

# Cost in open and distance learning

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**Commonwealth of Learning**

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# 1. Introduction

This booklet provides an introduction to costing in open and distance learning (ODL). It is designed both for people setting up new ODL programmes and for people wishing to improve the quality of the management of existing programmes.

## Overview

The booklet is organised as follows:

- this **introduction**
- **drawing up a budget**, moving from an initial definition of your project to identifying, quantifying and costing its components, to modeling the uncertainties (e.g. no. of students)
- **elements of cost-analysis**: this covers fixed costs, variable costs and the treatment of capital costs. We treat costing as a dynamic process since you need to match what you want to do to the available funds. For example, issues of instructional design interact with costs in order to achieve the most cost-efficient solution
- **cost-effectiveness**
- **the cost implication of media choice**: here we look at media effectiveness and the cost-structure of the various media. We also discuss the impact of the more recent ICT-based approaches in open and distance learning (e.g. **distributed e-learning**)
- **business models** in ODL.

The booklet shows you how to draw up a course budget. This is not difficult to do but it is also not possible to give you step by step instructions on how to do it since that depends on the context and purpose of your budget. This means that you need to understand some basic elements of cost-analysis so that you can modify the spreadsheets (see below) according to your needs.

The booklet includes a little bit of algebra and some require a modest competence in Excel spreadsheets..

## References

Some of the costing data that we have used is not referenced. This is because we made use of data supplied in confidence by ODL organisations. Thus, the unacknowledged data are real-world data but slightly disguised in order to hide the institutions from which they have come.

## The CD-ROM

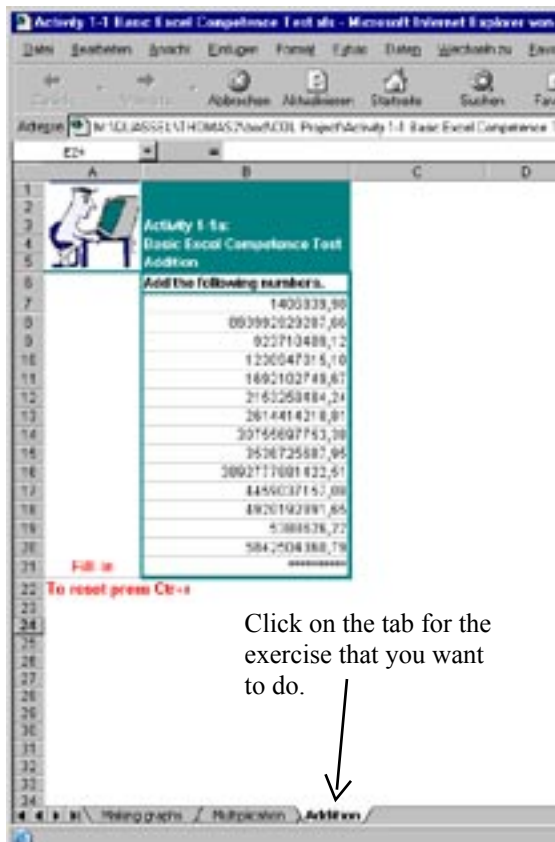
This booklet is accompanied by a CD-ROM, which contains a number of interactive Excel spreadsheets. *Interactive* spreadsheets mean that you can use them to actively explore the impact of the various cost drivers.

Although the booklet can be read on its own, the activities will help you to understand the ideas in more depth and give you some skill in applying them to your own projects.

### WARNING

**The cost figures in the scenarios may not apply to your context. You should always check local costs.**

Cost figures vary with contexts and with costing procedures. We have generally used 'real world' figures (i.e. figures we came across in different contexts); these may offer you some benchmarks in terms of order of magnitude. Beyond that you have to treat the figures as indicative rather than precise.



The spreadsheet activities are intended to do two things:

1. They allow you to explore **cost-structures**, i.e. how costs will behave when the volume of activity (e.g. the number of students taught) changes
2. They provide **generic templates** for reporting and analysing costs, which can be modified for your purposes, and in which you can enter the cost data, which apply for your context.

### Excel pre-requisites

We have assumed that you have a basic familiarity with Excel spreadsheets.

### **Activity A-1: Basic Excel competence test**

To use the spreadsheets in this booklet, you need to be able to:

- add a column of numbers (Activity 1-1a)
- multiply a set of figures (Activity 1-1b)
- generate a graph (Activity 1-1c).

If you are unsure about your skill level, try the three parts of this activity. To do the activity, open the file *Activity 01* on your CD-ROM. The three parts to the activity are on the three separate worksheets. You need to click on the appropriate tab for the exercise that you wish to do, as in the figure below. [Click here](#)

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#### **WARNING**

**Do not keep several activities open at the same time. They include reset macros (Ctrl+r). Since all macros have the same name, they interfere with each other.**

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If you wish to modify a spreadsheet to adapt it for your use you should:

- remove the protection (which can be done easily since they are not protected with a code name)
- then save it under a different name.

## **2. Drawing up a budget**

We shall start the booklet by showing you how to draw up a budget and adjust it to the available funds. This will lead to a very basic template for reporting and forecasting costs in distance education.

Some of what you read may not be completely clear until you have read *Elements of cost-analysis*, which come later.

### ***From ‘identifying ingredients’ to ‘modelling costs’***

Drawing up a budget is a dynamic rather than a static process. You start by defining what type of courses you want to develop; then you identify the activities that will be involved and their costs – we call this the ‘ingredients approach’. You will probably want to compare different options (e.g. in terms of media or level of student support). The uncertainties that are involved suggest that you need to take a modelling rather than budgeting approach. So, in addition to looking at the basics of budgeting, this section will provide you with a foretaste of modelling.

#### **The ingredients approach**

Preparing a course is similar to preparing a meal. You need to decide what to cook before you buy the ingredients. This explains why Levin (1983) refers to this method as an **ingredients approach**. In order to draw up a budget for an ODL course, you need to

- decide what you want to teach (and what activities will be involved)

- identify which ingredients are needed to achieve your objectives in terms of:
  - human resources
  - premises and accommodation
  - equipment and furniture
  - stocks, supplies, consumables, and expenses
- specify the quantities needed of each item, and
- find out their respective costs.

### **Modelling costs**

It is, however, not always possible to specify all parameters in advance. The quantities of some items, for instance, depend on how many students will be attracted to a course. Moreover, the costs of some ingredients may change. Because this is so, it makes sense to **model** the costs. Modelling costs refers to creating mathematical equations (e.g. the ‘total cost equation’ or the ‘average cost equation’), the parameters of which are specified by the ingredients approach. To move from describing the costs of the ingredients to modelling the cost behaviour requires that:

- the costs are classified in categories (e.g. fixed/variable, capital/operating)
- cost items within categories are aggregated and
- the resulting figures are finally inserted into the mathematical equation.

All this will be described in the section *Elements of cost-analysis*. In the text that follows we will introduce a basic scenario to help make these theoretical ideas concrete.

### ***A generic template for costing ODL***

When reporting ODL costs it helps to develop a template which reflects the main cost drivers in the system. We therefore revisit the definition of Keegan (1990) and look at Rumble’s ‘rich picture’ of ODL systems (Rumble, 1997). Based on this we develop a first generic template for reporting costs.

### **Defining ODL**

Keegan’s definition of distance education includes the following elements:

1. The quasi-permanent **separation of teacher and learner** throughout the length of the learning process (this distinguishes it from conventional face-to-face education).
2. The influence of an **educational organization** both in the planning and preparation of learning materials and in the provision of student support services (this distinguishes it from private study and teach-yourself programmes).
3. The use of **technical media** – print, audio, video or computer – to unite teacher and learner and carry the content of the course.

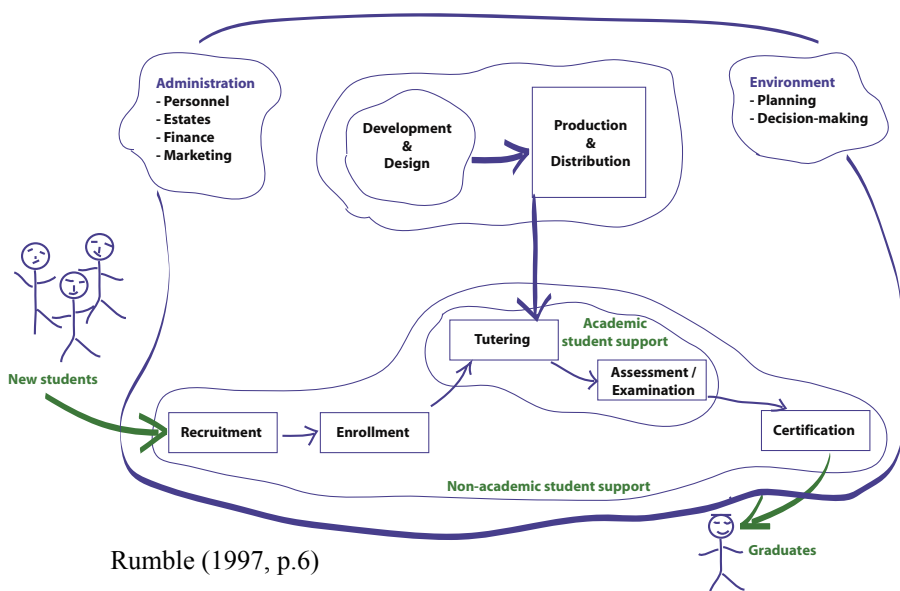
4. The provision of **two-way communication** so that the student may benefit from or even initiate dialogue (this distinguishes it from other uses of technology in education).
5. The quasi-permanent **absence of the learning group** throughout the length of the learning process so that people are usually taught as individuals and not in groups, with the possibility of occasional meetings for both didactic and socialization purposes.

(Based on Keegan, D. (1990), Foundations of Distance Education, Routledge, p. 14. Emphasis added.)

This definition can be interpreted from the perspective of developing a generic costing template for ODL systems as follows. While (1) provides a sort of ‘minimalist definition’ of ODL which is to be elaborated in the subsequent points, (2) marks the importance of a providing institution. In terms of cost-analysis this corresponds to the institutional overheads or (with respect to courses) indirect costs. (3) refers to the cost drivers of course development, which are direct costs. (4) refers to the direct costs of course presentation (delivering the study material and supporting students’ learning). (There is a fifth point stipulating the quasi permanent absence of a group in the process of learning who became obsolete in times of CMC and videoconferencing.)

Rumble (1997) identifies four systems: the materials subsystem, the students subsystem, the logistical and the regulatory subsystems.

**Figure A-1 Distance education - a rich picture**



### Direct costs of development

If we focus on the two main subsystems while keeping in mind the definition of distance education, the following format seems appropriate for reporting costs: The activities in the

materials subsystem subsystems relate to the development of course materials which is distributed to the learner via different media such as printed study guides, audio or video tapes, or CD-ROMs. **Course material development costs** will be a main heading in our costing template. These are essentially fixed costs.

The cost drivers for materials development depend very much on the media used. For print based courses the main costs are:

- authoring the texts (sometimes involving subject experts and instructional designers)
- editing
- desk top publishing.

Since most other media include at least some printed complementary material, authoring and lay outting are cost drivers in almost all cases.

Radio or TV production involves all sorts of media specialists. In both cases production overheads may have to be included if the production facilities are located in the institution.

Using computers may involve high programming costs, especially if multi-media materials are developed. On the other side, if computers are used mainly for communication purposes, development costs are lower since commercially available platforms provide the necessary facilities.

### **Direct costs of presentation**

ODL includes the costs of two-way communication to support the learner (Keegan, 1990). In the following we call the process of teaching a course (based on the pre-prepared materials) ‘course presentation’, which includes all the costs of tutoring and student support. The **course presentation costs** will be a further main heading in our costing template. The costs of student support depends strongly on the number of students in the system. Generally, the costs of student support are variable costs.

Typical cost drivers are tutor marked assignments (TMAs), counselling and tutoring. Costs will also be affected by whether students are to learn individually or in groups. Even in traditional correspondence courses there are often options to join evening classes at regional learning centres or enrol in summer schools (e.g. to prepare for examinations).

### **Indirect costs (overheads)**

There are a number of costs, which do not arise directly from a specific course. Such costs are classified as ‘indirect costs’ or ‘overheads’. They include buildings (such as offices), equipment (servers, radio transmitters) or services (cost of the director). Whether such costs should be included when budgeting for a particular course will depend on the purpose of the costing exercise; how they are to be treated depends on the nature of the respective cost driver (e.g., a capital or an operating cost).

Obviously, in a full cost-analysis, indirect costs should be included. However, when budgeting for a particular course or when comparing courses with different combinations of media, overhead costs can sometimes be ignored since they do not affect the comparative cost of the different approaches. If overheads are to be included they then have to be shared in some way

between the different courses. Sharing out overheads is a fairly complex activity and may involve methods such as ‘activity based costing’ (ABC).

### Generic costing template

The above classification can be taken as a generic costing template for ODL. There are the indirect costs relating to the institutional overheads, and the direct costs for (1) the development of materials, and (2) the costs of course presentation. If we measure the volume of activity by the number of students enrolled in the courses, costs of development are fixed (i.e. they do not change as the number of students changes), while costs of course presentation vary strongly with the volume of activity (i.e., the larger the number of students, the larger the presentation costs become). This will be an important point to remember when the cost-structure of ODL is analysed in terms of the composition of fixed and variable costs.

This background allows us to produce our first generic template (Table 1).

**Table 1 Generic costing template**

	Units	No. of units	Cost per unit	Total costs
INDIRECT COSTS				
Overheads				
DIRECT COSTS				
Development costs				
Presentation costs				

The template reflects the three main elements that we have identified so far:

1. The indirect costs (overheads) of the institution.
2. The development of the materials.
3. Delivering the material to the students and communicating with them (course presentation costs).

### The template applied: a basic scenario

To illustrate how the template is used we will consider a very basic ODL scenario: a correspondence course in bookkeeping. We will plan for two booklets, a textbook and a book of exercises. Students will be asked to send in assignments, which will be marked.



**Table 2 Costing template for the bookkeeping course**

	Units	No. of units	Cost per unit	Total costs
<b>INDIRECT COSTS</b>	% of total budget			25% of total budget = $0.25 \times 70\,800$ = 17 700 <sup>a</sup>
<b>DIRECT COSTS</b>				
<b>Development costs</b>				
Authoring	Person/days	5	US\$ 300	$5 \times \text{US\$ } 300 = \text{US\$ } 1\,500$
Editing	Person/days	2	US\$ 250	$2 \times \text{US\$ } 250 = \text{US\$ } 500$
			<b>Total fixed costs</b>	<b>US\$ 2 000</b>
<b>DIRECT COSTS</b>				
<b>Presentation costs</b>				
<b>Production and Delivery</b>				
Printing and mailing	Booklets	2	US\$ 10	$2 \times \text{US\$ } 10 = \text{US\$ } 20$
Student support				
Tutorials (group of 20 <sup>b</sup> )	Person/hours	4	US\$ 30	$4 \times (\text{US\$ } 30)/20 = \text{US\$ } 6$
Assignment marking	Assignment	5	US\$ 12	$5 \times \text{US\$ } 12 = \text{US\$ } 60$
			<b>Total variable cost per student</b>	<b>US\$86</b>

a: Overheads are often determined as a percentage of the total direct costs b: For the institution the tutor is the cost factor. However, we want to portray the course presentation costs as variable cost per student. Since the tutor teaches up to 20 students the cost per student are cost per tutor/hour divided by group size.

The costs in Table 2 can now be used to project the costs of running the course. Such a projection would require decisions about the shelf life of the course and assumptions about the average annual enrolment.

**Table 3 Costing template (cost projection)**

	Development	Year 1	Year 2	Year 3	Year 4	Total
No. of students (N)		200	200	200	200	800
Accumulated N		200	400	600	800	800
<b>Fixed costs of development (depreciated)</b>	2 000	500	500	500	500	2 000
<b>Variable cost per student (V) per year</b>	86	$86 \times 200 = 17\,200$	17 200	17 200	17 200	68 800
Accumulated V		$86 \times 200 = 17\,200$	$86 \times 400 = 34\,400$	$86 \times 600 = 51\,600$	$86 \times 800 = 68\,800$	68 800
<b>Total direct costs</b>						70 800
<b>Total costs (including overheads)</b>						88 500

## **Activity 2: Applying the generic template**

1. Open the Excel file Activity A2.
2. Inspect the layout of the scenario
3. Look at the formulae connecting the various columns and lines. In order to see the connecting formula you need to have activated under **View, Toolbars** and then select **Standard**. NOTE: if you do not see the connecting formulas as described you may have to go to **Tools, Options, General** and make sure that under **Settings** you do not have **RIC1 reference style** ticked. [Click here](#)

## **3. Elements of cost-analysis**

Cost-analysis needs to record costs in a comprehensive manner and then classify them in a way, which facilitates modelling. In order to record costs in ODL we suggest the use of a generic template that distinguishes between **direct costs and indirect costs**. Direct costs refer to:

1. Developing course material.
2. Teaching the course (course presentation).

Indirect costs include overheads which not directly contribute neither to the development of the course material nor to the actual teaching of the course.

After recording all the various costs we analyse them into:

1. Operating and capital costs.
2. Fixed and variable costs.

You should think of these categories as two binary distinctions which are independent from each other like fat and lean on the one side, and blond and black haired on the other side. The fact that someone is fat does not imply that he/she is blond etc. Similarly, capital costs may be fixed or variable, and variable costs may be operating costs or capital costs.

### ***Capital and operating cost***

We know that money has something to do with time. If I need to borrow money from the bank it is not sufficient that I give back the money later on: the bank will charge interest. This reflects the fact that the value of money depends on time. Having US\$ 1 000 now is better to have US\$ 1 000 in five years.

### **Operating costs**

The distinction between capital costs and operating costs is based on a convention about the *financial year*. If the value corresponding to the costs is consumed within the same financial year in which the costs are incurred, we refer to them as *operating costs* (or *revenue costs*). If this is not the case, we speak about *capital costs*. All capital costs are non-recurrent costs,

while many operating costs are recurrent. However, there are *non-recurrent* operating costs. If you buy a ream of paper, this would be classified as an operating costs, which is non-recurrent, while the salary of an administrator would be a recurrent operating cost.

### **Activity A3: Classifying cost drivers as capital and operating costs**

This activity asks you to classify some costs into categories.

Open the Excel file A03 for this activity.

You should use copy and paste to copy the items from the list into the categories.

You can class the same item into all categories. [Click here](#)

### **Depreciating capital costs**

Capital costs are those cost, whose value is *not* consumed within one financial period. For example, a computer is used over a number of financial years. The convention is therefore to charge the costs to the period during which the computer is used. There are several different ways of doing this, such as:

1. Simple depreciation.
2. Social discount
3. Annualization.

#### ***Simple depreciation***

Simple depreciation divides the costs by the number of years during which the item is to be used. In the case of a computer this might be three to five years. For example, if a computer costs US\$ 2 000 and is to be used for five years, then the depreciation value ('depreciation rate') would be  $US\$ 2\ 000/5 = US\$ 400$ . This is the value to be charged in each of the financial years.

In other words, each year, the value of the computer is reduced by US\$ 400. This is illustrated in Table 4. The **written down value** (last line of Table 4) illustrates how over time the initial value is 'eaten up'. This is the meaning of depreciation: the value diminishes over time. The written down value corresponds to the remaining, the un-depreciated part of the value.

**Table 4: Simple depreciation**

Value type	Amount	Year 1	Year 2	Year 3	Year 4	Year 5
Initial value	US\$ 2000					
Depreciation value	$US\$ 2000/5 = US\$ 400$	US\$ 400	US\$ 400	US\$ 400	US\$ 400	US\$ 400
Written down value		US\$ 1600	US\$ 1200	US\$ 800	US\$ 400	US\$ 0

Depreciation is mainly important when auditing. We include it here since we want to introduce the **social discount** which helps to understand annualization.

## Capital costs and social discount

Theoretically you use up a value equivalent of US\$400 in the first year remaining with an un-depreciated remainder of US\$1600 at the end of the first year. It is as if, in each period, you pay only for the value consumed in that period. The un-depreciated part of US\$1600 could earn interest if you keep it in a bank. The next year you could earn interest on the new un-depreciated value - US\$1 200. This part could remain in the bank for two years earning interest accordingly. Table 5 illustrates the idea of the ‘social discount rate’, which varies over the years but is generally higher than the depreciation rate.

**Table A- 5 Social discount**

Value type		Year 1	Year 2	Year 3	Year 4	Year 5	Total
Initial value	2 000	2 000	2 000	2 000	2 000	2 000	
Depreciation value	$2\,000/5 = 400$	400	400	400	400	400	2 000
Written down value		1 600	1 200	800	400	0	
	Compounded at 5%	1 680	1 323	926	486	0	
	Forgone interest	80	123	126	86	0	
Social discount	Depreciation rate + forgone interest of un-depreciated part	480	523	526	486	400	2 415

In this case the rate to be charged per year varies considerably. This is, however, due to the variation in forgone interest to be charged to the different years. But such variation seems to suggest that each year a different ‘size of the value’ is consumed, while in fact the value consumed is about the same in each year. While it makes sense (under certain conditions, which we will specify later) to account for forgone interest on capital costs, it is implausible to charge differing rates to the different years while the value consumed is largely the same in each year. This leads to annualization.

### Activity A4: *Depreciating capital costs*

This activity allows you to depreciate capital costs.

1. Open the spreadsheet.
2. Type in your own values for the amount and the number of years.
3. If you want to increase number of years, you can extend the table to the right by selecting the Year 5 cells and dragging them to the right.
4. You should make sure that the last written down value is always zero. [Click here](#)

### Annualising capital costs

Annualization means that capital costs are not simply depreciated but that the forgone interest on your initial investment is taken into account. This is done by a so called *annualization* formula.

$$a(r, n) = \frac{r(1+r)^n}{(1+r)^n - 1}$$

The formula looks complex, but what it does is effectively to take into account forgone interest. At the same time it takes into account the critical comment on social discount rates, which charges different rates at different years in spite of the fact that the (use-)value consumed is largely the same for each period. *Annualization distributes the effects of the forgone interest in such a way that the annualization rate for each year is the same*

**Table 6 Annualization**

Value type	Amount	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Initial value	2 000						
Depreciation value	2 000/5 = 200	400	400	400	400	400	2 000
Social discount	Depreciation + forgone interest	480	523	526	486	400	2 415
Animalisation		462	462	462	462	462	2 310

#### **Activity A5: Calculating interest**

This activity enables you to calculate compound interest using the formula. The result is shown in the graph.

1. Open the spreadsheet Activity A05.
2. Type in your own values for the amount and the interest rate.
3. You can use Ctrl+t to show a 50 year scenario from which you can see that the interest rises exponentially rather than linearly. [Click here](#)

#### **Activity A6: Comparing depreciation and annualization**

This activity enables you to compare depreciation and annualisation.

1. Open the spreadsheet Activity A06.
2. Enter your own interest rates, number of years and amounts.
3. Observe how the annual values differ for depreciation and annualisation. [Click here](#)

#### **Activity A7: Producing a table of annualization factors**

This activity enables you to produce a table of annualization factors for various rates of interests and numbers of years.

Use the spreadsheet Activity 07 for this. [Click here](#)

*Start in Table 1*

Replace the red interest figure with the rate that you wish to use.

Go to Table 2

Type the interest rate that you are using so that it replaces one of the rates already in Table 2

Go back to Table 1

You now need to copy the  $a(r, n)$  values (but not the formulae behind them) from Table 1 to your chosen column in Table 2. To do this you must use Copy/Paste Special/Values Only. You will find this under the Edit drop-down menu.

*Note:*

You cannot set  $r = 0$  since this would lead to a division by zero. If no interest is taken into consideration annualization coincides with depreciation.

### Annualise or depreciate only?

When would it be appropriate to annualise, and when would simple depreciation do? You need to consider the following:

If decisions on large capital investments are to be made and there are real alternative options – i.e. the money is not ring-fenced and could genuinely be used for something else - then it is sensible to annualise since these figures include the opportunity costs and might tip the balance towards an alternative option.

If, however, there is no real alternative and the institution is not allowed to use the money for other than the specific purposes under consideration, it does not make sense to annualise.

### The generic costing template and the capital costs/operating costs distinction

Table 7 classifies some cost drivers that you are likely to come across when using the generic costing template and shows the distinction in each case between capital and operating costs.

**Table A- 7 Some cost drivers**

		DIRECT COSTS		INDIRECT COSTS
		Of development	Of presentation	Overheads
<b>Capital costs</b>		Authoring a text		Building costs, server costs (buying)
<b>Operating costs</b>	Recurrent	Authoring a text	Staff costs (tutors)	Director's salary
	Non-recurrent	Authoring a text (outsourced)		

Essentially non-recurrent operating costs can be treated along similar lines as capital costs.

### Fixed and variable costs

Possibly of even greater importance than the distinction between **capital costs** and **operating costs** is the distinction between **fixed costs** and **variable costs**. You will see that the main argument for the cost-efficiency of ODL – the expectation that distance learning generates economies of scale – rests on this distinction.

The distinction relates to volume of activity. The principal activities of an ODL institution consists in teaching students. Hence **fixed costs** are those which do not increase with the volume of activity, i.e. the number of students taught. Development costs of teaching materials are fixed costs in this sense. You need only develop the study guides once for a particular course and they can be used by many learners. Of course, you would have to reprint them as new students enrol but the development costs remain a one-off. The costs for reprinting and posting the materials to the students are examples of **variable costs**. Ideally, all costs can either be classified as either fixed or variable. However, some costs are classified as semi-variable. These are those costs, which are fixed up to a certain threshold. Typical semi-variable costs are costs of class tutors.

### **Activity A8: Classifying cost-drivers as fixed and variable costs**

1. Open the spreadsheet Activity A08.
2. Classify each cost driver in the list as follows:
  - Select an item from the list.
  - Copy and paste it onto the stars of one of the categories.
  - The evaluation will tell you whether you have correctly categorised the item.

[Click here](#)

### **Total cost equation**

For the time being we will focus on fixed and variable costs only. In this slightly simplified case the total costs are the sum of the fixed and variable costs:

total costs = fixed costs + variable costs

$$TC = F + V \times N$$

Where: TC = total costs

F = fixed costs

V = variable cost per student

N = number of students

Note well that the  $V \times N$  for Variable costs is a composed term in which V stands for Variable cost per student and N for Number of students. (Example: if it costs US\$ 4 per student to replicate some content on a CD-ROM and post it to the respective student, it cost US\$ 400 to do the same for all hundred students you may have in the same course. The respective Variable costs are US\$ 400 which is composed out of US\$ 4 per student times 100, the number of students.)

Mind that the *total costs* equation is a function of N (total costs depending on the number of students). In order to denote this mathematicians would write:  $TC(N) = F + V \times N$ .

### **Activity A9: Exploring the Total Costs equation**

This activity allows you to vary the fixed and variable parts of the cost equation so that you can see how the graph of the costs varies.

1. Open the Excel spreadsheet A09.
2. Try changing the variable costs per student. What happens?
3. Try changing the fixed costs. What happens?

(If you want to understand the maths behind this, you may recall that the equation

$$TC(N) = F + V \times N$$

is a linear equation of the form  $f(x) = kx + c$  where  $c$  is the intersection with the  $y$ -axis and  $k$  is the gradient (slope) of the graph. In our case the constant is  $F$  which identifies the starting plateau of the costs, while  $V$  (variable cost per student) is the gradient. The higher the value of  $V$ , the steeper the gradient.) [Click here](#)

You may have noted that the factor  $V$  affects the slope of the graph of  $TC$ . The higher the value of  $V$ , the steeper the curve.  $F$  affects the plateau, i.e. the starting level of the curve. Generally educational planners try to include as many students as possible but at the same time to keep total costs down as much as possible. The important observation in this context is that eventually  $V$  is more decisive than  $F$ . You may start at a higher initial cost level, but if  $V$  is lower, there will an intersection point beyond which the function with the lower gradient (i.e. value for  $V$ ) will have a lower unit cost per student. This can be seen more clearly when we look at the average cost function.

### Average cost equation

The total costs equation leads to the other important equation about **average costs**. Average costs are total costs divided by the number of students  $N$ .

average cost per student = total costs / number of students

$$AC = TC/N$$

$$AC = (F + V \times N)/N = (F/N) + (V \times N)/N$$

$$AC = F/N + V$$

Where:  $AC$  = average costs

$F$  = fixed costs

$V$  = variable costs per student

$N$  = number of students

It is important to understand this equation clearly, because it provides important guidelines for cost-efficient course planning. The important point is what happens to average costs as  $N$  increases.

As  $N$  increases,  $AC$  decreases, other things being equal.

This is what is meant by **economies of scale**.

The right-hand side of the equation is made up of two components. The first,  $F/N$  decreases as  $N$  increases. The second,  $V$ , does not change as  $N$  increases since it is the variable cost **per student**.

This result is often described as the fixed costs are ‘spread over more students’. Each student is charged a part of the fixed costs. The more students there are, the less each has to pay.

This is what educational planners want: falling unit costs. Mathematicians like to look at extremes and ask what would happen if we were to increase the number of students *ad infinitum*. The answer is that, in this case, the first term ( $F/N$ ) approaches zero or, in mathematical language, the average costs ‘converges to’  $V$ .



### Activity A10: Exploring the average costs equation

The average costs graph (Figure 1) shows how cost-effectiveness arises from increasing student numbers.

1. Open the spreadsheet Activity A10.
2. Try different values of  $F$  and  $V$  to see how the graph changes.

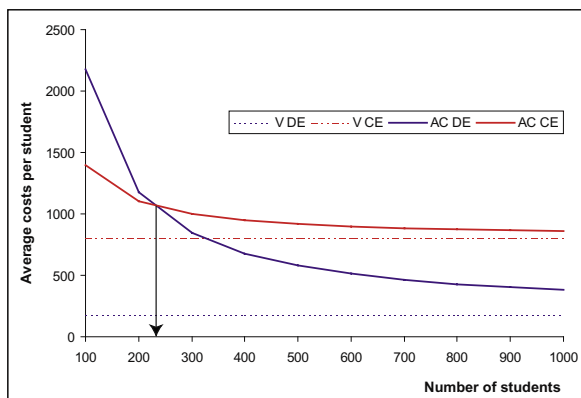
#### Note on the maths

The AC equation is an algebraic transformation of the total cost equation (TC).

You can see from the graph that the line is *asymptotic* – that is, it tends towards the long-term value  $V$  but never quite reaches it.

AC is only defined for  $N \geq 1$ .  $AC(1) = F + V$ . Since often  $V$  is almost negligible,  $AC(1)$  is approximately  $F$  while  $AC(N)$  for very big  $N$  is approximately  $V$ . This differential between  $F$  and  $V$  identifies the scope for any economies of scale. [Click here](#)

**Figure A 1 Average costs and economies of scale**



In Figure A1 the red lines refer to **conventional education (CE)** and the blue lines to **distance education (DE)**. AC DE stands for the *Average Costs per Student in Distance Education* and V DE for the *Variable Costs per Student in Distance Education*. Similarly AC CE stands for the *Average Costs per Student in Conventional Education* and V CE for the *Variable Costs per Student in Conventional Education*. The interpretation of the figure is the following: Since V DE is smaller than V CE and AC CE cannot fall below V CE, the graph of AC DE will, if student numbers are large enough, fall below the graph of AC CE (towards V DE). At the intersection point you find a downward pointing arrow which marks the *break-even point*. The break even point marks the number of students, beyond which (in this case) AC DE undercuts AC CE.

It is important to note that AC cannot fall below  $V$ , however large the number of students becomes. The variable costs per student therefore represent a bottom line, below which the average costs per student cannot fall. This implies an important strategic guideline:

**To lower average costs per student keep variable cost per student low.**

The other strategic guideline has already been mentioned:

**To bring the average cost per student down, increase the number of students.**

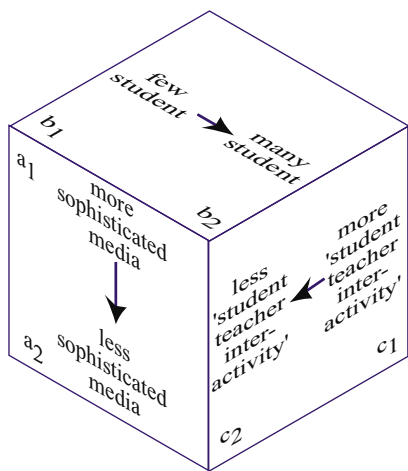
This guideline needs some additional comment. The cube in Figure 2 shows that economies of scale vary according to the number of students already enrolled. The higher the number of students, the lower the average costs reduction effect of including **another student**. Hence you have to judge whether it makes sense to increase student numbers when economies of scale are already largely exhausted.

Of course, the number of students cannot be increased at will. You need to attract students and marketing efforts themselves are a cost factor and may not succeed in increasing numbers at an economic cost. Students may prefer multi-media courses with high level of learner support. If you want to offer this in order to attract further students you will need to increase  $V$  or  $F$  or both. Hence, it is important to keep in mind that  $N$ ,  $F$ ,  $V$  are not independent. The behaviour of  $N$  is influenced by  $V$  and  $F$ . If you lower one of these parameters, students may walk away from your course and the plan to lower average costs may backfire, because the lower number of students means that fixed costs can be spread only over fewer numbers such that average cost per student will rise, possibly initiating a vicious circle.

### Perraton's costing cube

Hilary Perraton reference? has portrayed the relation between **volume**, **media sophistication** and the **interactivity**. His cube (Figure A 2) has three dimensions and the arrows show the direction of reducing cost per student.

**Figure A 2 Perraton's costing cube**



Follow  $\longrightarrow$  to reduce the cost per student

In fact, Perraton's visualisation is very close to the average cost formula. The fixed costs in distance education are generally related to media sophistication, the variable cost per student is strongly influenced by the level of interactivity. (The cube is slightly modified. The original cube speaks only about face-to-face tuition. However, meanwhile we can sustain teacher student interaction at a distance (e.g. videoconferencing, online conferencing). But all these forms of interactivity between student of teacher, irrespective of the technology used, claims the teacher's time and contributes to increase variable costs.) The Internet and videoconferencing influence the cost per student much as face-to-face tuition does. The number of students, varying from of few to many, is explicitly referred to in both models.

### Marginal costs

We need to include a definition of marginal costs since the term is part of the language of ODL.

Strictly speaking **marginal cost** means **the cost of including one more student in your system.**

We can express this like this in mathematical language:

$$\begin{aligned} MC &= TC(N+1) - TC(N) \\ &= [FC + V \times (N+1)] - [FC + V \times N] && \text{Where: } MC = \text{marginal costs} \\ &= FC - FC + V \times (N+1) - V \times N = V \end{aligned}$$

The equation shows that the cost of including one more student in your system is equal to the variable cost per student. The interesting point here is that fixed costs do not impact on marginal costs. Offering something at marginal costs therefore strictly speaking means to offer it at a price that makes no contribution to fixed costs. Fixed costs in ODL are mainly related to development costs. Saying you offer something at marginal costs often implies that you are willing to write-off the development costs.

### **Semi-variable costs**

We have treated fixed costs and variable costs so far as a binary distinction. This means any cost driver can either be treated as fixed cost or as variable cost per student, as  $F$  or as  $V$ . This is a little unrealistic. In practice, many costs are **semi-variable**. Such costs are fixed up to a certain threshold volume.

For example, you can increase the number of students in an online seminar without adding another class as long as the number of students is below the maximum class size. Beyond this size you need to start a new class and employ a further tutor.

The graph of a semi-variable cost takes the form of a step function: within limits you may increase volume of activity (i.e. number of students) without rising costs. At a certain point costs will jump.

Formally, we define semi-variable cost function as follows:

$$SV = [N/G] \times SN \quad \text{Where: } \begin{aligned} SV &= \text{semi-variable cost} \\ N &= \text{number of students} \\ G &= \text{group size} \\ [N/G] &= \text{number of groups (the square} \\ &\quad \text{brackets signify the process of rounding)} \\ SN &= \text{semi-variable cost per group} \end{aligned}$$

Note that the number of groups (or classes) needed is defined by the number of students in the system and the maximum group size.

Theoretically, it can be argued that all costs are semi-variable. Most cost drivers are to some extent affected by increase in volume of activity if only the increase is big enough. It may be that the concept of semi-variable costs has been ignored for a long time because ODL was more or less seen as 'individual studies'. Nowadays it is increasingly possible to teach classes at a distance. In this case the notion of semi-variable cost as distinct from fixed and variable costs per student becomes more and more important.

$$\text{total costs} = \text{fixed costs} + \text{semi-variable costs} + \text{variable costs}$$

$$TC = F + [N/G] \times SN + V \times N$$

Where: TC = total costs

F = fixed costs

SN = semi-variable cost per group

$SN \times [N/G]$  = semi-variable costs (i.e. semi-variable cost per group x number of groups)

$V \times N$  = variable costs (i.e. variable cost per student x number of students)

### Activity A11: Exploring the effects of group size (TC)

This activity explores semi-variable costs.

1. Use spreadsheet Activity A11 for this.
2. Try changing the group size.
3. Then try different combinations of fixed cost, variable cost, semi-variable cost and group size.
4. Observe what happens in each case.

In ODL systems with little or no group work, semi-variable costs are not very important and can usually be ignored.

When there is a significant amount of group work, semi-variable costs become important. You can see why as you change the input values in this spreadsheet. [Click here](#)

This leads to a modification of average costs also:

$$AC = TC/N$$

$$AC = F/N + ([N/G] \times SN) / N + (V \times N)/N$$

$$AC = F/N + SN/G + V$$

### Activity A12: Exploring the effects of group size (AC)

This activity looks at the effect of group size on the average cost equation.

1. Use the spreadsheet Activity 12 for this.
2. Try different group sizes to see their effect on average cost.

The effects of group size on the graph are generally less visible. [Click here](#)

#### Unit costs

Another useful concept is **unit costs**. You have seen that various cost drivers can be seen as variable cost per student, e.g.:

- print costs per student
- postage costs per student.

In order to keep unit costs low you need to control all the items that contribute to unit cost per student.

The main lessons that we can draw from our study of semi-variable costs is that larger group sizes lead to greater cost efficiency. The drawback is that this reduces the level of interactivity, a feature, which many see as an important indicator of quality.

### The generic costing template and the fixed costs/variable costs distinction

How does the generic costing template relate to the distinction between fixed and variable costs? Table A- 8 below classifies some cost drivers.

**Table A- 8 Some cost drivers for fixed and variable costs**

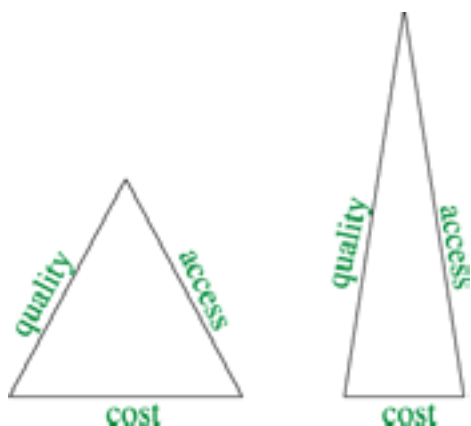
	DIRECT COSTS		INDIRECT COSTS
	Of development	Of presentation	Overheads
<b>Fixed costs</b>	Authoring a text		Director's salary
<b>Variable costs per student</b>		Marking of TMAs	Help desk

#### Summary and caveat:

1. ODL has a different cost-structure than conventional education.
2. Cost-structure in this context refers to the composition of fixed and variable costs in the total or average cost formula.
3. ODL has a generally lower variable cost per students. This is its strategic advantage. Even though often ODL may require a higher up-front investment, these higher costs can be spread across many learners.
4. The high level of fixed costs is often seen as a guarantee for quality. The rationale for expecting ODL to be more cost-effective than conventional teaching is the combination of comparatively low variable cost per student and high fixed costs safeguarding quality (effectiveness). High quality and low costs, according to this line of thinking, can only be achieved in large systems which has a further positive and intended effect: increasing access.
5. One further comment: The efficiency path would lead to lower average cost per students. Given the enormous demand for education (and the 'perverse way' of rising unit costs, the capacity of distance education to bring down average costs per student is closely related to its remit to broaden access to education. Especially, in developing countries coping with large numbers is one of the main reasons to turn to distance education (Perraton, 2000). However, planners should be aware that lowering average costs per student in this model is achieved by expanding the system, which, in turn, rises total costs. (This caveat to any cost-analysis, exclusively singing the praises of distance education for lowering unit costs, is forcefully developed by Butcher & Roberts, 2004.) :

John Daniel portrays this expectations by his eternal triangles as in Figure 3. According to Daniel (2001) the cost structure of ODL allows costs to be reduced while at the same time increasing access and quality. This reflects our theoretical expectations, but is makes assumptions that may not apply in every context.

**Figure A 3 The cost-quality-access triangle**



#### **4 Cost-effectiveness of ODL**

This section explains the notion of cost-effectiveness and how it is measured. We also reviews some of the evidence for the cost-effectiveness of ODL.

##### ***Efficiency and effectiveness: the concepts***

There is a handy phrase coined by Drucker that ‘efficiency is about doing things right and effectiveness is about doing the right things’ (cf. Mace, 1996). Doing things right means achieving the optimal relation of inputs and outputs (or outcomes). In this sense a procedure is efficient if it maximizes the output/input ratio. We can distinguish two types of efficiency: **production efficiency** and **economic efficiency** (or **cost-efficiency**). An increase in production efficiency means achieving more output for a given input, while an increase in cost efficiency means reducing the costs of inputs for a given output.

##### **Effectiveness**

The notion of **effectiveness** is about doing the right things, i.e. achieving the set goals. Effectiveness measures can be defined in a binary manner (i.e. goal achieved not achieved) or by specifying a percentage by which the goal has been achieved (e.g. 42% in a test). Obviously the way one achieves one’s goal will not necessarily be the most efficient way. This means you can be effective but inefficient.

Can you be efficient without being effective? In a way you can: You might very efficiently produce a product that nobody wants to buy. Cost per unit are low and the production process is running smoothly. But if you produce without a market you are not effective in achieving the objective of making good profits. (In ODL, for example, your degree-program might be cost-effective but your students might remain unemployed. This shows that effectiveness depends on the specified goals: the program is judged effective by internal standards: students pass their degree and pay their fees; the program fails by external standards: students are not productively absorbed into the labour market.)

## Cost-effectiveness

**Cost-effectiveness** refers to the most efficient way to achieve a set goal. Cost-effectiveness maximizes the ratio of outcomes/costs of inputs. We speak in educational contexts of **outcomes** rather than **output** since in most cases are the outcomes not are not directly countable as outputs usually are.

There is no general agreement about when to use cost-effectiveness and when to use cost-efficiency. However, there is some agreement that outcome measures should relate to learning (i.e. learning gains). Hence we would refer to **cost per learning gain** as a cost-effectiveness measure. Some authors (e.g. G. Rumble, 1997) speak of cost-efficiency when it comes to **cost per student** and even **cost per graduate**. We would suggest that the cost-efficiency and cost-effectiveness are analogous to outputs and outcomes.

If no educational assessment is involved, we would refer to cost-efficiency, e.g. cost per student would be an efficiency measure.

If educational assessment is involved, we would refer to cost-effectiveness, e.g. cost per graduate would be an effectiveness measure.

## *Efficiency and cost-effectiveness ratios*

The easiest (though rather uninformative) way of measuring cost per students is to divide all the total cost of the system by the number of students. When using cost per student to compare **open and distance learning (ODL)** with **conventional education (CE)**, ODL does well. However, when the measure is cost per graduate the picture changes. Often high **drop-out rates** impact negatively on the cost-effectiveness measures of ODL.

### Efficiency ratios

The **relative cost-efficiency** is defined by the following efficiency ratio:

$$\text{efficiency ratio} = \frac{(\text{cost/student})_{\text{ODL}}}{(\text{cost/student})_{\text{CE}}}$$

If efficiency ratio = 1 then both systems are equally efficient

If efficiency ratio >1 then ODL is less efficient

If efficiency ratio < 1 then ODL is more efficient.

### Example

Assume the cost/student in an ODL system are US\$250 and the cost per student taught by conventional method is US\$950, then the efficiency ratio is:

$$\text{efficiency ratio} = \frac{(\text{cost/student})_{\text{ODL}}}{(\text{cost/student})_{\text{CE}}} = \frac{\$ 250}{\$ 950} = 0.26$$

Since the ratio is <1 the ODL system is more efficient in terms of cost per student.

## Cost-effectiveness ratios

Cost-effectiveness analysis is an approach to inform decision making and not a substitute for it. For different options or strategies, cost and outcomes are related as a ratio. Outcome measures may measure institutional effectiveness, such as number of successful graduates, or scores in learning gains.

We can think of ODL as a strategy to deliver education with parameters such as:

- unit costs
- success rate (as opposed to drop out rate).

We can then use these parameters to compare conventional and distance systems. If we let B stand for ODL and A stand for conventional approaches, we can then identify four possible cases, as in Table 9. Two cases (2 and 3) lead to clear decisions as to whether to use ODL. The other two cases (1 and 4) require further investigation before a decision can be reached.

**Table A- 9 Cost-effectiveness ratios (CER) and decision-making**

<p><b>Case 1</b></p> <p>Cost unchanged or reduced, effectiveness unchanged or reduced, i.e.</p> $\text{cost } A \leq \text{cost } B$ <p>and</p> $\text{effectiveness } A \leq \text{effectiveness } B$ <p><b>Decision: explore further</b></p>	<p><b>Case 2</b></p> <p>Cost increased, effectiveness unchanged or reduced, i.e.</p> $\text{cost } A > \text{cost } B$ <p>and</p> $\text{effectiveness } A \leq \text{effectiveness } B$ <p><b>Decision: Opt for ODL</b></p>
<p><b>Case 3</b></p> <p>Cost unchanged or reduced and effectiveness raised, i.e.</p> $\text{cost } A \leq \text{cost } B$ <p>and</p> $\text{effectiveness } A > \text{effectiveness } B$ <p><b>Decision: Reject ODL</b></p>	<p><b>Case 4</b></p> <p>Cost increased and effectiveness raised, i.e.</p> $\text{cost } A > \text{cost } B$ <p>and</p> $\text{effectiveness } A > \text{effectiveness } B$ <p><b>Decision: Explore further</b></p>

### Example

Assume that for a particular ODL system the cost/student is US\$ 250 and the success rate is 40%. So the cost per graduate (a cost-effectiveness measure) is:

$$\text{Cost per graduate ODL} = \frac{(\text{cost/student ODL})}{\text{success rate ODL}} = \frac{\$ 250}{40\%} = \$ 625$$

Obviously the cost per graduate is considerably higher than the cost per student since the costs for both graduating and non-graduating students are being applied to the graduates alone.



Assuming that for a particular conventional course the cost/student is, e.g. US\$ 950 and the success rate is 70%, then the cost per graduate is:

$$\text{Cost-effectiveness CE} = \frac{(\text{cost/student CE})}{\text{success rate CE}} = \frac{\$ 950}{70\%} = \$ 1\,357$$

Re-calculating the efficiency ratio on the basis of this cost-effectiveness measure we get as new efficiency ratio:

$$\text{CER} = \frac{\text{cost-effectiveness ODL}}{\text{cost-effectiveness CE}} = \frac{\$ 625}{\$ 1\,357} = 0.46$$

#### *Note*

Cost-effectiveness is an efficiency measure. The CER is an efficiency ratio for comparing two systems on the basis of a specific cost-effectiveness measure (cost per graduate). This means that even though the efficiency ratio has deteriorated in the transition from the **cost per student** to the **cost per graduate** measure, ODL still is judged as being more efficient (or, more precisely, even more cost-effective) though it has lost some of its edge due to its higher drop-out rate (reflected in the efficiency measure being nearer to 1).

#### **Activity A13 : *Efficiency and cost-effectiveness ratios***

This activity allows you look at the effects of drop-out/retention on efficiency ratios. High drop-out rates have negative impacts on efficiency ratios based on cost-effectiveness ratios.

1. Use the spreadsheet Activity A13 for this.
2. Try changing cost per student and dropout rates for the two modes.
3. Observe what happens to the cost-effectiveness ratio. [Click here](#)

#### **Activity A14 : *The effects of drop-outs***

In this activity you can see what can happen when you try to increase efficiency by lowering student support. While you may improve efficiency (cost per student) you may decrease your cost-effectiveness (measured as cost per graduate).

1. Use the spreadsheet Activity A14 for this.
2. To lower student support, enter a figure in cell F11. e.g. to lower student support by 10%, enter 0.01. [Click here](#)

Case two in Table 9 (with B standing for ODL), is the one most often used in practice. We assume that the outcomes are similar, e.g. we assume that a traditional graduate and an ODL graduate represent the same outcome. Given the assumption of equal outputs, the cost-effectiveness ratio becomes a cost comparison, and we opt for the strategy, which produce the lower cost graduates.

## Comparing cost-effectiveness: illustrations

Much of the cost-effectiveness research compares cost per graduate without first making sure that graduates represent the same output. In the 70s and 80s a series of such studies based on comparable methodologies was undertaken. They showed that in many cases ODL is cost-effective, though less so when it comes to cost per graduates rather than cost per students. Some of these studies are summarised in Table 10.

It is rare to find a case where the efficiency ratio of ODL is not favourable. Even in terms of cost per graduate the outcomes of ODL are more favourable. (Though in some cases distance teaching institutions does not count graduates but ‘full credit equivalents’.) The positive results have not, though, lead to widespread acceptance of ODL.

**Table 10 Cost-effectiveness ratios**

Institution	Efficiency ratio	Cost-effectiveness ratio	Source and comment
<b>School level</b>			
Malawi Correspondence College (MCC) vs.			Wolff and Futagami, 1982 <sup>a</sup>
• conventional day secondary school	0.62	1.60	Note that the cost per graduate is higher for the MCC
• boarding school	0.23	0.73	
Air Correspondence High School, Korea vs. regular high school	0.18	0.22	Lee <i>et al.</i> 1982 <sup>a</sup>
<b>Teacher education</b>			
LOGOS II (Brazil)	n/a	0.05 - 0.08	Oliveira and Orivel, 1993 <sup>a</sup>
Primary teacher orientation course at AIOU (Pakistan) vs. conventional university	n/a	0.45 - 0.7	Perraton, 2000
<b>University level</b>			
Open University UK vs. conventional university	0.26	0.38 - 0.45	Wagner, 1977 <sup>a</sup>
	0.41	0.53 - 0.70	Rumble, 1976 <sup>a</sup>
STOU Thailand vs. conventional university	n/a	0.14	Lockheed <i>et al.</i> 1991 <sup>a</sup>

Notes: a: Rumble. 1997, p. 143

## *Institutional cost-effectiveness*

Institutions need to find the right range of courses to offer. Generally, an institution has to offer a minimum range of courses to be credible, or even in order to be visible. However, in principle it would be best to specialize on a few best-selling courses. Offering more courses increases costs but this can be offset by increasing the number of students. Mace (1978), for instance, proposed reducing the number of costly multi-media courses at the British Open University (OUUK) in order to reduce costs.

We need to explore the relation between scale and range of courses, which we do below.

### Scale and scope

The model of open and distance learning discussed so far is predicated on the assumptions that quality can be safeguarded by:

- high quality course materials
- implying a high level of fixed costs for course development
- and that these fixed costs should be spread over many learners.

However, in reality, potential student markets may be smaller than required. Specialist courses in higher education for instance may seldom draw large audiences. This situation poses a dilemma, especially for institutions of higher education. If an institution follows the logic of efficiency it would focus on courses with high enrolment. In other words, it would only offer best-selling courses. However, by doing this an institution may fail in its social remit of expanding the world of knowledge. In fact, too limited a range of courses may damage the prestige of an institution, and may prove to be counterproductive.

We now need a formula to help us explore how total costs are affected by the number of courses offered in a particular ODL institution. The formula is as follows:

$$TC = F + (VC \times M) + (V \times N)$$

Where: F = fixed costs

VC = variable cost per course (per year)

M = number of courses

V = Variable cost per student

N = number of students

$$AC(N) = [(F + VC \times M) / N] + V$$

### Activity A15: Scale and Scope I

1. Use the spreadsheet Activity A15 for this.
2. Note that you cannot change any of the data in this spreadsheet – it is for observation only.
3. The graph illustrates that average costs per student fall as student numbers rise but rises as the number of courses increases.

(Data are projected unit costs per student in UK GBP at the OUUK. They are taken from UNESCO. (2002). Trends, policy and strategy considerations. Paris: UNESCO.(p. 74)).

[Click here](#)

### Activity A16: Scale and Scope II

1. Use the spreadsheet Activity A16 for this.
2. Here you can now see the formula behind Activity 15:  $AC(N) = [(F + VC \times M) / N] + V$ .
3. This time you can try changing the number of courses to see the effect on average costs.

[Click here](#)

## Innovation: the proportion of new to old courses

The higher the proportion of new courses to old courses, the higher an institutions costs will be. This is because new courses involve high fixed costs. We therefore need a formula to help us explore the effect on costs of varying the ratio of new to old courses. The formulae is:

$$TC = F + VC_{new} \times O + VC_{old} \times P + V \times N$$

$$AC(N) = [(F + VC_{new} \times O + VC_{old} \times P) / N] + V$$

Where: F = fixed costs

VC = variable cost per new course (per year)

V = Variable cost per student

N = number of students

VCnew = annual annualized variable development costs per new course

VCold = annual variable development costs per course in presentation

O = Number of new courses

P = Number of old courses

### Activity A17: *New courses*

In this activity you can see how producing new courses affects average cost.

1. Use the spreadsheet Activity A17.
2. Try changing the proportion of new courses to all courses. What happens?

All this suggests that for the from the point of view of efficiency, an ODL institution should have a limited range of courses. These courses should have high enrolments with long shelf lives. If possible, they should make use of media with low variable costs, as we will see in the next section. [Click here](#)

## 5 Costing educational media

The rationale for expecting ODL to be cost-effective lies in its cost-structure, i.e. the composition of fixed and variable costs. This cost-structure of the institution as a whole is rooted in the cost-structure of the media or educational technologies it uses. They differ in their composition of fixed and variable costs. This section looks at the cost structure of the more traditional media used in ODL

### *Concepts*

We do not make a clear distinction between media and educational technologies here. (Traditionally, the word 'media' is more used for one-way traffic communication such as radio or television broadcasting. The technological character of these media is largely hidden from the learner, who only needs to turn a radio button.) When it comes to technologies which allow two-way communication (e.g. computers), the user needs considerable competence. While early analyses of distance learning emphasized the organizational aspects of emerging digital technologies now the cost-effectiveness of educational technologies has become more central.

In this section we discuss some basic concepts for understanding media. First, we list some media; then we discuss the media equivalence hypothesis; relate media to some basic modes of learning and, finally, discuss student learning time as an indicator to facilitate the comparison of media.

## Types of media

The following list gives a snapshot on how the a major distance teaching institution internally classified the technology it used. The document included also information about the academic and production input required to support one hour of student learning. (The information provides us with some ‘real world’ benchmark data. However, little can be generalized from such figures since it depends very much on the specific characteristics of the content developed in each case.)

**Table A- 11 Types of media**

Acronym	Medium	Comment	Academic (hrs)	Production (hrs)
Print		Study guides in units often 48 pages	32	20
A/V	Audio-vision	Tape + print etc.	25	18
TV+	TV + print	Study guides	75	673
Tut'l	Tutorial			0
TMA	Tutor marked assignment		7	5
HEK	Home experiment kits		61	70
RSch	Residential school		62	16
CMA	Computer marked assignment		18	23
ICMA	Interactive computer marked assignments	Use generative questions with hints, feedback and scoring	30	37
CTools	Computer tools <sup>b</sup>	Computer-based tools, spreadsheets, data analysis	17	46
CRes	Computer based resources <sup>c</sup>	Indexed and searchable databases, e.g. articles, picture library, databases	19	42
CAL	Computer assisted learning	Interactive, adaptive, simulation/tutorial teaching program	73	722
MM	Multi media	Multimedia CAL , with AV media incorporated	230	809
CMC	Computer mediated communication <sup>f</sup>	Asynchronous computer conferencing for tutorials, discussion, and self-help groups	5	0
Agr	Audio-graphics	Voice + shared screen for tutorials and group discussion	23	9
Video			75	350

Footnotes

*a* **Interactive computer marked assignments (ICMA)** Computer-generated test questions or exercises that can be assessed by the program, using concealed multiple choice questions or alphanumeric or graphic input that can be interpreted in order to give the student feedback and an appropriate score. Editing work includes checking the wording of interactive assignments which is a quick and rather straightforward task.

- b* **Computer-based tools (CTools)** Commercially available packages such as spreadsheets, statistics packages, computer-aided design tools etc. Editors are involved in the discussion about computer tools but not directly involved in their production.
- c* **Computer-based resources (CRes)** Electronic information resources e.g. encyclopaedia, databases, library resources, image banks, etc. structured, indexed and searchable.
- d* **Computer assisted learning (CAL)** Computer-based tutorials including simulation/modelling packages. Editors are not generally involved in the production of this type of material except to provide the important role of critical reader/development tester.
- e* **Multimedia CAL** Similar to CAL but with more presentational characteristics of multimedia. Multimedia products vary considerably in their content and the amount of time required for study (SLH). The complexity of the content is not necessarily related to study time, and the mix of skills required to produce multimedia products varies with their content.
- f* **Computer mediated communication (CMC)** Asynchronous computer conferencing for tutorials.
- g* **Conferencing tutorial** Simultaneous networked text-only tutorial, with tutor and students connected via data lines to exchange 'discussion' usually only capable of transmitting text, not voice or graphics.

### **Media equivalence hypothesis**

For a medium to be cost-effective, it first needs to be educationally effective. In the early days of distance education, distance educators had to show that it was possible to teach effectively using media. Research, which compared models of teaching e.g. with radio and classroom teaching, indicated that variation within the various models were greater than between them. These findings came to be known as the 'media equivalence hypothesis' saying that the effectiveness of the teaching learning process does not depend on the medium used. It is certainly true that there is no silver bullet medium which leads, irrespective of the context, to more effective results. (As a consequence, suggestions that a particular instructional design will lead to substantial 'compression of learning time' should be treated sceptically.)

In spite of a general acceptance of the media equivalence hypothesis, it does make sense to check the proposed configuration of **subject to be taught**, **audience characteristics**, and **media capabilities** to make sure that the elements fit well together. If, for example, you want to teach pronunciation you would include an audio medium, and in order to teach renaissance art, you would need to be able to present colour pictures. However, it is safe to say that, within limits, you can teach effectively in any medium.

### **Media and modes of learning**

Whatever medium is chosen, course developers need to make sure that the basic modes of teaching and learning are adequately supported. A simple and practical distinction of such modes of learning is provided by the following categories: **attending**, **discussing**, **practising** and **articulating** (Laurillard, 1993). Since not all media can support all of these modes of learning, there are clearly some limitations to the media equivalence hypothesis.

#### *Attending*

Attending refers to reading, listening, and viewing (from the learners perspective) and can be supported by unidirectional media like text (printed or on screen), audio media (radio, audio cassettes) and video (TV and video cassettes).

### *Discussing*

Discussion can be promoted with face-to-face meetings, telephones, computer conferencing and video conferences.

### *Practising*

Practising can be supported by experimental kits, or, to some extent, by simulations and computer based training.

### *Articulating*

Articulating refers to the need in educational contexts to evaluate and assess learners. This can be done through assignments in print and multiple choice types of exercises.

Table 12 shows that traditional media will support attending but that they do not facilitate interactivity between teacher and learner apart from corresponding about assignments. When developing courses it makes sense to analyse where each learning mode is needed and to decide which media will be used to support each.

**Table 12 Media and modes of learning**

	Attending	Practising	Discussing	Articulating
Print	X			
A/V	X	(X)		
TV+	X			
Tut'l	X	X	X	X
TMA		X		X
HEK		X		
RSch		X		
CTools		X		
CMA		X		X
ICMA		X		X
CRes	X	X	X	X
CAL	X	X		X
MM	X	X		X
CMC			X	X
Agr	X		X	X

### **Student learning hours**

We can assume that equivalent media will have the same effectiveness. This means that we can compare them by comparing their costs alone.

To compare the cost of media we need a **common unit of measurement** otherwise we would have an 'apple and orange' problem. The only sensible unit of measurement to compare the cost of media is **cost per hour of student learning** supported by each specific medium. We will write: cost/SLH (medium).

**Cost/SLH(print)** then means the cost to provide reading for one hour of student learning. **Cost/SLH(TV)** would refer to the cost of providing one hour of student learning in form of a TV-film.

A corollary of the media equivalence hypothesis would suggest that no medium *per se* has a higher effectiveness per hour than another. To assume otherwise would undermine any cost per learning time calculation. However, cost per learning time is first of all a means of costing inputs. Its purpose is to compare the costs of supporting learning in various media. It is not a substitute for testing learning outcomes.

Accreditation of learning between institutions is based on learning time. A course of three US American credit points corresponds to 150 SLH. Since credits are intended as measures of effective learning we could regard cost per student learning hour as, to some extent, as a cost-effectiveness proxy. (Assuming we develop two versions of a 150 SLH course, one as a low cost print version, one as high cost multi-media course and students are equally successful we would say that the print version is more cost-effective than the multi-media version.)

Specifying course credits in terms of student learning hours (SLH) is becoming increasingly common. For distance learners, who often study part time, such notional required learning time may be important for their choice of courses. Moreover, it provides a reference point for the course developers, e.g. when determining the amount of reading to be expected. If you tell students that they can successfully complete the course if they invest ten hours per week, then you need to carefully control the amount of reading, the time for completing the assignments and, possibly, the time they would have to listen to the radio or communicate in an online class.

The notion of student learning hours is sometimes used to describe the number of learning hours the course offers. This sounds a bit doubtful since learning is a learner activity and something that can be provided externally. However, it is possible to estimate how many hours a typical student would need to complete a given course. Hence, if we say a course comprises 150 SLH it means, according to the estimations of the provider, students should be able to complete the course within that time. In this sense we see ‘number of learning hours’ as a characteristic parameter of a given course.

In order to model the costs of media, we need to identify the characteristic **fixed costs of development of one hour of student learning with the respective medium** and the **aggregate variable costs per student characteristic for the medium**. The first parameter contributes to the fixed costs of development and is often a big number, such as for example, US\$ 90.000 for developing one hour of educational television, the second parameter contributes to the variable cost per student and is often small (in case of television nearly zero). Quite often the cost per student learning hour of a medium mean in this context refers to the **fixed costs of development of one learning hour in the respective medium**.

The other sense, in which student learning hours are sometimes used is more context dependent. It defines the number of student learning hours produced as the product of the number of students and the notional learning time for each student. This way of using student learning hours makes sense only within a given context (e.g. a specific course). If you know the specified the number of learning hours a course offers in a specific medium as well as the number of student enrolled, you can calculate the cost per learning hour per student for the respective medium.



Both ways of using student learning hours make sense but it is important to be aware of the distinction. If you read that the cost per student learning hour for television is US\$ 90 this implies that 1000 students have viewed the programme and the development costs have been spread over this number of learners. This is compatible with saying that the fixed cost of developing one hour of ETV (educational television) is US\$ 90 000.

### ***Costing the traditional media***

The examples that we have looked at deal with print, radio and audio cassettes, TV and video as well as different computer applications. As we have said before, these figures should not be treated as reliable cost information. Though the individual figures used in the activities are real world figures they may not apply in your context.

While figures vary substantially (Table 13) we can distinguish some orders of magnitude within which they vary. Taking print as the medium of reference, audio may be expected to be about ten times as expensive, radio 30 times, video 50 times and television 150 times.

**Table 13 Benchmark costs SLH/medium**

Unit		Academic input	Production related input	Total fixed costs of development	Variable cost per unit	SLH equivalent to unit	Cost/SLH	Comparison	
								Low	High
Print	StG (48 pp)	28 00	700	3 500	1,8	10	350	1	
Print	StG (48 pp)	15 000	7 000	22 000	1,8	10	2 200		1
Audio	30 min	930	600	1 530	2	0,5	3 060	9	2 x 10
Audio	30 min	3 600	9 000	12 600	2	0,5	25 200	72	12
Radio	20 min	300	2 860	3 160	0	0,33	9 480	28	5 x 30
Radio	20 min	600	13 500	14 100	0	0,33	42 300	121	20
Video	30 min	2 700	8 000	10 700	4,5	0,5	21 400	62	10 x 60
Video	30 min	2 000	40 000	42 000	4,5	0,5	84 000	240	39
TV	25 min	1 800	36 000	37 800	0	0,42	90 720	260	42 x 150
TV	25 min	3 000	75 000	78 000	0	0,42	187 200	535	86

The following sections review the classical media and make some of the assumptions leading to the above figures explicit. Most of the spreadsheet activities are based on these figures.

### **Printed material and correspondence**

The most important instructional medium is the text. It played a central role in the initial phase of distance education as printed text (e.g. ‘study guide’) and now plays an important role in distributed e-learning as digital text. From a costing point of view the difference is one in distribution, rather than development. (There are some added costs in editing a text to make it a hypertext (e.g. the inserting and testing of **links**.) However, essentially the cost structure remains similar. While digital distribution is less costly, the development of online material is slightly more costly.

Text (as printed material or in digital format) remains the most important medium in ODL. Even in the period when multi-media instruction was in vogue these media were ‘embedded’

in an instructional framework based on text. It is therefore important to understand the costs and the cost-structure of developing printed material.

In the next activity we assume that course specific study guides (StG) are developed with a standard length of about 50 pages (48 pages for optimal use of paper). To prepare a typical guide, we assume an input of 50 academic staff days at US\$300 per day, or US\$15000 per guide. Non-variable production costs (such as editing, design and fixed print) amount to US\$7000 for production. Added together this amounts to US\$22,000 per guide. (This is a high cost version where we assume that text is developed from the scratch. Lower costs are possible (Table 13).)

Our hypothetical courses will also include for assessment of 24 pages requiring 10 days of academic input. If again the academic person day is rated at US\$300, this amounts to US\$3000. Layout and editing (fixed print) will cost up to US\$2700. Hence the cost of preparing such an assessment booklet may amount to US\$5700. Since it is appropriate to modify the assignments annually we assume an additional five academic days per annum for maintenance, amounting to US\$1500 per year.

Coming to the variable costs of presentation, we distinguish between production related activities and the activities of supporting students' learning. In the first category we will assume that the replication and mailing costs per study guide are US\$0.75 per guide and US\$0.5 per assignment booklet.

Students learning is supported by giving them feedback on their assignments (priced at US\$21 per assignment) and tutorial meetings. For a group size of 25 students a benchmark may be US\$60 per tutorial contact hour contributing about US\$2 to the unit costs.

### **Activity A18: *Printed study guides***

For this activity you will use three spreadsheets, all placed in the same Excel workbook, Activity A18.

#### *Spreadsheet 1 – Portfolio and cost description*

The first spreadsheet reports the cost of a simple course based on printed study guides. Student learning is supported by tutor marked assignments and tutorials. Quantities and costs (the figures in red) can be varied in the spreadsheets.

#### *Spreadsheet 2 – Annual costs*

The second spreadsheet calculates annual costs. The default version in the spreadsheet calculates the annual costs on the basis of depreciation rates. A macro (Ctrl+t) calculates the respective annualization rate and substitutes it for the depreciation rate.

The spreadsheet calculates the cost per year (charging the development costs equally to the years of the shelf life of the course). This helps in setting student fees. Basically, student fees need to be slightly higher than the average cost per student per annum, creating a small profit margin that insures against risk. The profit margin and the number of student per year (both figures in red) can be changed to explore the implications for total costs, average cost per student, and break even points.

### Spreadsheet 3 – Total cost and average costs

The third spreadsheet shows you the results of the choices that you have made in the first two spreadsheets. It calculates the TC and AC equations, giving their respective graphs and break even points.

#### Things to try

1. Verify that annualization increases total costs and average costs.
2. Try reducing student support (e.g. no tutorials, no assignments).

#### Notes

1. If you want to run a macro you need to have the spreadsheet page for that macro open. Running a macro for another page is likely to cause errors. However, if this happens, close the activity without saving and start afresh.
2. The spreadsheet adjusts fees to reflect costs. The fee is based on average cost per student plus a margin for profit and a margin for risk. Our assumption that enrolment levels will not be affected by higher fees may not be realistic.
3. The V lines may not be visible on your economies of scale worksheet. This happens when the value of V is very low, making the V line contiguous with the bottom axis of the graph. [Click here](#)

#### Cost/SLH(print)

It is possible to estimate, based upon the above assumptions, a cost/SLH(print). Assuming US\$22,000 per guide and assuming further that one study guide supports about 10 hours of student learning, we would have:

$$\text{cost/SLH(print)} = \text{US\$ } 2200$$

This figure for cost/SLH(print) is at the high end of the spectrum. The elasticity of the figure is due partly to the assumptions one may make on the number of notional learning hours supported by such a study guide. If we assume that a study guide is the basis of study for 2 weeks and further assume a notional study load of 10 SLH per week then we would have:

$$\text{cost/SLH(print)} = \text{US\$ } 1100.$$

A reasonable benchmark figure would be:

$$\text{cost/SLH(print)} = \text{US\$ } 1500.$$

For the course planner the important benchmarks are a pair of two numbers:

$$(\text{cost/StG}, V_{\text{StG}}) = (\text{US\$ } 22\,000, \text{US\$ } 0.75) \text{ where StG stands for study guide.}$$

Figures in terms of cost/SLH per student (i.e.  $(\text{cost/SLH(print)})/N$ ) are very context sensitive. If you have hundred students you come up with a figure of  $(\text{cost/SLH(print)})/100 = \text{US\$ } 2\,200/100 = \text{US\$ } 22$  and if you have thousand students in the system the figure would fall

to US\$ 2.2. For the purpose of giving the course developer a benchmark to compare costs of media, it makes sense to focus on the **fixed costs of development per student learning hour** as unit of comparison. In addition, the respective **variable costs per student** have to be kept in mind. (Note, however, that it makes little sense to break the variable costs down for SLH.)

### **Radio and audio cassettes**

Radio broadcasting is, in terms of cost structure, the ideal medium. Marginal costs, i.e. the costs of including another learner, are zero at least as far as the medium is concerned.

For the first spreadsheet activity on radio costs we have assumed costs of about US\$ 14 100 per program of 20 min. This comprises production costs (US\$ 13 500 per program) and academic time (two academic staff days or US\$ 600). In terms of cost per learning time, we have:

cost/SLH (radio) = US\$ 42 300.

Transmission costs have to be added to this. These are not ‘variable costs per student’ but nor are they also fixed costs. For each cohort of students there is at least one transmission (in fact, a repeat transmission) costing US\$ 675. Hence we treat transmission costs as fixed costs incurred each time the course is presented.

### **Activity A19: Radio and print**

This activity allows you to explore the effect of including radio programmes. As an add-on radio only increases costs.

Use the spreadsheet Activity A19 for this.

Here are some issues to explore:

1. Is it possible to reduce other costs in order to make the choice of radio as the main medium of instruction competitive?
2. What happens if you reduce assignments and tutorials?
3. How does the annual enrolment level affect costs?

### *Notes*

1. If you want to run a macro you need to have the spreadsheet page for that macro open. Running a macro for another page is likely to cause errors. However, if this happens, close the activity without saving and start afresh.
2. The spreadsheet adjusts fees to reflect costs. The fee is based on average cost per student plus a margin for profit and a margin for risk. Our assumption that enrolment levels will not be affected by higher fees may not be realistic.
3. The V lines may not be visible on your economies of scale worksheet. This happens when the value of V is very low, making the V line contiguous with the bottom axis of the graph. [Click here](#)

## Radio or audio cassettes?

The figures for the next activity are based on Bates (1995) slightly simplified for the purpose at hand. They differ substantially from the figures used for the above activity. Bates indicates OUUK production costs for 20 min programs of US\$2860 per program, or US\$ 8 511 per SLH. Academic input is estimated as US\$300 per program or US\$ 900 per SLH. This amounts to fixed costs of development and production of one program of US\$ 3 160. In terms of cost per learning time we have: cost/SLH (radio) = US\$ 948 (Bates, 1995, p.142). The figures are converted (at a rate of 1.5) into US\$ without deflating them. Taking the figures out of context and simplifying them considerably would render deflating rather meaningless.)

Bates notes that costs would decrease if course production could run on full capacity since where there are large production overheads, the wider they can be spread, the lower their impact per program.

Audio cassettes and radio programs have distinctively different cost structures. Generally, the fixed costs of development for radio are higher (especially, the production costs) than those for audio cassettes, but the variable costs of distribution or/and storage for audio cassettes are higher since there are no corresponding costs for radio. The conclusion is that while for small enrolments audio may be more cost-efficient for large enrolments radio may be more appropriate.

We assume in the activity that producing a 30 min audio cassette requires 12 academic days (or US\$3 600) while the production cost amounts to US\$9000. This adds up to US\$ 12 600 for a 30 min audio cassette or, in terms of cost per learning time:

$$\text{cost/SLH(audio)} = \text{US\$ } 25\ 200.$$

### Activity A20: *Radio or audio cassettes?*

Use the spreadsheet Activity A20 for this.

The default version in this example is two radio programs per week and not much print.

1. Try changing from radio to audio cassettes.
2. What happens when you support the same number of learning hours with audio cassettes?
3. Which is the more cost efficient solution?
4. If you substantially increase enrolment does this change anything?

### Notes

1. If you want to run a macro you need to have the spreadsheet page for that macro open. Running a macro for another page is likely to cause errors. However, if this happens, close the activity without saving and start afresh.
2. The spreadsheet adjusts fees to reflect costs. The fee is based on average cost per student plus a margin for profit and a margin for risk. Our assumption that enrolment levels will not be affected by higher fees may not be realistic.

3. The V lines may not be visible on your economies of scale worksheet. This happens when the value of V is very low, making the V line contiguous with the bottom axis of the graph. [Click here](#)

Cost-structure refers to the relative composition of fixed and variable costs. For radio, there are next to no variable costs per student. Audio cassettes, on the other hand, though generally cheaper to produce, have the variable cost of replicating the cassettes, handling and mailing them.

If you want to compare media in terms of their cost per SLH you need to be aware of two factors affecting the figures:

1. First, some authors cite cost per student learning time as a cost per student. The disadvantage here is that figures become too dependent on the number of students to be useful for the course planner. If you use this definition you need to compare cost per SLH per student for some standard enrolment level.
2. The second factor is hidden in the assumption of listening time and learning time. Since you can stop and start a cassette, it is possible that a 30 min cassette provides more than 30 min learning time.

Figures on cost per learning time are difficult to interpret if such assumptions are not spelt out.

### **Television and video cassettes**

One source identifies the following costs for a 25 min TV program: Production costs US\$ 75 000 plus US\$ 3 000 (or 10 days) of academic input. This amounts to US\$ 78 000 for a 25 min program or:

$$\text{SLH(TV)} = \text{US\$ } 187\,200 \text{ for one SLH(TV).}$$

Added to this are US\$ 300 per broadcast.

Another source is, again, Bates (1995). According to Bates, the average production cost per program of 25 min is US\$ 36 000 and per SLH US\$ 85 400. To this academic input is rated with US\$ 1 800 per program. This amounts to US\$ 37 800 per program or:

$$\text{cost/SLH(TV)} = \text{US\$ } 90\,500.$$

To this transmission costs of US\$ 1 980 needs to be added.

### **Activity A21: Television**

Use the spreadsheet Activity A21 for this.

Here the default option is TV.

1. Try to find a less sophisticated option (say print plus audio cassettes), which allows you to increase student support (tutorials and tutor marked assignments).
2. What do you observe?

3. I think you will see that you can go a long way in terms of student support, if you go for low cost media.
4. Now increase the enrolment substantially.
5. What do you observe?
6. Is there a level of enrolment where the high cost TV option is more cost efficient?

### Notes

1. If you want to run a macro you need to have the spreadsheet page for that macro open. Running a macro for another page is likely to cause errors. However, if this happens, close the activity without saving and start afresh.
2. The spreadsheet adjusts fees to reflect costs. The fee is based on average cost per student plus a margin for profit and a margin for risk. Our assumption that enrolment levels will not be affected by higher fees may not be realistic.
3. The V lines may not be visible on your economies of scale worksheet. This happens when the value of V is very low, making the V line contiguous with the bottom axis of the graph. [Click here](#)

### Cost-effectiveness and volume of production

The activities indicate that the costs per SLH go down when good use is made of the available capacity. This would suggest that it is more cost-efficient for an institution to produce more rather than fewer television learning hours. However, since the fixed costs of development for one hour of educational television are quite high, you would need many more learners in order to cover these costs.

One source reports the academic input for the production of a one hour video as nine days of academic time and 44 days of production related activities. This amounts to US\$ 2700 for academic time and about US\$ 8 000 for production related inputs. The figure for cost per video supported student learning hour:

$$\text{cost/SLH(Video)} = \text{US\$ } 10\,700.$$

Another source reports much higher costs. In this case, a 30 min video costs US\$ 60 000 plus ten days of academic input, i.e. US\$ 3 000. This means:

$$\text{cost/SLH(Video)} = \text{US\$ } 126\,000.$$

Replication and mailing cost US\$ 2.25 per cassette in this case.

### Activity A22: Video cassettes

Use the spreadsheet Activity A22 for this.

This spreadsheet starts with television as the default option.

1. Try using video cassettes as an alternative (with same number of student learning hours).

2. What do observe?
3. You can substantially increase student support even add some other media.
4. You may have found out that going for video cassettes is the cheaper option. I assume you have increased student support. Now make the enrolment substantially higher. At what level does the expensive TV option become more cost efficient?

### *Notes*

1. If you want to run a macro you need to have the spreadsheet page for that macro open. Running a macro for another page is likely to cause errors. However, if this happens, close the activity without saving and start afresh.
2. The spreadsheet adjusts fees to reflect costs. The fee is based on average cost per student plus a margin for profit and a margin for risk. Our assumption that enrolment levels will not be affected by higher fees may not be realistic.
3. The V lines may not be visible on your economies of scale worksheet. This happens when the value of V is very low, making the V line contiguous with the bottom axis of the graph. [Click here](#)

### **Costing distributed e-learning**

The last few activities related to pre-computer media. Print still plays an important role in ODL and for some (especially big institutions, which can count on economies of scale) broadcasting remains an important option. However, computers offer new choices. In particular, we have to decide whether to use computers mainly for information exchange, retrieval, processing and management, or also as a means of communication. This has implication for cost-analysis. The first option follows the traditional cost structure of ODL, while networked computing may mean a considerable break with the established cost-structure of ODL.

By distributed e-learning we mean using ICT within ODL courses. ICT refers to digital technologies, both for information processing as well as for communication. E-learning in general includes the use of ICT for on-campus teaching or other sorts of contiguous training.

The core components of ICT are computers linked via the Internet. They can be used for exchanging information, information processing and retrieval, applications ranging from multiple choice questions to simulated dialogue. We call this the **type-i** variant since it emphasises the information processing aspect of ICT use. This variant raises **learner-content interactivity** (Moore & Kearsley, 1996 pp. 128-9), or **internal interactivity** (Hülsmann, 2000, p.26) to a new level of sophistication. Even in the case of print you can design a certain level of learner-content interactivity by using activities, in-text questions, multiple choice questions, and so on. Digital technology allows to proceed go further by using computer marked assignments (CMA), computer assisted learning (CAL), and computer based training (CBT).

All these applications enhance **learner-content interactivity** without involving the teacher or tutor. The **type-c** variant emphasises the communication aspect of using ICT (type-c) in distributed e-learning. Here ICT is used to facilitate communication between people, most importantly between students and the teacher. This variant facilitates the other forms of



interactivity (teacher-learner and learner-learner; cf. Moore & Kearsley, 1996 pp. 129-32), which sometimes is referred to as **external interactivity** (Hülsmann, 2000, p.26). The type-c variant includes synchronous and asynchronous sub-variants. Videoconferencing teachware is a synchronous format and CMC (computer mediated communication) is an important asynchronous format.

The distinction is based on the following observation made by Rumble (2001, p.74-75):

‘A number of case studies comparing the costs of online learning are beginning to emerge. This section attempts to summarise the information we now have. In approaching the issue it is worth bearing in mind that what constitutes an ‘online’ system varies enormously. Typologies have their dangers, but they can also be useful in sorting out one’s thinking – and the following typology is offered with this in mind:

- a) Type A online systems offer Computer-Based Learning (CBL) involving textual, audio, and video course materials in electronic format. No student support is involved.
- b) Type B online systems offer Computer Mediated Communications (CMC) supporting tutor-student and student-student interaction. This support may be offered in synchronous mode (Type B1) or asynchronous mode (Type B2).
- c) Type A/B systems combining both CBT and CMC.’

The following table classifies some computer applications in terms of type-i or type-c.

**Table A- 14 Classification of computer applications**

Acronym	Medium	Comment	Type
CMA	Computer marked assignment	Including multiple choice questions	Type-i
ICMA	Interactive computer marked assignments	Using generative questions with hints, feedback and scoring	Type-i
CRes	Computer based resources	Indexed and searchable databases, e.g. articles, picture library, databases	Type-i
CAL/ CBT	Computer assisted learning or computer	Interactive, adaptive, simulation/tutorial based training	Type-i
MM	Multi media	Multimedia CAL , with AV media incorporated	Type-i
CTools	Computer-based tools	e.g. spreadsheet, data analysis	Type-i
CMC	Computer mediated communication	Asynchronous computer conferencing for tutorials, discussion, and self-help groups	Type-c (asynchronous)
VCS	Videoconference system	Voice + shared screen for tutorials and group discussion	Type-c (synchronous)

Most of these elements are integrated into learning management systems (LMS) such as Blackboard, Lotus Notes or First Class. However, in CD-ROM courses many of these elements can still be provided.

## The type-i format: Computer applications

Most texts, even if they are to become printed material are nowadays created on a computer, i.e. in a digital format. Such documents can be distributed by email or put onto a server for users to access. Changing from a Word format to .pdf or a .html is just a matter of saving the document.

Older documents can be made available by scanning them, although that is a time-consuming process. If scanned documents are also to be edited or styled, then, text recognition software is also needed. These processes need hardware and software, but no specialist labour.

## Changing text

The need for specialist labour increases when it comes to changing standard text into hypertext. Hypertext is a text, which includes links. Such links may be **internal**, leading to other places within the document, or **external**, leading to other web sites. Standard software has made it quite easy to edit web pages and include links. The process becomes expensive only when a high design standard is required. In this case, specialist skills and software (e.g. Photoshop) are needed.

To edit study guides for use on the web is simple, requiring little more than the original skills of designing the study guides. But the digital format allows more effective content-learner interactivity. Multiple choice questions, computer marked assignments (CMAs) or spreadsheet simulations (such as you find in this booklet) are standard methods of learner-content interactivity. Such elements are often integrated into CBT packages. They often require sophisticated design and can be very costly, especially if audio or video clips are integrated into them. In many such cases academic time inputs are lower than those of the technicians involved, which means that production costs can be extremely high (e.g. in the case of CAL/CBT and multi-media (MM)).

The following section describes how computers can be used to enhance self-study by adding interactivity into course material. The definitions of the different categories are neither strict, nor mutually exclusive or exhaustive. They merely serve to indicate different levels of sophistication.

The following figures are again to be read with caution – the costs may not apply in your contexts. However, the figures used in our spreadsheet activities are ‘real world’ figures. Note that all figures below are related to one notional student learning hour.

### *Computer-based resources*

The simplest way to use a computer is to use it to provide access to resources by creating indexed and searchable databases for articles, pictures, etc. This requires considerable academic time as well as programming and general support input. According to one source academic input to create such resources to support one student learning hour has been rated at 19 hours or 2.37 academic person/days which amounts to US\$ 711. Other production-related inputs are rated at 42 hours. Based on our benchmark rate for production-related inputs at US\$ 180/day we get US\$ 943. Taken all together this would amount to US\$ 1 654. For the purpose of the spreadsheet activity we assume:

$$\text{cost/SLH}(\text{computer resources}) = \text{US\$ } 1\ 600.$$

### *Computer- marked assignment (CMA)*

There is a variety of options for using interactivity digital media. Automated marking of multiple choice questions is one of these options. To design assignments which can be graded automatically was reported by our source (reference?) to have required 18 hours of academic and 23 hours of programming input. This amounts to US\$ 675 (2,25 person/days x US\$ 300) of academic costs and US\$ 532 (2.9 x US\$ 180) of programming costs. Taken all together this would amount to US\$ 1 207. For the purpose of the spreadsheet activity we assume:

$$\text{cost/SLH(CMA)} = \text{US\$ } 1200.$$

### *Interactive computer-marked assignment (ICMA)*

If programming is more sophisticated and includes generic questions with hints, feedback and scoring one often speaks of **interactive computer-marked assignment (ICMA)**. Our source indicates 30 hours of academic and 37 hours of programming input. This amounts to academic costs of US\$ 1 095 (3.65 person days) and production-related costs of US\$ 832 (4.6 person days). Taken all together this would amount to US\$ 1 926 For the purpose of the spreadsheet activity we assume:

$$\text{cost/SLH(ICMA)} = \text{US\$ } 1900.$$

### *Computer-assisted learning or computer-based training (CAL/ CBT)*

Raising programming sophistication a further level we speak of computer-assisted learning or computer-based training. We refer to such interactive, adaptive, simulation/tutorials or teaching programs as CAL/CBT. As a benchmark value we found 73 hours of academic and 733 hours of programming and production-related inputs. Hence we have costs attributed to input of academic staff of 9.13 person/days or US\$ 2 737 and costs attributed to production-related activities of slightly more than 90 staff days or US\$ 16 245. Taken all together this would amount to US\$18 982. For the purpose of the spreadsheet activity we assume:

$$\text{cost/SLH(CAL/CBT)} = \text{US\$ } 1900.$$

### *Multimedia applications*

The multi-media formats are the highest in the league table of computer applications. These combine the various interactive media, e.g. multi-media CAL and audio visual media. This leads to high inputs both in academic time and in production related work. We find benchmark figures of 230 hours of academic input and 807 hours of production related inputs. This means 28.75 staff days or US\$ 8 625 of academic costs and 101 production related person/days costing US\$ 18,202 in production related costs (programming and media design). Taken all together this would amount to US\$18,982. For the purpose of the spreadsheet activity we assume:

$$\text{cost/SLH(MM)} = \text{US\$ } 1\ 900.$$

## *Computer tools*

To end with we will finally consider the use of simple computer tools like spreadsheets for calculation or statistical tools for data analysis. Given a benchmark figure of 17 hours academic time and 46 hours of production related time (including configuring the software for the task at hand) we estimate the respective costs as US\$ 637 (2.13 academic days) and US\$ 1 035 (5.75 production related days). Taken all together this would amount to US\$ 1 673. For the purpose of the spreadsheet activity we assume:

$$\text{cost/SLH}(\text{computer tools}) = \text{US\$ } 1600.$$

All these different applications use computers as information processing devices and can be classified as i-type., i.e. they can be saved to a CD-ROM and sent to students for self-study. The replication and mailing costs are low. We assume US\$ 2 per CD-ROM.

Important it is to note that i-type uses of the computer have the same cost-structure as traditional 'one way traffic' media (Holmberg, 1995, p.2). They allow economies of scale.

### **Activity A23: Computer applications**

Use the spreadsheet Activity A23 for this.

This spreadsheet starts with print plus some measures of student support as the default option.

1. Now, try to substitute the student support measures by content learner interaction using computer applications.
2. What do you observe?
3. Vary the student numbers. Which option is most sensitive to increased enrolment?

### *Notes*

1. If you want to run a macro you need to have the spreadsheet page for that macro open. Running a macro for another page is likely to cause errors. However, if this happens, close the activity without saving and start afresh.
2. The spreadsheet adjusts fees to reflect costs. The fee is based on average cost per student plus a margin for profit and a margin for risk. Our assumption that enrolment levels will not be affected by higher fees may not be realistic.
3. The V lines may not be visible on your economies of scale worksheet. This happens when the value of V is very low, making the V line contiguous with the bottom axis of the graph. [Click here](#)

### **Type-i advantages and disadvantages**

The advantage of the type-i variant of e-learning is that, though possibly costly to develop, it is in line with the traditional cost-structure of ODL which allows considerable economies of scale. Burning and distributing CD-ROMs is comparable in cost with copying and mailing audio or video cassettes.

There are, however, some problems with using computers in ODL. First of all, computers are a cost to students.

Then there is the fact that type-I applications with automated responses and other forms of content-student interactivity need to be saved on CD-ROMs and sent to students.

### **The type-c format: Computer mediated communication**

There are basically two ways of using computers as means of communication:

1. In a synchronous manner (e.g. for videoconferencing)
2. In an asynchronous manner (e.g. virtual seminars or threaded text-based conferences).

We will start with the latter case.

#### *CMC and the virtual seminar model*

Communication often has been seen as the Achilles' heel of ODL. Effective learner support used to prove difficult and costly to organise. ODL therefore has traditionally emphasised the individual study of course material that was so well designed that it pre-empted most questions. The remaining questions were dealt with by correspondence (now often by email), telephone counselling and (face-to-face) weekend seminars or summer schools.

Asynchronous text-based communication (or computer mediated communication (CMC)) has fundamentally changed this. It not allows effective student support but blurs the separation of content presentation (one-way communication) and dialogue (two-way communication). A major form of online teaching – the **virtual seminar** – has emerged.

#### **Activity 24: Virtual seminars**

Use the spreadsheet Activity A24 for this.

This spreadsheet starts with a basic print course with some amount of student support.

1. Use the spreadsheets to find out if a virtual seminar (VS) is more cost-efficient.
2. First set the print elements to zero and then opt for the VS option.
3. Check on page three of the spreadsheet what happens.
4. You will have found the VS slightly more costly. In particular, the costs rise more quickly with the number of students in the system.
5. You can explore how scale affects the system.
6. If you have only small cohorts, say 90 per year, what happens?
7. What happens when you have 400 per year?
8. Look at the slope of the TC function and the Variable cost per student. What do you observe? Can you conclude something about the scale economics of the VS option?

## Notes

1. If you want to run a macro you need to have the spreadsheet page for that macro open. Running a macro for another page is likely to cause errors. However, if this happens, close the activity without saving and start afresh.
2. The spreadsheet adjusts fees to reflect costs. The fee is based on average cost per student plus a margin for profit and a margin for risk. Our assumption that enrolment levels will not be affected by higher fees may not be realistic.
3. The V lines may not be visible on your economies of scale worksheet. This happens when the value of V is very low, making the V line contiguous with the bottom axis of the graph. [Click here](#)

Characteristics of virtual seminars include:

- a shift away from exclusive individual study to group communication and collaboration
- using threading as a structuring tool.

A virtual seminar has a cost structure quite different from that of ODL as discussed above. The development costs are lower and the commitment of teachers' time is higher. Moreover, teaching costs are semi-variable costs depending on class size and number of classes to be conducted. There is not much space for economies of scale. However, diseconomies of the range of courses is less of a problem. Virtual seminars are updated easily updated, which makes course shelf-life less of a problem. Courses can more easily be customised as can whole programmes, especially if they are designed in a modular manner.

However, if CMC is used just to provide more flexible student support, it becomes an add-on cost. This means it is about quality rather than cost-efficiency. In some cases the weekend seminars and face-to-face parts of student support are partially reduced to pay for the more flexible online tutorial support. There is, though, a pedagogical difference between virtual seminars, and the use of CMC as a sort of help desk function. In the virtual seminar, it is the discussion which drives the course (albeit along the lines of the pre-constructed plan) while, when using CMC as an optional help desk function, students may make use of it only intermittently. This explains the contradicting reports about online communication. While teachers in virtual seminars often report high volumes of communication, the use of CMC as alternatives of student support often leads to frustrating low volumes of communication. This suggests that the added value of CMC depends on the instructional design and the way it integrates CMC in the overall course set up.

Virtual seminars depend on a certain level of available infrastructure and software. They are not characterized by a **capital-for-labour substitution** (typical for distance education as an industrial approach to teaching and learning), but they may improve cost-efficiency through **labour-for-labour** substitution (cheaper labour for expensive labour).

It is possible to introduce a division of labour by employing teaching assistants for doing the more routine part of the work (loading the predetermined elements of an online course, organizing study groups, updating the schedule, assuring copy right etc). Meanwhile the lead faculty can focus on quality dialogue with the students. There are further strategies to reduce

the involvement of the teacher by emphasizing peer discussion. In such a model the tutor would encourage students to answer each others questions. Strategies like these, however, risk sacrificing the quality advantages to economic pressures. Students may not accept that a level of interactivity facilitated by advances in technology is reduced for cost-efficiency reasons.

Parameters determining the costs here are class size and time factors, i.e. student work load per week. Low class sizes can be difficult to manage and high class sizes may produce too high a volume of interactivity. Experience suggests that about a third of the students are active so that between 20 and 35 seems to be quite manageable in a class. Given a work load of 10 hours per week, such seminars would require about 10 to 15 hours of teaching time. If division of labour is to be introduced about 5 hours may be seen as routine work and can be done by a teaching assistant.

The above activity illustrates that asynchronous text-based communication does not follow the same economies of scale. (Note: it does not mean that asynchronous seminars are not scaleable. Scalability and economies of scale are not the same thing.)

#### *Videoconferencing and the extended classroom model*

Some distance educators are reluctant to recognise videoconferencing (referred to as video-network teaching in the extract below) as a mode of distance teaching.

‘Let us try to analyse the video-network teaching you have described:

- Is it carefully planned and carefully developed with the support of considerable financial means - which are used for instructional purposes - not for technical media? No.
- Are the best scholars in the given discipline engaged in order to produce an really authentic teaching? No.
- Has there been a cooperation of educational and subject matter specialists? No.
- Has the product - the teaching- been ‘objectified’? No.
- Has the product been mass-produced? No.
- Do the institutions use these networks in order to target at the greatest possible number of students? No.
- Do these models try to achieve what Henry Ford had in mind when he produced high quality products at low prices for everybody? No
- Is this instruction developed in order to reach and help students who were born into socially disadvantaged families and neighbourhoods and also to those who can never attend classes on campus for other reasons? May be.’

(Peters in Bernath et al. (eds.), 1999, p. 162)

This emphatic diatribe against videoconferencing is based on the conception of ODL as ‘most industrialized form of teaching and learning’ (cf. the reference to Henry Ford in the second last point). Note, however, that much of these challenges can also be made against

virtual seminars. The main difference to traditional distance education lies in the level of interactivity, the role of the learning group (class), and the use of available material instead of costly new course developments. Hence, in spite of the criticism, videoconferencing remains an option for the distance educator.

Videoconferencing is designed to allow lecturing at a distance, even at different sites simultaneously. There are two types of set-up of videoconferencing: the symmetrical (or peer) case and the asymmetrical (or master/slave) case. In the symmetrical case the sending and receiving stations are all identically equipped for sending as well as receiving.

**Table A- 15 Videoconferencing equipment**

Display Equipment	Costs	Network/connections	Costs
Overhead camera	2 508	Videodec (compression lab)	80 268
Teacher tracking camera	1 504.5	Videodec (Aethra)	10 033.5
Monitor 11"	1 504.5	Inverse multiplexer(Teleos)	5 016
Backprojectors (2)	22 074		
Video Matrix (16:4)	702		
Presentation manager	1 254		
PC+VGA/PAL	2 007		
Audio mixer	702		
Wireless microphone	501		
Sliding Blackboard	1 504.5		
Subtotal	34 261.5	Subtotal	95 317.5
Total			129 579

*Note:* Based on Hülsmann, 2000; converted in US\$

The above example illustrates that professionally equipped videoconferencing stations can be quite expensive. However, when equipment costs are depreciated over a five years life time and assuming that the available capacity is well used, cost per hour of videoconferencing is not too high.

Before we look into the actual cost figures we look at the cost equation for videoconferencing. In the symmetrical case with two sites ( $S = 2$ ) the cost per hour of teaching using a videoconference system (VCS) can be calculated as:

$$\text{Cost/SLH(VCS)} = (\text{DEC} + \text{TSC}) \times 2 + \text{LIC} + \text{LEC}$$

*Where:* VCS = video conferencing system  
 DEC = depreciated costs  
 TSC = technical support costs  
 LIC = line costs  
 LEC = lecturer costs

This means that we have at each site equipment costs and costs of technical staff. We have one line to pay for and one lecturer.

To find the average cost per learning hour per student we only have to divide the cost per student by the number of students  $N$ :



$$(AC/SLH(VCS)) = \frac{C/SLH(VCS)}{N} = \frac{[(DEC + TSC) \times 2 + LIC + LEC]}{N}$$

Since N, the number of students, can be considered as a product of the number of sites S and the average number of students per site G, we have for S = 2, N = 2 × G:

$$\begin{aligned} AC/SLH(VCS) &= \frac{[(DEC + TSC) \times 2 + LIC + LEC]}{2 \times G} \\ &= \frac{[(DEC + TSC + \frac{(LIC + LEC)}{2}]}{G} \end{aligned}$$

For the general case S ≥ we have:

$$\begin{aligned} C/SLH(VCS) &= (DEC + TSC) \times S + LIC \times (S - 1) + LEC \\ AC/SLH(VCS) &= \frac{[(DEC + TSC) \times S + LIC \times (S - 1) + LEC]}{S \times G} \\ &= \frac{[DEC + TSC + \frac{LIC \times (S - 1)}{S} + \frac{LEC}{S}]}{G} \end{aligned}$$

In fact, since (S-1)/S = 1-(1/S) approaches 1 when S gets larger, we may simplify the above formula and write:

$$AC/SLH(VCS) = \frac{[DEC + TSC + LIC + \frac{LEC}{S}]}{G}$$

This formula reflects the fact that the average cost per student declines if the number of sites increases.

The benchmark figures we use for the activity are based on Hülsmann (2000, pp. 132-138). Equipment costs fall broadly into two categories: costs of display equipment and network related equipment. The display equipment includes the equipment of the teacher station. A summary of equipment costs is presented in the above table. It was suggested that the equipment costs should be depreciated over five years at a usage rate of 1300 hours per year (5 years × 26 weeks per year × 5 days per week × 10 hours per day = 6500 hours). This however is using the equipment at full capacity, which would be difficult to do. More realistic it is to assume that for one hour of operating the equipment there is at least another hour of preparation and putting back the equipment. This is why we depreciate the equipment on the basis of 3000 hours of use over its lifetime. This leads to US\$ 43 per hour of depreciated equipment costs (DEC = US\$ 43).

Line costs: In the cited case ISDN lines were used for intercampus connection. The line costs depend on bandwidth: We assume 384 Kbps rated as US\$78 per hour (LIC = US\$78).

Personnel costs: The personnel costs consist of costs for technical support and the cost of the lecturer. Here we use the standard figures we have used throughout the activities. This leads to cost of technical support per hour of US\$ 25 (TSC = US\$ 25) and instructor costs per hour of US\$ 43 (LEC = US\$ 43).

Other parameters included in the above equation are group size and number of sites. In the activity you can explore how group size and number of size influences the average cost per SLH. Here we assume as a benchmark figure five sites with 15 students per site. This leads to cost/SLH (videoconferencing) per student = US\$ 15.5. (Note that this is a variable cost rather than a fixed cost of development!)

### **Activity A25: Videoconferencing**

Use the spreadsheet Activity A25 for this.

Here you might like to compare the default option (i.e. print + student support) with an option where the tutorials are substituted by videoconferences.

1. Which seems to be more cost-efficient?
2. Check page three of the spreadsheet to see the effect in each case.
3. How scale sensitive is videoconferencing as compared to tutorials?

#### *Notes*

1. If you want to run a macro you need to have the spreadsheet page for that macro open. Running a macro for another page is likely to cause errors. However, if this happens, close the activity without saving and start afresh.
2. The spreadsheet adjusts fees to reflect costs. The fee is based on average cost per student plus a margin for profit and a margin for risk. Our assumption that enrolment levels will not be affected by higher fees may not be realistic.
3. The V lines may not be visible on your economies of scale worksheet. This happens when the value of V is very low, making the V line contiguous with the bottom axis of the graph. [Click here](#)

### **Advantages and disadvantages of videoconferencing**

Videoconferencing has cost-advantages, essentially if savings can be made in terms of travelling costs.

The limitations of videoconferencing include the lack of time flexibility and the inverse relation between teacher student interactivity and audience size.

Protagonists of videoconferencing point out that it can bring the best teacher available to the remotest place. This, however, is a rather simplistic understanding of the teacher's role and the relation between teaching and learning. However, it is true that videoconferencing can be the most cost-efficient way to present an internationally renowned expert, albeit with limited interactivity options.

## Learning management systems

The advances in using computers for administrative purposes have already made considerable progress in all educational institutions. Learning management systems integrate pedagogical and administrative systems. They provide mechanisms for student registration, administration, assessment and teaching. They also track learning, courses and credits.

**Table A- 16 Some virtual learning systems**

Names	Pricing models	Comment
<b>Blackboard 5</b> www.blackboard.com	US\$ 20,000 pa for ca. 2000 user	Blackboard uses licensing as pricing model; temporary licences for testing for US\$ 7000 for a month
<b>Clix</b> www.im-c.de	Business price: from US\$ 75,000 onwards <sup>a</sup>	IMC prefers selling to licensing; servic gets expensive; telephone hotline costs per minute
<b>Distance Learning System (DLS)</b> www.ets-online.de	US\$ 230,000 from 10,000 users onwards <sup>a</sup>	Excluding support, maintenance and hosting
<b>IBT SERVER elearning suite v6</b>	Single server licence, scalable to 100 users € 8000 <sup>a</sup> Web authoring (5 authors) : € 7 500 <sup>a</sup> Assessment (100 user): € 7 500 Curriculum design (5 authors): € 5 000 <sup>a</sup> Skill management (100 user): € 7 500 <sup>a</sup> Resource management (100 users): € 3 200 <sup>a</sup>	
iLearning www.oracle.com	License pro named user pa € 60 <sup>a</sup> List price pro user € 34 plus 22% support pa <sup>a</sup>	
ILIAS www.ilias.uni-koeln.de	Open source	
Lotus Learning Space (LLS) www.lotus.com		Proprietary software; special feature: replication, which reduces cost to be online.
Top Class www.topclass.com		
WebCT www.webct.com		
H.U.T.GmbH H.U.T.VERDI	Business price: from € 80 000 onwards <sup>a</sup> License per user: €2	
Integrity Learning WBT Manager 1.51	Business price: € 42,500; license per user from € 5 300 according to no. Of users. <sup>a</sup>	
TLM Corp. The Learning Manager 3.2	€ 50,000 pa; per user € 2.5 a	

Notes: a: Hettrich, Koroleva, (2003). *Learning Management Systeme (LMS) und Learning Content Management Systeme*: Fraunhofer IAO.

It is difficult to say something about costs since prices are generally negotiated with the provider. There are more than hundred such systems on the market and there is fierce competition. Experts believe that there is a shake out going on, which will leave not many more than five major contenders. This explains why cost data are not easily available. Where figures are included they are referred to as ‘pricing models’, which signals that there is room for negotiation. Some typical systems are set out in Table 16.

Institutions need to be aware that initial terms may appear to be advantageous but once institutions are hooked onto a system, it is difficult to shift to alternative platforms. By then much material will be held in the system-specific format and staff will have been trained to feel comfortable with it and usually will be reluctant to change. Once the institution is hooked and many courses are running in the particular learning environment, the price may begin to rise. For example, a South African university licensed a LMS for US\$ 5 000/year for their 50,000 students for the five years. As at the end of the license period the price for a similar product and accompanying services was US\$ 110,000. The university had to decline. Eventually negotiations led to a compromise about which no public information is available. The example illustrates why open source platforms should always be considered.

## **6 Conclusions**

Throughout this booklet we have emphasized cost-structure. We have analysed media in terms of cost-structure and found that new media (mainly educational technologies based on networked computers) open up two different avenues for ODL. In summarising our conclusions, we need to note that the choice of technology cannot be done on cost alone; an institution must also consider where it is in its own technological development – and that of its students.

We also need to note the benefits of cooperation: It may be that the match between what an institution wants to do, and what it can afford to do does not lead to an acceptable outcome. Working with others may help overcome such limitations.

### ***Cost-structure and infrastructure***

All forms of distance education are predicated on a level of available infrastructure. The early forms of correspondence education required a functioning postal service, which, in turn, depended on a functioning railway system. Later generations of distance education (e.g. the use of multi-media as part of the open university model) required a broadcasting infrastructure. Digital radio as well as videoconferencing often requires a distribution of satellites, whose footprint is large enough to cover the region of the target audience. Distributed e-learning requires access to the Internet and the World Wide Web. It would never make sense to include the cost of building such infrastructures in the cost analysis of a particular course. The perception that ICT-based ODL is expensive in developing countries is based on such a skewed analysis. It is necessary to separate a cost analysis from a feasibility study. First we need to assure feasibility before we proceed to a cost analysis.

If we look at the different generations of ODL from the perspective of cost structure (i.e. the composition of fixed and variable cost components in the total and average cost equation) we may observe the following:

## Correspondence teaching

If we compare correspondence teaching (DE) with face-to-face (CE) we have little difference in fixed costs and clearly lower variable costs per student:

$$F_{DE} \leq F_{CE} \text{ and } V_{DE} < V_{CE}$$

This makes us expect that correspondence teaching is less rather than more expensive than conventional teaching.

## Multimedia

In the case of multi-media (as compared to face-to-face) the fixed costs are often substantially higher in ODL. Large numbers of students are needed to make this option (characterised by:  $F_{DE} > F_{CE}$  and  $V_{DE} < V_{CE}$ ) competitive in terms of average cost per student (or graduate). The many mega-universities which have adopted the distance teaching model illustrate that this model works and is, in principle, capable of offering quality mass education. The drawback of this model is that courses take a long time to develop and their shelf life needs to be long. Also, the enrolment level over which to spread the fixed costs may be difficult to attract. A distinctive disadvantage of the model is its limitations in terms of the range of courses. The more courses on offer, the harder it becomes to enrol enough students.

## Distributed e-learning

In terms of cost-structure distributed e-learning is similar to multi-media, being epitomized by high fixed costs of development. In both cases high enrolment levels are needed to achieve economies of scale to bring average costs down to an acceptable and affordable level.

## Virtual seminars

Virtual seminars (type-c) compared to traditional distance teaching show a different structure:

$$F_{\text{type-c}} < F_{DE} \text{ and } V_{\text{type-c}} > V_{DE}$$

The cost-efficiency of distributed e-learning of type-c lies in its economies of range and shorter time to market. For some distance educators the main variant of the distributed e-learning model sacrifices its democratic credentials as mode of education capable of opening mass access. It is not accidental that the debate focuses on the value of interactivity.

With the transition from the industrial and Fordist model of distance education to a post-Fordist model the main focus moves away from internal reorganization (managing technological change, re-engineering the institution) to external models of cooperation (and/or business models). ICT-based formats can easily be customized for different audiences. Institutions can form temporary alliances to offer courses to audiences outside the traditional jurisdiction of the providing institutions. These alliances may serve to recoup some of the scale lost in the post-Fordist model and allow to share development costs. Hence it is adamant for managers of distance and open learning to look at several business models of cooperation.

## ***Business models and models of cooperation***

### **Buying-in**

An ODL institution may buy in courses and adapt them for its audience. This makes sense if the price of the respective course plus the costs of adaptation are smaller than the costs of a development from the scratch. The Open Learning Institute of Hong Kong is said to have practised the model successfully (Dhanarajan, et al., 1994).

### **Cooperation with conventional universities**

A dedicated distance teaching institution may cooperate with conventional universities to serve as learning centres for its students. Such arrangements may be more cost-efficient than founding new learning centres. The FernUni Hagen and the Centre for Distance Education (ZEF) at Oldenburg University is a point in case. The FernUni gains by not having to construct new centres, which is costly and, education being within the jurisdiction of the states, may even not be possible. ZEF gains for not having to develop new courses and being able to focus on student support.

### **Networking the use of course materials**

A distance teaching institution may develop new teaching materials and establish a network of institutions which agree to teach those courses under their own responsibility. Both parties gain: the ODL provider spreads its costs over a larger number of students and the purchasing institutions gain materials that they could not have afforded to produce.

A professional development course for Nurses (*Psycho-Social Aspects of Nursing*) developed by ZEF/Oldenburg is a point in case. The material was developed in Oldenburg and taught and taught at various German universities (Hülsmann, 2000, Case study 5).

### **Cooperating centres**

Several institutions may join forces to establish a centre which develops courses on demand. For participating members the use of the courses is free. The centre can also market courses to outside the circle of allies and sell them at revenue generating conditions. Such a centre could also be charged with marketing and other tasks to make the alliance more visible to the respective professional world. An example has been the UK Open Learning Foundation (OLF).

### **Bilateral cooperation**

Bilateral co-operations may allow the sharing of developing costs and enlarge the learner base, even across language borders. The cooperation between UBC and Monterrey is a point in case.

Other business models may be more complex and include funding institutions. A distance teaching institution in the north may cooperate with an institution in the south to draw donor funding for capacity-building projects. Many international tenders prescribe cooperation beyond national borders. It is easy to see that even if ICT-based distance education (distributed e-learning) as such may not be more cost-effective than other options, it is much more

versatile in forging *ad-hoc* alliances for specific purposes. Since this versatility is seen as an asset business models do play a central part in cost-effective distance education.

## ***Conclusions***

Much of your strategic budget planning will be determined by your context (e.g. small institution, public or private provider, availability of infrastructure). In each case the spreadsheet template will differ slightly. But in all cases it makes sense to have at hand interactive spreadsheets with benchmark figures on costs.

The profile of ODL has undergone a substantial diversification which affects core features of ODL such as its cost-structure. Which model fits your context depends on the local infrastructure and market size. The new models of ODL do not necessarily challenge established working models (e.g. the mega-universities) but provide alternative strategies. Where audiences are smaller or quick customisation is required, e-learning formats may offer a post-Fordist alternatives, which, given the right infrastructure conditions, may be cost efficient.

The division of labour within a Fordist institution is substituted by a division of labour between smaller post-Fordist institutions, which bring together partners of technological competence, academic credibility (certification) and funding. Partners may come from different regions in the world and may represent a mix of private and public partners (PPP).

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