Identifying the Break-Even Point in Distance Courses

MARTINA KADAVOVÁ
Department of Economics
University of Hradec Kralove
Rokitanskeho 62, 500 03 Hradec Kralove
CZECH REPUBLIC
martina.kadavova@uhk.cz   http://www.uhk.cz

Abstract: - Distance education has become a very up-to-date item. The article describes the categorization of distance education costs and their integration into cost and revenue functions. The aim of the article is to define the break-even point – i.e. the economic effectiveness of a course, and thus specify the number of students for the minimal effectiveness of the course using various functions for calculating expenses in relation to their distance rate and stair-step functions.

Key words: - Virtual university – costs - efficiency – students – profit – benefit – break-even point

1 Introduction

Current educational subjects (both in private and state sectors) tend to behave as pure economic subjects. They try to maximize their asset which may be concealed in various forms. Generally, the number of educational courses and their quality is pointed out, increasing the attractiveness of the study of the educational subject. But in the background there is one common denominator. It is the trading profit. In case educational activities bring profits, the institution is able to widen the educational offer.

In the article we would like to attract attention to economic differences between traditional and distance education, especially from the point of view of costs and assets, which means dealing with the problem of the distance education profitability for an educational institution.

2 Items of the System

Before dealing with costs and yields per course, it is necessary to define what is essential for its preparation. The distance education successfully works only if the system approach is applied. Its main items are as follows: [16]
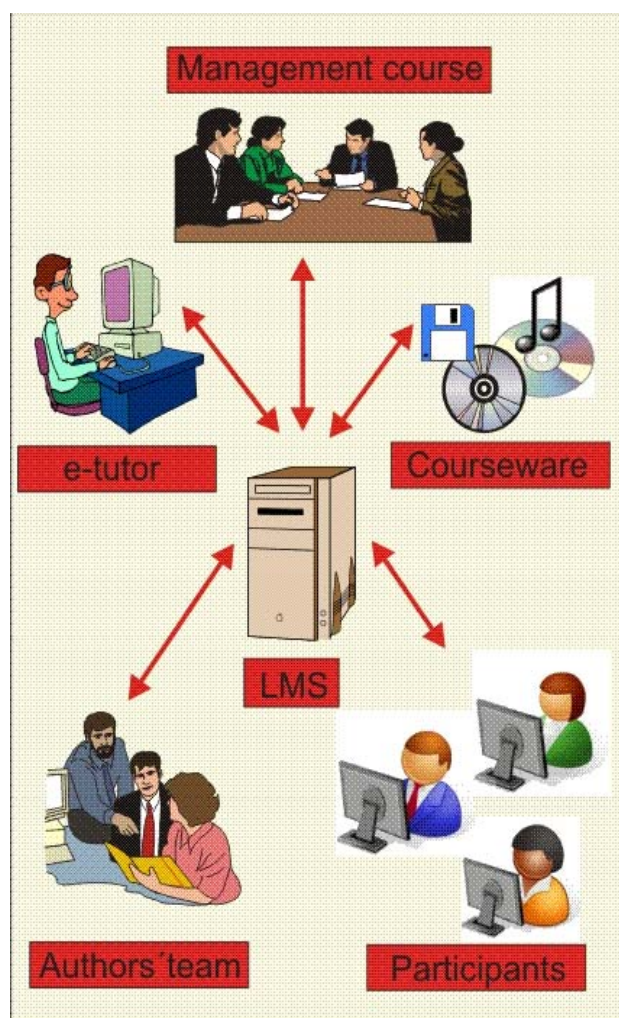

Fig. 1 – Participants and resources of the virtual university

a)   Participants

b) *Educational institution*
- Staff (educated authors of supportive study materials, consultants)
- Management of the educational institution
- Administrative staff
- Publishing and postal centre
- Information centre
- Consulting centre
- Regional study centre
- Laboratories

c) *Information and study materials*
Include study aids – books, study materials, study packets, teaching SW, LMS.

Similarly as in other cases, they can be divided to three groups of sources:
- general titles of CBT and WBT producers
- tailored programmes
- programmes prepared and produced in the firm from its own sources.

Library, the Internet, Intranet, electronic media, CD-ROMs, satellite broadcasting, MDA, consulting services, study centre, e-mail, audio or video cassettes.

Educational packet, e- tests.

SW correcting and evaluating students work, if it is not included in LMS.

d) *Technical equipment*
- Server, web server, high-speed Internet, network, cabling, LMS, software
- Laboratories
- Multimedia on-line instruction
- Web cameras for videoconferencing (+ access via USB to the computer)
- Digital video cameras for recording lectures
- PC card + SW for video processing
- Flip boards
- Data projectors
- Notebooks, personal computers
- Telephones, cell phones, faxes, MDA
- Digital television
- Loudspeakers, microphones
- Printers, copiers, scanners
- CD + DVD readers and burners, USB
- HW
- System requirements
- SW

e) *Human resources management*

Table 1 - Actors and their roles

Role	Description of the Role
Manager	Is responsible for the total quality of a study program. Coordinates the study program, checks feedback information and makes reports. Chooses proper lecturers for study programmes. Checks expenditures spent on a program.
Sponsor	Chooses and coordinates the team of co-workers working on a module (more similar to study programmes). Can be a quality guarantee of single programs.
Author	Prepares content (printed materials, documentation, presentations) of a course. Is responsible for the quality of provided information.
Mentor	Helps students to solve any problems during the whole study, can provide expert information about a course. For example helps with building of a study plan, defines the goals of study.
Tutor	**Roles of Tutor:** Can be an Author of study materials Is a guide for students during a course and leads students during the study and helps them with reaching the goals of the course. Checks and examines the progress of students during a course. Gives motivation.
Student	Is a participant of a course. His/her goal is to increase knowledge and skills. Students work alone or in a team. He is in contact with another students and his tutor. Distance students need to have a strong motivation.
Administrator	Is an ICT expert, who coordinates preparations of electronic background for distance learning. Defines,

	develops and validates different components of a learning system.
Opponent	Is a specialist in some field, who checks and evaluates content of studying materials.

Participants and resources can be illustrated even in the form of UML notation, which illustrates positions of participants in the Virtual University system. Fig. 7: Roles of VU

In the system of the Virtual University, other roles appear as well, but in this article, I will only center on the most important ones.

Each of these Roles must be included in the model of the Virtual University according to its interaction with the system. [12], [13]

Each role of the system has to be elaborated in detail and its activities within the system have to be examined in detail. By analysis of activities of roles, we will get to requirements imposed by the system and thereby to the intricacy of the system, which will be finally reflected in the financial costing ness of the construction and administration of such a system. For example elaboration of the role Student in the form of UML notation can be seen in the diagram fig. 8 Role of a student in the system of Virtual University.

3 Frameworks for Costing

At the macro-level the costs of any system are driven by a combination of the following factors, all of which are susceptible to management control:
- Course populations
- The number of courses offered
- The lengths of courses' lifetimes
- The media and technologies chosen
- The extent to which cost-inducing actions, for example the use of copyrighted materials, are avoided
- The extent to which costs are imposed on students, either as tuition, or by moving the system boundaries so that activities the institution might once have paid for are now paid for by students (e.g. access to tutorial and library services)
- The extent to which the institution employs people on contracts for service (i.e. salaried posts) to develop courses and teach students, rather than on contracts of service (i.e. hired as casual labor, to be paid by the manuscript/script/tutorial hour/test marked, etc.)

- The extent to which the institution adopts working practices that reduce the costs of labor by, for example, designing courses to be wrapped-around the existing textbooks rather than developing new materials, and using author-editor models of course design, rather than big course team models
- The use of technology to increase the student load per academic or administrator
- Increases in the teaching load of academic staff at the expense of other functions – for example, research and public service, and …
- 'Labor for labor' substitution – the replacement of expensive academic labor by student and adjunct labor, in order to reduce staff costs.

An important element in costing is to understand the system being costed so that cost elements are not missed. Far too many analysts restrict their analysis to their own budget. Of course, understanding one's own budget and controlling it is important. The answers one obtains to questions such as 'How much will this cost me?' and 'Will doing it this way cost more or less than doing it that way?' will help one decide whether, from a purely parochial interest, whether one should or should not proceed with a given course of action. [11]

4 Categorization of E-learning Costs

In the process of comparing costs and revenues in the distance and traditional education, a clear definition of the basic terms is necessary, i.e. what they consist of. Not the whole virtual university is evaluated, but only one distance educational course.

4.1 E-learning study costs

The standard structure for cost and revenue classification is used as it is in the common sphere of commerce, i.e. the variable and fixed costs will be counted.

4.1.1 Fixed costs
- Designing study materials – when creating an e-learning course, at the very beginning study materials must be prepared, including their electronic form in the e-environment. This is a non-recurring action.
- Authors´ royalties for creating study materials in the text form – authors must be evaluated in terms of finance.
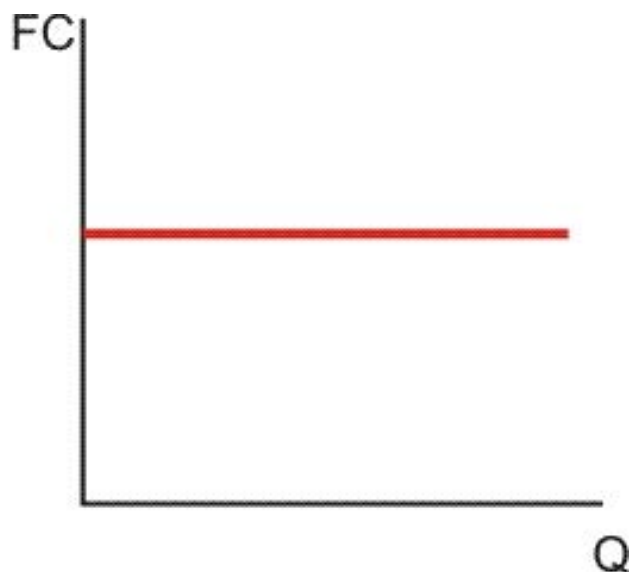- Printing study materials
- Costs of designing an e-course

Fig. 2: Fixed costs

4.1.2 Stair-step function fixed costs

The level of fixed costs depends on such criteria as a number of students, frequency of tutorials, etc. It means stair-step function costs must be added to classical fixed costs, see the following examples:

a) Requirements for SW and HW infrastructure of the distance education depend on the number of competitive working students.

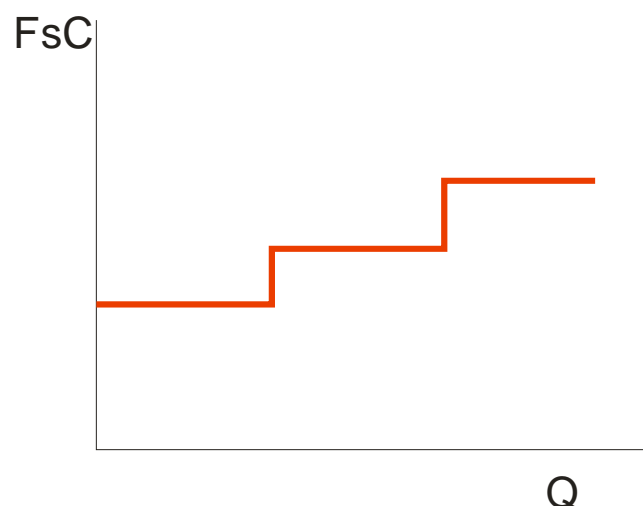b) Financial means necessary for tutorials depend on the number of students and frequency of tutorials.

Fig. 3: Stair-step fixed costs

4.1.3 Variable costs

- Virtual environment user license
- Running an e-course – tutors and administrators of each group are evaluated
- Consumer material costs

- Rental service costs paid for tutorial rooms
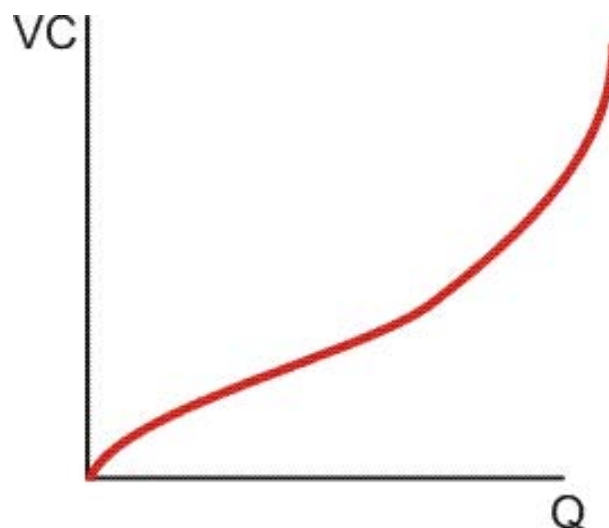- Printing study materials
- Staff costs

Fig. 4: Variable costs

4.1.4 Total costs

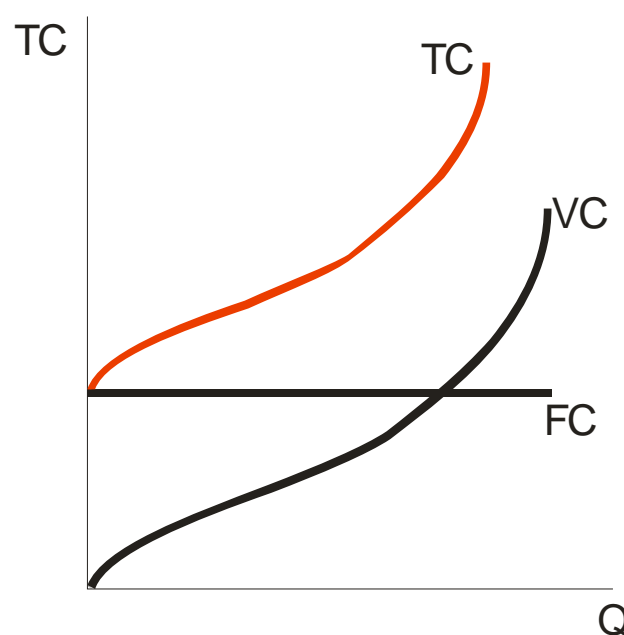The total costs cover variable and fixed costs.
$TC = FC + VC$

Fig. 5: Total costs

4.1.5 Average cost

Furthermore, expenses per one student are calculated, which is an aliquot part of the total costs, i.e. the total amount divided by number of students (N).
$AC = (FC + VC) / N$

4.1.6 Average fixed and variable cost

Average fixed and variable costs are counted in the same way:

AFC = FC / N

AVC = VC / N

5 Profits

The traditional and distance course revenue varies and consists of two items:

a) Contribution on each student (either from a state or public institution supporting education).

b) Contribution from each student (some universities require full or partial fees from students).

Total of these sums creates the income per student.

6 The Break-Even Point

Finding the rate of return comes from a principle of comparing costs and profits and finding a number of students, who have to be in the course so that the course is profitable. In economical formulation it is the break-even point. When costs and profits are equal, the more students above the minimal number we have, the higher profit we will receive.

To be able to find the point we must formulate cost and profit functions.

6.1 The basic cost function

The cost function reflects variable and fixed costs.

Fixed Costs:

F_1 - designing study materials

F_2 – authors royalties

F_3 – print

F_4 – creating e-course

Variable Costs:

V_1 – virtual learning environment license

V_2 - running an e-course

V_3 – consumer material

V_4 – rent for tutorial rooms and office rooms

V_5 – rental services for tutorial rooms (including HW, web camera, data projector, flip board, internet…)

V_6 – indirect expense

V_7 – staff costs

Staff costs consist of:

- Staff costs for designing modules

- Staff costs for creating supportive study materials
- Staff costs for teaching the module (tutor's salary)
- Staff costs for instruction support (study department)
- Staff costs for management
- Staff costs for examination board, etc.

N – Number of participants in a course

$$TC = (F1 + F2 + F3 + F4) + (V1 + V2 + V3 + V4 + V5 + V6 + V7) * N$$

(1) The basic costs function

Other elements could be the costs which were not displayed here, or are still unknown, and marginal to the educational institution.

6.2 The costs function taking into account step function fixed costs

Fixed costs are on the same level without consideration of the number of students. It changes by step. E.g. when the number of students increases by 25 students, another classroom for tutorials must be rented, another HW and new SW licenses bought.

Other costs are added to the cost function (1):

Fs_1 = step function fixed costs for tutorials

Fs_2 = step function fixed costs for SW

Fs_3 = step function fixed costs for HW

It results in a new function:

$$TC = (F1 + F2 + F3 + F4) + (Fs1 + Fs2 + Fs3) + (V1 + V2 + V3 + V4 + V5 + V6 + V7) * N$$

(2) The new costs function

6.3 The cost function in a time-period

The point of time has to be taken into account in the situation. The costs increase in relation to the time-period. Three time periods are used for displaying the costs.

6.3.1 Short course (not longer than 14 days)

In a short course no tutorials are taken into account.

The process of providing certificates is expressed as a fixed item.

F_5 – certificate costs are added to the function.

$$TC = (F1 + F2 + F3 + F4 + F5) + (Fs1 + Fs2 + Fs3) + (V1 + V2 + V3 + V4 + V5 + V6 + V7) * N$$

(3) The costs function for short course

6.3.2 One-term course (not longer than 6 months)

If the course lasts 1 – 6 months, tutorials must be organized. The costs for 3 tutorials are included: an introductory, middle, final one.

Zlámalová, Rumble and other authors emphasize the necessity of introductory tutorials for courses longer than one month.

This item is a fixed cost and includes tutor's salary, fare, rent for classrooms, SW and HW, refreshments etc., and F6 – tutorial costs, are added, including F5 – Certificate.

$$TC = (F1 + F2 + F3 + F4 + F5) + (Fs1 + Fs2 + Fs3) + (V1 + V2 + V3 + V4 + V5 + V6 + V7) * N$$

(4) The costs function for one-term course

6.3.3 Full study (Bachelor's degree programme and Master's degree programme)

The full study is the most important and represents the most expenditures.

This type of study includes not only tutorials but also summer school (one week per 6 moths) to form those demanded skills which cannot be formed via distance instruction. The frequency of tutorials and/or summer schools is expressed by variable costs and the item "summer school" is added to the costs. Its coefficient depends on the support of special aids, laboratories, time view etc. and results in:

$$TC = (F1 + F2 + F3 + F5 + F6) + (Fs1 + Fs2 + Fs3) + v * (V1 + V2 + V3 + V4 + V5 + V6 + V7)/ * N$$

(5) The Cost function for full study

Furthermore the costs covering the final phase of study, i.e. final exam and certificate ceremony, are added. The function includes F7 function – final study fixed costs.

$$TC = (F1 + F2 + F3 + F5 + F6 + F7) + (Fs1 + Fs2 + Fs3) + v * (V1 + V2 + V3 + V4 + V5 + V6 + V7)/ * N$$

(6) The Cost function for full study

6.4 The revenue function

As presented above, it also respects the revenue particularity.

R_1 – contribution on each student
R_2 – Contribution from each student
R_3 – revenue from grants

N – Number of students

$$TR = (R1 + R2) * N + R3$$

(7) The revenue function

6.5 The break-even point

The break-even point introduces the place of the equilibrium between costs and revenues, i.e.:

$$TR = TC$$

or

$$(R1 + R2) * N + R3 = (F1 + F2 + F3 + F4) + (V1 + V2 + V3 + V4 + V5 + V6 + V7) * N$$

(8) The Break-event function

This is the general equation (6) of the break-even point. It arises from precondition that the whole study is a distance study and there are no personal sessions. If there are any tutorials or certificate ceremony present in a course, the appropriate costs must be included to the function.

$$(R1 + R2) * N + R3 = (F1 + F2 + F3 + F5 + F6 + F7) + (Fs1 + Fs2 + Fs3) + v * (V1 + V2 + V3 + V4 + V5 + V6 + V7)/ * N$$

(9) The Break-event function with tutorial and diploma

The function no. 9 contains tutorials during the term, summer school and certificate ceremony. Other items of the educational organization can be included.

The break-even point depends not only on costs but also on the amount of determined fees for a course, that is for example in the case of a low fee, 120 students at least have to be in the course, but in the case of a high fee, e.g. only 25 students are necessary. Another dependency of the break-even point is that each course is subject to different costs (e.g. craft, artistic, music courses etc require a small number of students in the group and will be thus subject to higher costs).

Also competition in the market has been constantly growing, which is reflected in the resulting price of the course.

No less important is the image of the educational institution/university. Guarantee of a high-quality education at a prestigious educational institution will also have an impact on the price of the course.

It is further also necessary to determine a minimum number of students, on which will depend whether the course will be realized. This number will differ according to the type of the educational institution and also according to the range of its offer.

7   The UHK Current Data

The University of Hradec Kralove (UHK), Faculty of Informatics and Management (FIM) made the cost comparison of the ECDL course and the results [8] were as follows (see the Table 2 and the Fig. 6):

According to this graph, the distance course is profitable, if it has 115 and more participants.

Proceeding from our own experience, we can confirm this number. Currently we are running two projects on virtual university: RIUS and EVENE. Both of them required immense starting costs on preparation of courses. International researches mention the number of 300 students as a minimum.

When preparing simple courses, e.g. consisting of one module only, the level of costs is mainly given by:

- The text study materials (design, print, authors royalty),
- An e-learning course in a virtual learning environment,
- The virtual learning environment user license,
- Tutor's and administrator's salary,
- Rental service costs paid for tutorial rooms,

- indirect expenses and
- VAT.

These distance courses were profitable, if they had 115 and more participants. Separation of fixed and variable costs could be one of the reasons. Fixed costs prevail in virtual courses (except for the tutor's salary, but it could be considered fixed as well because the tutor has a contract for a determinate period and the salary varies according to the number of course participants.) Another difference is the immense starting costs in virtual courses. But they are very slowly increasing with the growing number of participants. In present courses, the starting costs are not so high, but increase considerably with the growing number of students. The Figure 5 displays the comparison at FIM UHK.

International research in this field [1], [2], [16], [17] etc. shows the total number of 300 students in courses to be effective. This number is influenced by the level of the course demanding ness, i.e. how demanding and sophisticated the preparation was.

8   The Process of Modelling of the Break-Even Point

The above mentioned analyses show that finding the break-even point (point of equality of costs and profits) is a question with many variables.

a) various kinds of costs
b) various types of costs (fixed, variable)
c) various types of courses
d) various lengths of duration of courses.

In practice, we could hardly find two identical courses at universities at this moment, which could be placed into the same group and for which the same figures would apply. Nevertheless, there is still a need (which has been increasing continuously in my opinion) to identify costs and profits of an e-learning course as precisely as possible, before the realization of the course is initiated (in fact, it is a certain form of a business plan, whether to initiate the realization of the course or whether to cancel it already in the phase of preparation).

Currently there is a new trend, that an increasing number of universities have been buying already prepared courses from prestigious educational institutions. As regards these courses, it is then much easier to express the amount of their costs.

I consider the above mentioned equations as a starting point for construction of an "interactive" model, that could be – after certain "user

modifications" - applied in the general environment of traditional educational centers.

As for me, user modifications mean the possibility to enter, before the calculation of the break-even point, a group of data into the model that describe costs of the immediate environment of the course such as e.g.:

a) administrative requirements
b) physical spaces
c) technical background
d) requirements of tutors and people directly or indirectly participating in the education (salary costs).

In my opinion, interactivity is a certain guide (some software program), that would ask in steps (or by one-time filling-in of a table) about basic variable facts related to the course that is being calculated.

This model would presuppose a certain database of realized e-learning courses (of course with their exact classification into the above mentioned groups) and on the basis of answers, it would evaluate the financial requirements and it would recommend the amount of "tuition" for the given course.

Another possible element of this questioning would be searching for the most similar courses and enabling contact with parent educational centers that realized these courses to share their experiences, so that we can avoid problems and become aware of what can be done better in the case of the given type of the course.

This all would lead to a relatively exact determination of financial requirements of the course and thus of the corresponding needs of financial resources.

The main objective of such an interactive model is to increase markedly the effectively of the financial resources expended on the distance education and to achieve such a state, when a maximum of collected resources would be invested into an effective functioning of the educational system and a minimum of resources would be expended on the bureaucratic machinery, that represents an "unnecessary evil". An increasingly higher number of educational courses have been appearing that, after the end of the subsidy program, "suddenly loose" their financial benefit for the educational institution (the course is loss-making after the end of the subsidy period) and represents a financial burden in the form of negative effectively for the institution. Correct setting of the costs and profit side of the course already in its beginnings is

a necessary KEY factor for a long-term effective functioning of the distance education.

9 Conclusions

Having found the break-even point, the number of students is set to create and run a profitable course. The effectiveness of any course can be calculated and compared by using this simple method.

Granted finances were not taken into account in the example, but they are often the principal starting point which enables the work.

The contribution shows that any profitable and effective distance module requires great numbers of participants, according to foreign researches: at least 300 students to cover the costs (including fees and payments for printed and multimedia study materials). Correct and general information on the provided possibilities is essential for the system approach to virtual university development.

An advantage of distance courses, in contrast with the classic courses, is the fact that average variable costs, but above all average fixed costs, are decreasing in the long term. With increase in the number of participants of the course, inputs such as the number of teachers do not have to be increased in the long term: it is not necessary to rent new classrooms, it is not necessary to print other materials. All materials are created in an e-learning course that can be easily updated and students can print current information as needed.

The division of costs and their amount differ in various institutions. It is not possible to create and present a static division but a dynamic model which could be adjusted to the conditions of an institution.

Working in a virtual learning environment brings advantages to universities, e.g. decreasing costs on operation, traveling expenses, accommodation, effective training, continuous updating, etc.

Even though the distance and virtual study is running in some large and rich states (Great Britain, France, Germany, Ireland), it is financially demanding and cannot work without considerable state grants and support. The cost calculations cover author's remuneration, salaries, distribution costs, rental service costs, etc. Starting costs which may include establishing (building) administrative and study centers, preparing LMS, are very high. That is the reason why the virtual study is supported from several sources (foreign supportive programmers, tuition, production of teaching aids for other customers, selling the study materials, etc.) [1], [16].

10 Appendices

Number of participants	Distance course	Traditional course
20	483 750 CZK	137 500 CZK
40	547 500 CZK	275 000 CZK
60	611 250 CZK	412 500 CZK
80	675 000 CZK	550 000 CZK
100	738 750 CZK	687 500 CZK
120	802 500 CZK	825 000 CZK
140	866 250 CZK	962 500 CZK
160	930 000 CZK	1 100 000 CZK
180	993 750 CZK	1 237 500 CZK
200	1 057 500 CZK	1 375 000 CZK

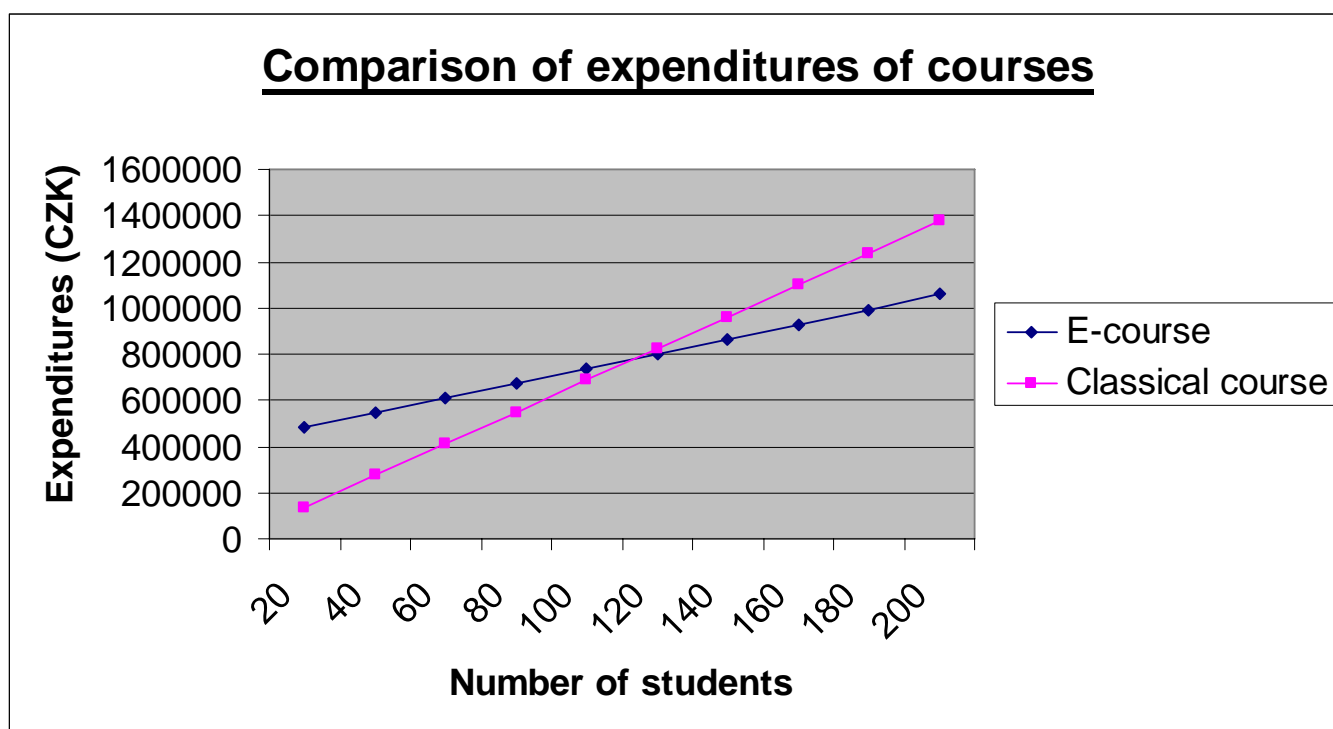Table 2 Both types of courses - Total costs
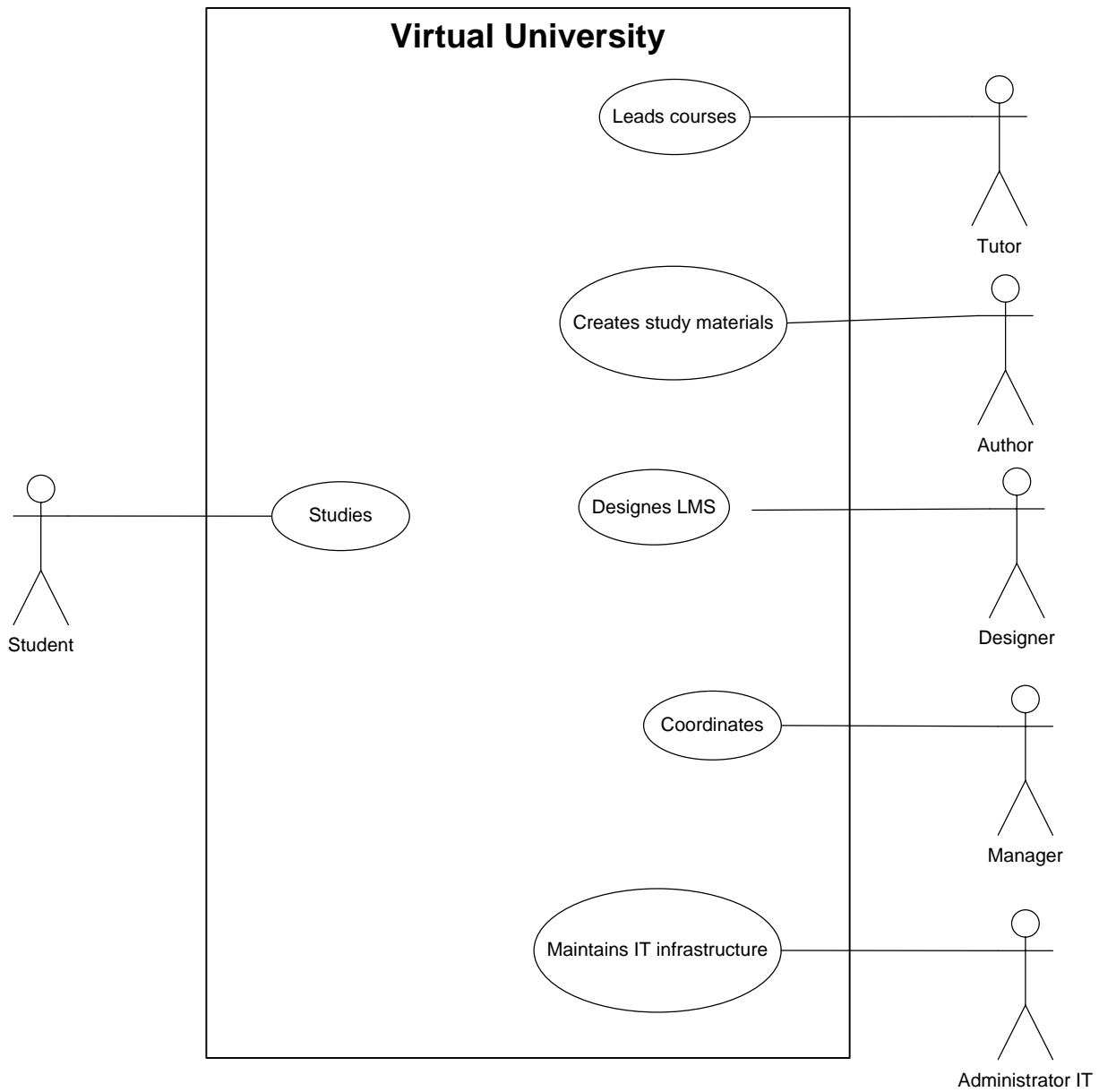

Fig. 6: Comparison of costs

Fig. 7: Roles of VU

Fig. 8 Student role in the system of VU

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