is a difficult exercise One point to consider is "What is one hour of teachware?"

As a guide, it is possible to give the development times of the two ODID 4 CBT modules produced using toolbook The coder had considerable toolbook experience

The first of these modules represents a page turning CBT with very limited interaction - Coding time was in the order of two weeks

The second module is much more interactive and represents a better example of teachware Coding time for this was 5 weeks

Both modules take around an hour for the average student to complete

8.8.3 Points to consider

Where coding involves programming this should be documented to facilitate changes in subsequent years

Make extensive use of reusable components

- graphics,
- templates for student interface,
- code samples, etc ,
- subcontract expert tasks such as video, animations, etc

8.9 Beta Test

8.9.1 General

Following coding there are two Beta testing stages to go through

- Contents accuracy check involving the author and the SMEs,
- Target audience check involving a typical sample of students

8.9.2 Contents Accuracy Check

This can be carried out as on going process following the completion of each topic

The coded teachware must be checked by the author to ensure that the coder has reproduced what the author intended This will include checking of any video, animations, graphics, etc , specified by the author The SME must also check the teachware to ensure that there are no technical errors in the material

8.9.3 Target Audience Check

The teachware should be given to a group of students representing a typical target group

Ideally the evaluation should be carried out by a method that will produce quantitative results

This could be in the form of a questionnaire, verbal debriefing or by using an observational method

All these evaluation techniques involve time and resource that may not be available It is however important to get target audience reactions Following these reactions, modifications may be required to various sections of the teachware

8.9.3.1 Time to Complete

As part of the target audience testing a record should be made of the time that each student takes to complete the teachware This will be of value to the final users and will also assist the developer in creating a model of development time against user time

8.9.4 Re-check

Following evaluation and modification it may be necessary to re run the beta checks to confirm the validity of the modifications

8.10 Production and Delivery

8.10.1 General

At an early stage in the design process, decisions on production and distribution will have been made

These decisions will have been based on where and when the teachware is to be used

8.10.2 Options

8.10.2.1 Network

Teachware delivery by network is a viable option and removes the need for extensive production of disks/CD-ROM's

Delivery of video over a digital network requires a high capacity network and associated networked boards Transmission capacity problems may mean that distribution of video over an existing network is not a practical proposition Expert advice should be sought at an early stage if this option is being considered

With the increasing development of the Interment and WWW world-wide teachware distribution should become viable within the next two to three years

Advantages

- Useful for in house distribution,
- Simplifies version maintenance,
- Facilitates student monitoring

Disadvantages

- Multimedia components may cause data transmission rate problems

8.10.2 2 CD-ROM

CD-ROM provides one of the only methods for the distribution of teachware containing components such as video, sound and animations

A basic CD-ROM can contain up to 600 MB of data which is sufficient for the majority of teachware

CD-ROM production is now relatively cheap and the number of computers with installed CD-ROM drives is rapidly increasing

Advantages

- World-wide standard,
- CD-ROM reader is rapidly becoming a standard PC item,
- Cheap to produce,
- Reliable technology,
- High capacity

Disadvantages

- Bulk production requires specialist company

8.10.2.3 Diskettes

Diskettes (3 5 inches 1 44 MB) provide a viable method of distributing teachware that does not contain extensive multimedia features. Generally speaking, they are suitable for the smaller teachware courses (up to 10 hours)

Diskettes also allow the distribution of modular sections of teachware over an extended time period

Advantages

- Useful for modular distribution,
- Cheap existing technology,
- Good for small teachware courses

Disadvantages

- Bulk production facility required,
- Limited capacity

8.10.2.4 Other Media

There is a multitude of other media available for the bulk distribution of data These range from removable hard disks, through tapes to new floppy drives capable of storing 120 MB on a slightly modified 3 5 inches diskette.

The major disadvantage of all these media is the fact that there is no large installed base of equipment using any of them

Within an organisation having the equipment as a standard item they may be useful but for general distribution the problems are too great to consider them

8.11 Quality Control

8.11.1 General

Quality control is an essential part of teachware development and production A teachware package produced without adequate quality control may look reasonable but may not

- be suitable for the target audience,
- be easy to maintain

Quality control can be broadly broken down into.

- design standards,
- documentation standards,
- evaluation standards,
- release procedures

Discussion of this is beyond the scope of this document but some brief ideas are covered below

8.11.2 Design Standards

Standards for the layout of screens and use of colours should be established

These should ensure that the HMI is useable and provides an easy interface to the student

Where possible screen layouts should be consistent throughout the teachware

8.11.3 Documentation Standards

Where programming is carried out as part of the coding procedure it is essential that the program code is adequately documented

This should be to a standard to allow modifications to be made during the life of the course

8.11.4 Evaluation Standards

Evaluation standards refers to the establishment of an evaluation procedure that provides quantifiable results of the evaluation of the teachware

The evaluation procedure should be documented and progressively modified to achieve these aims

Selection and design of a procedure is beyond the current scope of this document

8.11.5 Release Procedures

Establish a procedure for the release, tracking and maintenance of courses With courses being used in a wide spread of geographical areas it is essential that a register is maintained

It is suggested that standard software practice of giving release numbers to each edition is used

Thus the first release of a teachware unit would be Version 1 0.

Minor upgrades are identified by increasing the figure to the right of the decimal point e g Version 1 1, Version 1 2, etc.

Major upgrades are identified by increasing the figure to the left of the decimal point. e g. Version 2 0, Version 3 0, etc

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SUPPLEMENT

Guidelines for the Production of Computer Based Training

1996-1999

HUM.ET1.ST07.2000-GUI-01

Edition	:	**0.3**
Edition Date	:	**26.09.96**
Status	:	**Proposed Issue**
Class	:	**EATCHIP**

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9. SUPPLEMENT: EQUIPMENT

9.1 Technical Equipment

9.1.1 General

It is considered that the most common personal computer platform within Europe is the IBM™ PC compatible Although Macintosh ™ type equipment may offer technical superiority in many areas the small numbers in use mean that the production of CBT for this equipment alone would severely limit its potential market

Authoring software capable of cross platform development is available

9.1.2 Equipment Specification

The following equipment specification should be considered as the minimum for the purchase of new equipment for CBT use As equipment specifications change rapidly actual equipment that you buy will probably be superior Nevertheless, this specification allows a high standard of CBT to be used and should be useable for a number of years

- IBM PC compatible,
- Pentium™ or better processor,
- 16 MB RAM or better,
- 420 MB hard Disk or better,
- 1024 x 768 resolution colour display capable of showing a minimum of 256 colours,
- Quad Speed CD-ROM,
- Sound blaster compatible sound card.

or non IBM PC compatible equipment equalling or bettering the above capabilities and being able to run Windows ™

Where possible developers should attempt to make their products compatible to the current fairly common equipment specification of:

- IBM PC compatible,
- 486 or better processor,
- 8 MB RAM or better,
- 240 MB hard drive or better,
- 600 x 800 resolution colour display capable of showing a minimum of 64 colours,,
- Double speed CD-ROM

or non IBM PC compatible equipment equalling or bettering the above capabilities and being able to run Windows™ .

This will facilitate the wide useage of such CBT

9.1.2.1 Note - Upgradeability

At the time of preparation of this manual the equipment specification represented state of the art technology and was capable of providing high quality teachware presentations The rapid development of computer technology makes setting of a common specification difficult As time progresses equipment with higher specifications will become available Where this equipment is backwardly compatible with these standards it could be utilised if required Where such new equipment is not backwardly compatible with developed teachware serious consideration should be given before upgrading as, although the new equipment may be superior, the improvement in teachware technical quality may be insufficient to justify the teachware upgrade costs

9.2 Software

9.2.1 Operating System

For general use the operating system to be used should be Windows 3.1 ™ This will ensure ascending compatibility with Windows 95 ™ and with Windows NT ™

Variants of Windows ™ capable of running under various emerging systems are, or will shortly be available The specification of Windows ™ should thus permit the use of teachware over a wide machine base

It is recognised that some specialised requirements may require other operating systems to be used

9.2.2 Authoring Software

It is recognised that the establishment of a common authoring language throughout the EUROCONTROL States may not be possible within the short term

To facilitate the exchange of software it is recommended that only Windows ™ based authoring languages be used

The teachware shell defined in this manual will permit the integration of teachware developed in different Windows ™ based authoring languages

It is recognised that some specialised requirements may require other authoring languages to be used

9.3 Teachware

9.3.1 General

In general, teachware should be useable on the widest selection of equipment available At the moment, this would mean production for the minimum equipment standard.

9.3.1.1 Backwards Compatibility

Many organisations will wish to develop teachware for equipment within the advanced or multimedia standard In these circumstances they may consider producing teachware that is backwardly compatible to the minimum equipment standard

Such teachware would operate successfully on the minimum equipment standard but would not utilise any of the multimedia facilities in the teachware

Production of such courseware entails some additional time and effort and may not always be feasible

9.4 Enhancements

9.4.1 General

The following enhancements to teachware are currently possible and will become increasingly used over the next few years

The advanced equipment requirements will be upgraded when necessary

The minimum equipment requirement will NOT be upgraded until, at least, 1999 This is to ensure a long life for teachware developed to that standard

Note The minimum equipment standard permits development of high quality teachware that should remain useable for several years to come

9.5 Sound

9.5.1 Introduction

The use of sound can greatly enhance teachware and should form part of any teachware produced for the multimedia equipment standard

The use of sound can add considerably to the final size of the course software

Sound can be incorporated in teachware relatively cheaply and the facilities to play back the sound on a PC are low cost It is also relatively easy to design backwardly compatible teachware that incorporates sound

The use of sound will almost certainly require that most teachware is distributed by CD-ROM

9.5.1.1 Equipment Required

In addition to the minimum equipment standard, a sound card conforming to the sound blaster standard

9.6 Video

9.6.1 Introduction

Video can be used to illustrate some points with greater clarity than a still image or textual explanation

A common standard for video is yet to emerge It is envisaged that the price of devices capable of producing full screen full motion video will continue to decrease

Two formats seem to lend themselves to the use in teachware. The formats depend on the method of use of the video

9.6.1.1 Short Clips

Video For Windows ™ (VFW) and/or Quicktime ™ compatible systems would be useable where short clips are to be inserted in teachware modules At the moment, playback of these is limited to small images unless a special board is installed.

9.6.1.2 Complete Videos

MPEG compatible systems will be useful where it is required to store a complete video, on CD-ROM, as part of a course

9.6.1.3 Equipment Required

Software only playback is possible for VFW ™ and Quicktime ™ Additional hardware is required for full screen playback at high quality. The majority PC manufactures are intending to include such devices on the motherboard

Digitising of video for use by VFW ™ and Quicktime ™ requires a relatively low cost capture card

Playback of MPEG encoded video will require the addition of a suitable card

Recording of MPEG encoded video also requires a special card

The use of video will require that teachware is distributed by CD-ROM or network

REFERENCES

[Ref. 1] Air Traffic Controller Training at Operational Units (HUM.ET1.ST05.4000-GUI-01) Ed 1.0, EUROCONTROL, 1995.

[Ref 2] Guidelines for ATS Upgrade Training (HUM ET1.ST05.4000-GUI-02). Ed 1 0, EUROCONTROL, 1996.

[Ref 3] WW Lee & RA Mamone The Computer Based Training Handbook Educational technology publication

[Ref 4] The Open University, Human Computer Interaction, Glossary and Index, 1990

[Ref 5] Trainair Training Development guideline, ICAO, second revision.

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DEFINITIONS

List of terms	Definitions
Audio aids	Aids to communication which utilise the sense of hearing
Audio visual aids	Aids to communication ,with special reference to controlled learning, which utilise both sight and hearing
Authoring system	Software tool allowing course developers to produce teachware for CBT
CBT learner station	Personal computer or work station dedicated to one student to practice CBT Today's equipment is with colour screens and mouse Sound cards and CD-ROM readers are re-commended Networking facilitates teachware administration and updating
Computer based classroom presentation	Use of a computer by an instructor to provide audiovisual aids in the classroom There is no direct interaction between the student and the computer
Computer based examination	Use of the computer to give and assess examinations Usually consisting of randomly selected multiple choice or similar questions
Computer based page turning	Use of an electronic book with no interaction between the learner and the computer apart from "page turning " and more generally navigating from one item to a new one
Computer Based Training (CBT)	Provision of knowledge and skills by means of a computer with numerous interactions, student responses analysis and free individual rythm of learning (self-paced manner) This encompasses interactive guided learning and interactive exploration
Interactive exploration	Training method used in CBT where the student is allowed to follow his own path through the training material There is extensive interaction between the student and the computer in the form of questions, feedback and participation
Interactive guided learning	Training method used in CBT where the student has to follow a predetermined path through the training material. There is extensive interaction between the student and the computer in the form of questions, feedback and participation

List of terms	Definitions
Media	Physical means by which an instructional message is communicated
Module	A subsection of a teachware unit referring to a particular module teachware comprises Modules comprising units respectively dealing with subject, topic and elements
Simulator	A device which presents the student with a representation of the important features of the real situation and reproduces operational conditions which enable him to practise directly real time tasks
Screen	Information displayed on a computer screen at any one time, which might include animation or extra information which may be displayed upon selection One or more screen(s) grouped together comprise a module Screens deal with items
Teachware	A software specifically used to CBT to a student (it is derived from TEACHing and softWARE)
Video	The electronic generation, recording, storage and reproduction of visual images and associated sounds
Visual aids	Any aids to communication, learning, teaching and remembering which utilise the sense of sight

ABBREVIATIONS

ATC	Air Traffic Control
ATCO	Air Traffic Controller/Air Traffic Control Officer
ATS	Air Traffic Services
AVI	Audio/Video Interleaved
CBT	Computer Based Training
CD-ROM	Compact Disk - Read Only
DED	Directorate EATCHIP Development
DEL	Deliverable
DF	Direction Finder
EATCHIP	European Air Traffic Control Harmonisation and Integration Programme
EWP	EATCHIP Work Programme
ET	Executive Task
FPL	Flight Plan
HMI	Human Machine Interface
HRT	Human Resources Team
HUM	Human Resources (Domain)
IANS	Institute of Air Navigation Services
ILS	Instrument Landing System
JPEG	Joint Photographic Expert Group
KB	Kilo Byte
MB	Mega Byte
MET	Meteorology
METAR	Meteorological Actual Report
MPEG	Moving Pictures Expert Group
NDB	Non Directional Beacon
OCX	New object similar to VBX
ODID	Operational Display and Input Development
PC	Personnal Computer
PCX	A window compatible BIT format
RAM	Random Access Memory
ROM	Read Only Memory
R/T	Radio Telephony
SME	Subject Matter Expert
ST	Specialist Task
TSG	Training Subgroup
TV	Television
VBX	Visual Basic Extensions
VDF	Very High Frequency Direction Finding
VOR	Very High Frequency Omni Directional Radio Range
VWF	Video For Windows
WWW	World-Wide Web

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