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MODEL OF THE MANAGEMENT
OF THE BUDGETING AND CONTROLLING PROCESS
IN THE ORGANIZATIONAL ENTITIES
OF ACADEMIC INSTITUTIONS

Abstract

In this article, the tendencies of the development of financing and functioning of academic institutions on the present-day educational market are presented. The required changes are characterized in the way finances are managed with a particular consideration of public academic institutions. Proposals are provided in relation to the determination of standard revenues of the organizational entities of academic institutions, analysis methods of the costs of the functioning of these entities and the budgeting of their operation. Prospects are presented of the development of the controlling of the realization of the budgets of the organizational entities of academic institutions.

1. INTRODUCTION

The national higher education system is entering a new stage of its functioning. A growing competition between academic institutions, progressing changes in the rules of financing of academic institutions, the numbers of students recruited which are to decrease in the coming future, increasing investment demands, growing numbers of unemployed graduates, increasing demands on the part of the economy concerning the quality of teaching and related to the skills possessed by graduates: all of these force changes in the management of academic institutions. Running of academic institutions, regardless of the social functions they perform, is becoming increasingly more similar to managing of an enterprise. The financing systems of academic institutions are changing: their community functions, in line with the tendency which is occurring at present, is being taken over by grants and other financing sources obtained; cf. Figs. 1, 2 and 3.

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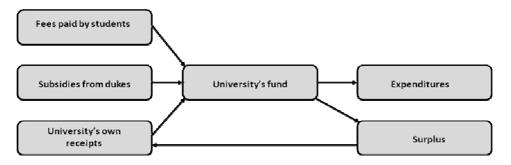
Fig. 1. Diagram of the flow of finances at a medieval university
Source: Author's own studies

2. PURPOSE AND SCOPE OF THE STUDY

The basis for decision making in management processes is formed by the knowledge of standard revenues, the real functioning costs, the ability to determine the budgets of individual organizational units, pursuing an adequate staff policy as well as the accuracy of the forecasting of future events in the manner of the university financing, on the labor market, the development of the competition.
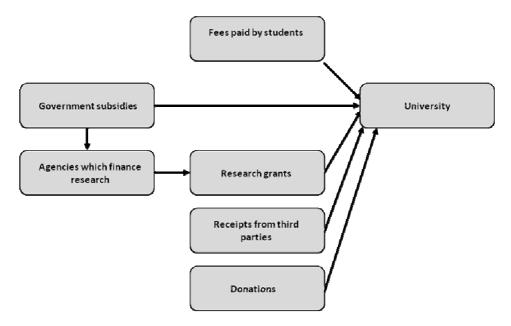

Fig. 2. Diagram of the flow of funds at present-day universities
Source: Author's own studies

Management of the university's finances is reflected in the efficiency of the use of financial streams, also in the structure of capitals. It has a huge influence on the possibility of the

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development and investing in the university's assets, which constitute the basis for scientific and didactic activities. Decisions concerning the direction of the flow of financial streams are taken under a current internal analysis; they make it possible to determine the strengths and weaknesses of the organization. Tools in the form of analysis indices which correspond to the specificity of the functioning of an academic institution allow one to measure efficiency.
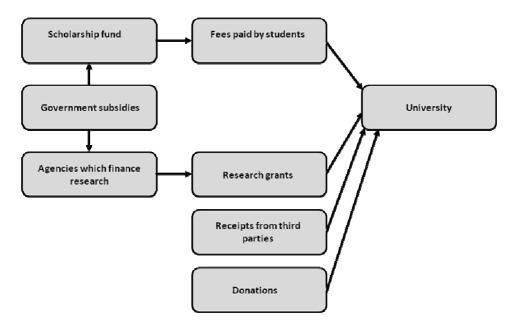

Fig. 3. Diagram of the flow of funds at third generation universities
Source: Author's own studies

Current monitoring serves the purpose of an assessment of the financial situation and makes it possible to address unfavorable internal economic phenomena, i.e. the efficiency of the use of financial streams. Monitoring of changes on the market of didactic services makes it possible to compete with competitors and to meet the requirements and preferences of customers.

The purpose of the present study is:
– to develop the data required to determine the management model at a university; this model will guarantee the achievement of the objective and the realization of the university's strategy with specific conditions being met;
– to develop a budgeting model which determines the distribution of funds and the way in which these are disbursed;
– to develop a control method of the realization of financial values and its cohesion with strategic objectives.

The chief effect of the model developed is such an academic institution management system which permits an effective use of the property resources and the financial resources of an academic institution. It also allows a coordination of the activities of all units and enables an achievement of the strategic objective.

Theses of the study:

The budgeting and controlling model of the organizational entities of an academic institution based on the determination of the standard functioning cost of the organizational entities of an academic institution in combination with the motivating system of the effectiveness of their functioning and the development strategy of an academic institution form the basis for the management of the present-day academic institution:

- financing through revenues,
- a smaller contribution of permanent co-financing,
- a greater staff level factor,
- knowledge of the effects of the operation of teams that are smaller than a faculty.

3. STANDARD REVENUES OF THE ORGANIZATIONAL ENTITIES OF AN ACADEMIC INSTITUTION

3.1. Notion of standard revenues of organizational entities

The algorithms of the allocation of funds, which are at the disposal of an academic institution to its organizational entities, form the basis for the determination of the standard revenues of the organizational entities of an academic institution. The problem is to determine the real revenues of these entities; these revenues constitute their contribution to the total budget of an academic institution. Standard revenues are understood to be revenues related to didactics, subsidies from the government budget, fees paid by students, receipts from research work and other services to production and service enterprises, local government institutions etc. This is also funds obtained by organizational entities e.g. from cooperation with the economy, through an execution of scientific and research projects by them etc.

3.2. Algorithm of the determination of standard revenues

A complex organizational structure of an academic institution, the development prospects of an academic institution, the staff development, establishing new fields of study, functioning within the framework of an academic institution of various didactic teams and research teams with various operating costs: all of these result in a requirement to introduce algorithms of a division of funds for the construction of budget and financial controlling of the operation of the individual organizational units of an academic institution[2]. These algorithms, with a growing pressure on an economization of the operation of an academic institution, are constantly being improved and their development has not been completed as of this day. These algorithms are characterized by an increasing accuracy of calculations, determination of funds found and budgeting of increasingly smaller organizational entities of an academic institution: chairs, independent departments etc.

The model proposed to cover the needs of decision making at an academic institution permits a determination of the real costs of the functioning of an organizational entity (1).

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[2] MATUSZEK J., JUCHA M.: *Koszty kształcenia studentów na przykładzie kierunku studiów Zarządzanie i Inżynieria Produkcji, Komputerowo zintegrowane zarządzanie*, Tom II, Opole 2011, s. 98-107

$$Fj = Fk_j + Fs_j = Fk_j + \sum_K ((F_{SBKj} + F_{SCKj}) * \frac{IG_{Kj}}{IG_K}) \qquad (1)$$

where:

F_{SBkj} – funds allocated to "j" unit from government budget for students attending classes organized by it and who study on "kth" field of studies,

F_{SCkj} – funds allocated to "j" unit from fees paid by those students who attend the classes organized by it and who study on "kth" field of studies

KS – field of studies,

IG_{kjp} – number of hours related to given classes taking into consideration cost consumption index "p" of classes run by "jth" organizational entity on "kth" field of studies,

IGk – number of hours of classes on the field conducted by an academic institution on "kth" field of studies, whereas:

Fj – funds allocated to "j" entity, for j = 1, …J,

Fkj – funds allocated to "j" entity for the staff of this entity,

Fsj – funds allocated to "j" entity for those students who attend the classes conducted by it.

With this settlement of finances in relation to chairs, the funds allocated correspond to the real functioning costs of chairs. The abovementioned costs need to constitute the basis for making strategic decisions of an academic institution and a department; they should form the grounds for the budgeting of the organizational entities of a department. The heads of the entities are forced to economize (the more there are hours conducted on a field of studies in those units that conduct this field, the smaller amounts of funds are allocated to them).

4. CALCULATION OF TEACHING COSTS

4.1. Modeling of teaching costs

In order to introduce actions concerning the functioning of an academic institution both in the area of costs and incomes, the university authorities need to possess fast and properly computed initial calculation so that the effects of the decisions taken could be determined.

An academic institution, while preparing to open a new field of studies, before it takes a decision, needs to collect information concerning the following:

- any additional costs to be borne by an academic institution,
- the values to be reached by the costs during the first year,
- what costs will burden the budget of the academic institution in the years to come.

Obtaining of this information with the currently used account of costs based on historic data does not permit a calculation of future costs. This requires a lot of work and time, which is also a cost value: "time is money".

A solution was proposed based on the results of an analysis of the structure of costs by type which was conducted on the basis of reporting data from several academic institutions[3]. The results of this analysis demonstrate that the most important cost which is borne by academic institutions is personnel costs as they constitute over 70 per cent of the total costs. If we accurately assess the personnel costs, the remaining value can be added on the basis of a cost margin.

For the purpose of a calculation of personnel costs, the data is required concerning those parameters which have an impact on them. When analyzing personnel costs, it was established that the head of an entity, prior to making a decision concerning opening of a new field of studies, needs to be familiar with those analytical values which have an influence on the calculation of the final cost; these are the following:

- number of lecture groups,
- number of class groups,
- number of laboratory groups,
- staffing,
- rates of remuneration for those who are employed to operate the field of studies.

The authorities of an academic institution need to know the value of the costs; they also need to know what profits can be expected in relation to the subsidy obtained and fees for studies in connection with the opening of a specific field of studies. Owing to this information, it can be established what the consequences of the decisions will be. If a loss is the result of specific activities, it needs to be assessed over what period it will maintain; if the result is a profit, then its value needs to be determined.

In order to obtain complete information in this scope, the account of teaching costs makes it possible to capture the full teaching cost over the financial year.

In order to find a cost structure which will provide an answer to the question: how much does one student cost over a year?, it is necessary to establish and to analyze several managerial factors which are required to take a decision, such as the following:

- what product (e.g. a new field of studies),
- data concerning the demand in the scope of dynamics,
- qualitative limitations (fashion, demand on the labor market for concrete specialists, easy and comfortable studying),
- the picture of the situation on the market.

One needs to pay attention to the fact that in the case of determining fees for educational services, costs are not the only value that limit their amount. An example is fees for legal, medical and psychology studies. The price for the abovementioned field of studies depends from the demand, while the price for extramural studies is not a factor which discourages future students. An example where the price for the studies constitutes the main condition concerning undertaking of studies is technical studies, which require a huge amount of work on the part of future students during the studies; technical studies are much more difficult concerning the subjects; yet another factor is skills which are tested during laboratory classes on technical studies.

A decision taken by the university authorities concerning the possibility to undertake actions aimed at starting such a field of studies needs to depend above all from the scientific

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[3] KOPCZEWSKI M., JUCHA M.: *Analiza kosztów kształcenia w procesie podejmowania decyzji w szkołach wyższych, Uwarunkowania zastosowań e-biznesu w gospodarce,* Wyższa Szkoła Ekonomiczno-Informatyczna, Warszawa, 2008

personnel, secondly from the laboratories and their equipment, and thirdly from the costs that need to be borne in order to obtain a good quality of teaching.

Taking into account the abovementioned quantitative parameters (e.g. the number of hours, the hourly rate) and qualitative parameters (the level of teaching), it is to be stated that the teaching costs are not the only factor on which decisions taken at an academic institution are based. The cost values that need to be calculated and the qualitative factors give a complete value of didactic services.

A numerical example will be presented below, which demonstrates the significance of the calculation of the basic decision factor, i.e. the cost of remuneration.

4.2. Estimation of teaching costs

The purpose of an estimation of teaching costs is to determine which costs need to be taken into account when planning to open a new field of studies. In item 4.1, those costs were described which have a substantial impact on decisions related to planning a new field of studies. The components of personnel costs related to conducting didactic classes on a field of studies are comprised of data concerning the following:

- number of didactic hours,
- types of didactic classes,
- the hourly rates of those persons who conduct didactic classes.

The abovementioned data constitutes the elements of the dependence[4] which calculates the costs of conducting a subject. The component of the cost of conducting a subject includes the personal cost, which can be calculated on the basis of (2):

$$Ko = \left[(Lh_w \cdot Gr_w \cdot A_w) + (Lh_c \cdot Gr_c \cdot A_c) + (Lh_p \cdot Gr_p \cdot A_p) + (Lh_l \cdot Gr_l \cdot A_l) \right] \cdot N$$

(2)

where:

Ko – the personal cost of the subject,

Lh_w – the number of lecture hours for the subject,

Lh_c – the number of class hours for the subject,

Lh_l – the number of laboratory hours for the subject,

Lh_p – the number of project hours for the subject,

Gr_w – the number of lecture groups,

Gr_c – the number of class groups,

Gr_l – the number of laboratory groups,

Gr_p – the number of project groups,

A_w, A_c, A_l, A_p – an hourly rate for the teacher who conducts: lectures, classes, laboratories, projects,

N – the value which increases the costs of remuneration (benefits to employees 30%), a constant of 1.3.

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[4] KOPCZEWSKI M., JUCHA M.: *Analiza kosztów kształcenia w procesie podejmowania decyzji w szkołach wyższych, Uwarunkowania zastosowań e-biznesu w gospodarce,* Wyższa Szkoła Ekonomiczno-Informatyczna, Warszawa, 2008, str. 118

The personal costs obtained from Dependence (2) is a component of the cost of conducting a subject (3):

$$K_{pp} = K_o + (K_o \cdot C),$$ (3)

where:

K_{pp} – the cost of conducting a subject,

K_o – personal cost (gross remuneration + margins),

C – proportion of personal costs to total costs 2/8 (costs of maintaining rooms, laboratories: energy, materials, external services, depreciation, equipment).

On the basis of Dependence (3), the cost of conducting a subject is calculated by accepting an estimate number of didactic hours. At the same time, the data concerning remuneration rates is calculated on the basis of remuneration tables of those employees who are academic teachers, as specified in the Regulation issued by the Minister of Science and Higher Education concerning the conditions of remuneration for work and granting of other benefits in relation to work to employees hired by public academic institutions, dated 22 Dec. 2006, Journal of Laws No. 251, Item 1852 from the year 2006. The results obtained from Dependence (3) are presented in Table 1 on the example of a subject which is conducted in the "Information Science" field of studies by the Faculty of Electronics and Information Science at the Koszalin University of Technology. This subject is conducted for 44 hours. The following persons are involved in conducting the subject: one professor who delivers lectures and an assistant who conducts classes. The didactic hours are divided into two types of didactic classes in the form of 22 hours of lectures and 22 hours of classes. It was accepted for the purpose of calculations that the cost of the monthly gross remuneration of the professor is approximately PLN 5,000 and PLN 2,800 of the assistant. The remuneration multiplied by 12 months and divided by the teaching load gives the hourly rate of conducting the didactic classes. The teaching load is the number of didactic hours conducted by an academic teacher during an academic year, which corresponds to the position in the university. For example, 240 hours of the teaching load are accepted for the professor to calculate the rate, and 240 hours of the teaching load for the assistant to calculate the rate; the result was multiplied by the number of the didactic hours and further increased by 30 per cent. This increase is related to margins for remuneration which constitute those costs which must be borne by an employer to hire employees. These are social insurance premiums, the employee benefit fund and the reward fund.

The example given above demonstrates dependences between the remuneration cost and the data required for its calculation; it demonstrates the possibility to calculate the total costs of conducting a subject. In order to calculate the cost of conducting a field of studies, the subjects included in the curriculum need to be put together; further, the number of hours, the forms of conducting of classes and the number of student groups need to be established. When possessing these values, the employees need to be assigned to each subject; then, on the basis of the contract concluded with each of them, we can determine the rate for one hour of classes conducted.

Tab. 1. Components of the calculation of the costs of conducting a subject related to opening a new field of studies

Subject	Number of hours	Form of conducting of classes	Number of groups Grw/Grc	Lecturer's position	Rate for didactic hour Aw/Ac	Costs of remuneration	Personal costs Kow/Koc	Cost of conducting of subject Kpp
Analog technique–signals and systems	44	22 lectures	1	professor	PLN 250	5 500	7 150	**28 958**
		22 classes	4	assistant	PLN 140	12 320	16 016	

Source: Author's own study

The cost of conducting a field of studies is the sum of the costs of the realization of the subjects which are foreseen to be conducted in the teaching standards, which are obtained from the following dependence:

$$Kpk = (Kpp_1 + Kpp_2 + Kpp_3 + \cdots + Kpp_i), \qquad (4)$$

where:

Kpk – the cost of conducting of a field of studies,

Kpp_i – the cost of conducting of ith subject.

What cost will be borne by an academic institution when introducing an exemplary subject?

The calculation results obtained with the use of the model provide answers to this and other questions above. They enable those who manage an academic institution to take a decision concerning those fields of studies which are being opened or closed.

Prior to taking a decision concerning opening of a new field of studies or concerning a continuation of an existing one, it is to be remembered that over 70 per cent of the teaching cost of a student is remuneration and margins.

One also needs to bear it in mind that it is not only numerical data concerning costs which is required to make managerial decisions. Several non-measurable factors need to be considered. First of all, one needs to determine what product is of an interest to them: e.g. a new field of studies; data concerning the demand needs to be collected; a long-term forecast of the demand for a given field of studies needs to be provided, it is to be determined how this demand will be changing in time.

The authorities of an academic institution need to remember that the cost is a certain consequence of taking decisions concerning the fields of studies. For this reason, fast information concerning its amount will offer a possibility to secure a source to cover this expense.

The precise data used in the example do not allow one to determine the teaching costs in a situation when we deal with a plan. This plan does not include answers to those questions which are asked at universities:

- What will be the intake of students? – this is the basis for the planning of finances in didactic activities in compliance with the dependence as accepted in the example.

- How many student groups will there be?
- How many didactic hours will there be?

The lack of information concerning the number of students accepted forces an estimate; hence, it is necessary to develop a model which takes into account the imprecise nature of information. Approximate values need to be accepted in planning as it will never be possible to foresee an exact number of students accepted, which determines answers to the questions as to how many groups and how many hours.

For this reason, the model proposed of the calculation of the teaching costs includes an element of uncertainty in the form of fuzzy numbers.

The cost calculation model based on fuzzy numbers has allowed the gap to be filled concerning the lack of strategic information. For this reason, the proposal for academic institutions in the form of a model of the costs account addresses the needs of managers. This is a model which offers the possibility to provide answers to questions related to the cost of the subject, the field of study, the entity and the entire academic institution concerning the teaching of students and graduates. It facilitates forecasting with the aid of imprecise data and permits an introduction of historic (precise) data, owing to which the plan can be reviewed with respect to its execution. Any aberrations occurring serve as an indication and make it possible to make input data more precise as the imprecision level of input data determines the imprecision of output data.

4.3. Estimation of teaching costs based on fuzzy numbers: an example

The purpose of this example is an illustration of the determination of the total cost of conducting of a subject on the basis of the model proposed. The determination of the cost is related to the subject of Economic Sciences.

Table 2 contains those components which are used to determine costs. The manner of the determination of the cost of conducting a subject Kpp is specified in the internal regulations of the academic institution. The following factors: the number of groups, the hourly rate of work, the number of hours etc. have an influence on the value of the cost. Value Kpp in Table 2 was determined on the basis of precise data. It was assumed that the number of groups formed in the new academic year is 1 for lecture groups and 4 for class groups.

Tab. 2. Components of the calculation of the costs of conducting of a subject in relation to opening of a new field of studies

Subject	Number of hours	Form of conducting of classes **Lhw/Lhć**	Number of groups $\dfrac{Gr_w}{Gr_c}$	Lecturer's position	Rate for didactic hour **Aw/Ać**	Costs of remuneration	Personal costs Ko	Costs of conducting of subject Kpp
Economic Sciences	70	45 lectures	1	Professor Assistant	300 zł 120 zł	13500	17 550	**47 357**
		25 classes	4			12000	15 600	

Source: Author's own study

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Concerning this approach, there arises the following question: *what costs are related with conducting of the subject in the case when part of the data is of an imprecise nature?* For example, the number of lecture and class groups is determined with fuzzy numbers. To provide an answer to this question, the model MK (1) proposed was used.

In the model, the following set was accepted of fuzzy decision variables $\hat{V}$:

$$\hat{V} = \{\widehat{Ko}_w, \widehat{Ko}_c, \widehat{Ko}, \widehat{Kpp}, \widehat{Lh}_w, \widehat{Lh}_c, \widehat{Gr}_w, \widehat{Gr}_c, \hat{A}_w, \hat{A}_c, \hat{C}_1, \hat{C}_2, \hat{N}_{w1}, \hat{N}_{w2}\}, \tag{5}$$

where:

$\widehat{Ko}_w$ – the personal cost of lectures,

$\widehat{Ko}_c$ – the personal cost of classes,

$\widehat{Ko}$ – the personal cost of conducting of the subject,

$\widehat{Kpp}$ – the cost of conducting of the subject,,

$\widehat{Lh}_w$ – the number of lecture hours for the subject,

$\widehat{Lh}_c$ – the number of class hours for the subject,

$\widehat{Gr}_c$ – foreseen number of class groups,

$\widehat{Gr}_w$ – foreseen number of lecture groups of the representation of fuzzy numbers,

$\hat{A}_w$ – the hourly rate of the teacher in charge of the lectures,

$\hat{A}_c$ – the hourly rate of the teacher in charge of the classes,

$\hat{C}_1, \hat{C}_2$ – constant proportionalities of personal costs to total costs,

$\hat{N}_{w1}, \hat{N}_{w2}$ – the value which increases the costs of remuneration.

Variables $\hat{V}$ represent costs and the components required for their calculations. The relations which describe how the values of costs depend from specific parameters are formulated in the form of relationship $\hat{R}_{LR}$:

$$\hat{R}_{LR} = \{\hat{R}_{LR,1}, \hat{R}_{LR,2}, \hat{R}_{LR,3}, \hat{R}_{LR,4}\}, \tag{6}$$

where the individual relations in compliance with [4] take the following form:

$$\hat{R}_{LR,1}: \quad \widehat{Kpp} \cdot \hat{C}_2 = \widehat{Ko} \cdot \hat{C}_1 \tag{7}$$

$$\hat{R}_{LR,2}: \quad \widehat{Ko} = \widehat{Ko}_w + \widehat{Ko}_c \tag{8}$$

$$\hat{R}_{LR,3}: \quad \widehat{Ko}_c \cdot \hat{N}_{w1} = \widehat{Lh}_c \cdot \widehat{Gr}_c \cdot \hat{A}_c \cdot \hat{N}_{w2} \tag{9}$$

$$\hat{R}_{LR,4}: \quad \widehat{Ko}_w \cdot \hat{N}_{w1} = \widehat{Lh}_w \cdot \widehat{Gr}_w \cdot \hat{A}_w \cdot \hat{N}_{w2} \tag{10}$$

The variables of costs, i.e. $\widehat{Ko}_w, \widehat{Ko}_c, \widehat{Ko},$ form a set of input variables $\hat{U}$ whereas the remaining variables $\widehat{Lh}_w, \widehat{Lh}_c, \widehat{Gr}_w, \widehat{Gr}_c, \hat{A}_w, \hat{A}_c, \hat{C}_1, \hat{C}_2, \hat{N}_{w1}, \hat{N}_{w2}$ form output variables $\hat{V}$.

For output variables, relations $\hat{R}_{LR\hat{Y}}$ are known which assign their values to the variables:

$$\hat{R}_{LR\hat{Y}1}: \ \widetilde{Gr}_w = (2,2,2,0)_{LR} \tag{11}$$

$$\hat{R}_{LR\hat{Y}2}: \ \widetilde{Gr}_c = (8,8,2,3)_{LR} \tag{12}$$

$$\hat{R}_{LR\hat{Y}3}: \overline{Lh}_c = (25,25,0,0)_{LR} \tag{13}$$

$$\hat{R}_{LR\hat{Y}4}: \overline{Lh}_w = (45,45,0,0)_{LR} \tag{14}$$

$$\hat{R}_{LR\hat{Y}5}: \hat{A}_w = (300,300,0,0)_{LR} \tag{15}$$

$$\hat{R}_{LR\hat{Y}6}: \hat{A}_c = (120,120,0,0)_{LR} \tag{16}$$

$$\hat{R}_{LR\hat{Y}7}: \hat{N}_{w1} = (13,13,0,0)_{LR} \tag{17}$$

$$\hat{R}_{LR\hat{Y}8}: \hat{N}_{w2} = (10,10,0,0)_{LR} \tag{18}$$

$$\hat{R}_{LR\hat{Y}9}: \hat{C}_1 = (10,10,0,0)_{LR} \tag{19}$$

$$\hat{R}_{LR\hat{Y}10}: \hat{C}_2 = (7,7,0,0)_{LR} \tag{20}$$

All the variables apart from $\widetilde{Gr}_w$ and $\widetilde{Gr}_c$, accept precise data represented in the form of singletones.

It is to be noted that those relations which occur both in set $\hat{R}_{LR}$ and in $\hat{R}_{LR\hat{Y}}$ accept the form of "equivalent" relations, whose degree of fulfillment $\hat{\mu}_i$ is defined (19). It was accepted that the degree for each relation $\hat{R}_{LR}$ and $\hat{R}_{LR\hat{Y}}$ is 1 (S, $\hat{S}_{\hat{Y}} = 1$).

In the context of the model defined in this manner, the question concerning the cost of conducting of the subject of Economic Sciences is as follows:

Are there such values of variables $\widetilde{U}$ (the values of costs), for which relations included in set $\hat{R}_{LR}$ and relations from set $\hat{R}_{LR\hat{Y}}$ will certainly be fulfilled (degree S, $\hat{S}_{\hat{Y}} = 1$)?

The problem under consideration was brought down to the problems of the fulfillment of limitations PS , and it was solved with the use of techniques of programming with limitations. The set of solutions obtained contained only one permissible solutions. The costs of conducting of the subject are as follows:

$$\widetilde{Ko}_c = (31200,31200,7800,11700)_{LR} \tag{21}$$

$$\widetilde{Ko}_w = (35100,35100,17550,0)_{LR} \tag{22}$$

$$\widetilde{Ko} = (66300,66300,23350,29350)_{LR} \tag{23}$$

$$\widetilde{Kpp} = (95285,95285,33357,41928)_{LR} \tag{24}$$

The values of the costs obtained are presented in Fig. 4.

With the size of the number of lecture groups $\widetilde{Gr}_w$ "*being not greater than 2*" and of class groups $\widetilde{Gr}_c$ "*being ca. 8*", the cost of conducting the subject ($\widetilde{Kpp}$) is between 61928 and 137213. The middle value of number $\widetilde{Kpp}$ is 95285. This means that we are certain that on level 1 we will obtain the cost on this level. We have a zero level of certainty that the cost will

reach the value of 61928 or 137213. For this reason, the level of the costs of conducting the subject is "*ca. 95285*".

The determination of the costs of conducting the subject on the basis of fuzzy numbers makes it possible to determine the range of those costs which are possible to be obtained with those data whose value is not certain and is difficult to assess with hundred percent certainty. In general, each component of cost $\widetilde{Kpp}$ may be a fuzzy number in a specific space of consideration with the level of certainty being assigned. In this manner, based on the older years, one can determine the number of students on the basis of the teaching efficiency on the individual years of studies.
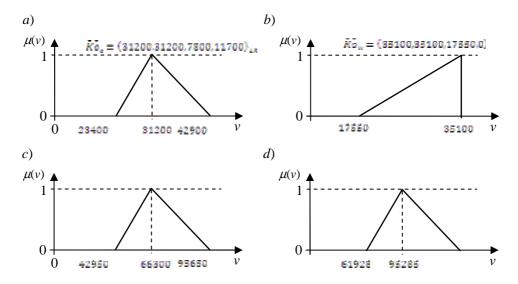

Fig. 4. Costs of conducting a subject: a) personal costs of classes, b) personal costs of lectures, c) personal costs of conducting a subject, d) total costs of conducting a subject
Source: Author's own studies

5. BUDGETING OF ORGANIZATIONAL ENTITIES OF AN ACADEMIC INSTITUTION

The real revenue of the organizational entities of an academic institution forms the basis for the determination of standard revenues of these entities. The basis for the budgeting of these entities is formed by the determination of the real costs of their functioning, conducting an analysis of these costs, a formulation of actions aimed at their reduction and further the determination of their budgets. The field marked on UAR may have for example three values, where:

U – standard revenue,
V – budget assigned,
R – real costs borne.

Having the revenues estimated in accordance with the model accepted and having the costs assessed, we build the budget of the organizational entity and of the entire academic institution.

However, we face the problem which concerns not only the lack of balancing of the budget but also the question as to whether those entities which are balanced are to cover the costs of other entities with worse financial results. Perhaps a good solution is to liquidate such entities regardless of the effect? What decision is to be taken? An answer to this question will be provided in the further chapter concerning provision of variants related to decision making.

6. SELECTED PROBLEMS OF MANAGING AN ACADEMIC INSTITUTION

Management of an academic institution involves a selection of an optimal variant which yields the best effects possible in the form of an economic account, yet this is not all. Those who manage an academic institution are also directed by the strategy of operation. The number of candidates in a given field of studies has the greatest impact on the effects of operations in the didactic area. The number of students in a given field of studies and the teaching efficiency constitute important elements, as well; cf. Fig. 8.

We need to verify what conditions have an influence on the selection of specific fields of studies. The first factor which has an influence of the candidate choosing a given field of studies is an academic institution. Those academic institutions are selected which enjoy a high renown in the state, i.e. large academic centers with many years of tradition and a high scientific and didactic position. The second criterion is the competiveness of an academic institution, which is manifested in its scientific potential and the didactic offer. The labor market is yet another factor. This means that there is a possibility for graduates to get good jobs concerning earnings and professional satisfaction. Future candidates look at how well the graduates of a given academic institution are doing, as this provides an image of the teaching quality and an estimation of the usefulness of the knowledge and skills on the labor market.
The environment is yet another important factor, which on many occasions has an influence on undertaking studies on a given field. This decision is influenced by parents, fashion, and very frequently the fact that a friend has chosen the same field of studies, cf. Fig. 9.
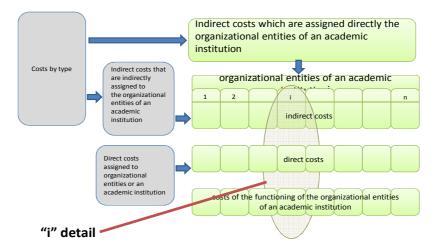

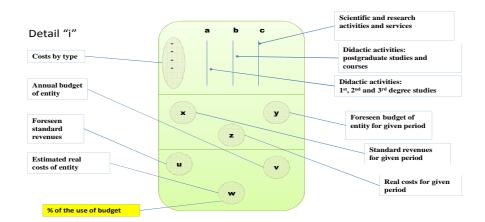Fig. 5. Accounting sheet of an academic institution

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Detail "i"

Costs by type

Annual budget of entity

Foreseen standard revenues

Estimated real costs of entity

% of the use of budget

a   b   c

Scientific and research activities and services

Didactic activities: postgraduate studies and courses

Didactic activities: 1st, 2nd and 3rd degree studies

x   y

z

Foreseen budget of entity for given period

Standard revenues for given period

u   v

Real costs for given period

w

Fig. 6. "i" detail from the accounting sheet of an academic institution, those parameters that determine the financial conditions of an organizational entity of an academic institution (places of the generation of costs)
Source: Author's own studies

Two basic factors: the number of candidates to studies and the teaching efficiency have an influence on the number of those studying in a given academic institution. If the number of candidates to studies in relation to a given field of studies is decreasing and the number of students is also dropping, this means that such a field of studies will have to be eventually closed.
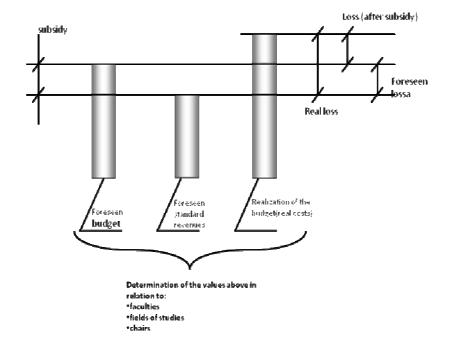
Fig. 7. Principle of budgeting of organizational entities of faculty
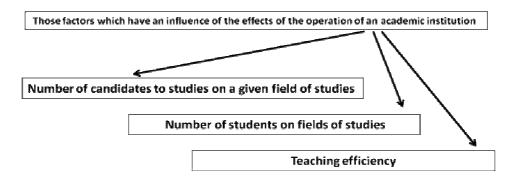*Source: Author's own studies*

Fig. 8. Those factors which have an influence on the effect of the operation of an academic institution
Source: Author's own studies

If, however, admittance of students to the first year of studies compensates for the decreasing number of students on higher years, this means a stability of a given field of studies. In those conditions when as a result of high numbers of those recruited and a high teaching efficiency a given field of studies has a growing number of students, this demonstrates a development and constitutes a certain source of revenues for the academic institution; cf. Fig. 10.
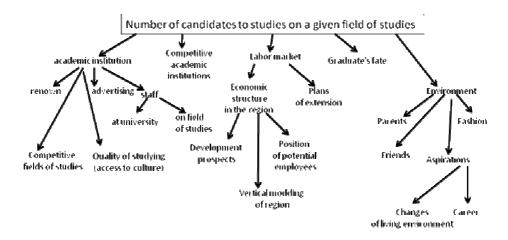
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Fig. 9. Those factors which have an influence on the number of candidates to a given field of studies
Source: Author's own studies

The teaching efficiency as an element which has an influence on the number of students depends from students, i.e. if they want to study and to complete studies, or whether they change their university or the field of studies; or, perhaps as a consequence of various events, they decide to resign from studies.

The effects of the operation of an academic institution depend from the factors discussed above, which have different consequences; some of these deteriorate these effects and others make these effects stronger. This may for example mean a large number of students and a high teaching quality. Management of an academic institution consists in choosing such a decision which will eventually result in its development in safe conditions of financing.
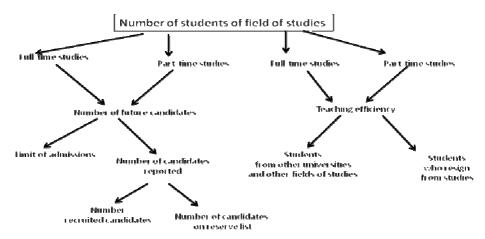

Fig. 10. Those factors which have an influence on the number of students on a given field of studies
Source: Author's own studies

In the model proposed of the management of an academic institution, various variants of solutions are taken into account, cf. Fig. 11. The results obtained of the analyses conducted facilitate the choice of those which the manager recognizes as the most favorable ones. The choice is made with the use of a multi-criteria method on two stages:
- determination of a set of compromises (a set of Pareto-optimal solutions)
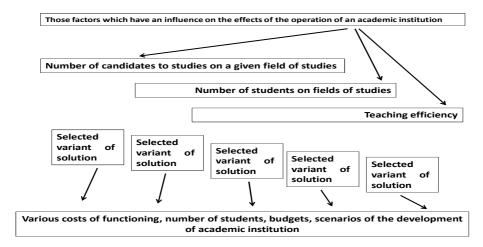- selection of the best solution from the set of compromises

Fig. 11. Variation of decision making
Source: Author's own studies

Optimum in Pareto sense, Fig. 12:
- determination of the area of solutions
- determination of the area of possible solutions
- determination of the area of possible solutions in Pareto sense
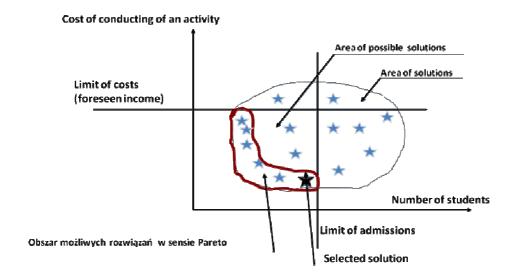 determination of optimal solution

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Fig. 12. Estimation of costs of the number of students by experts according to the estimation of
the influence of factors on the functioning of an academic institution
Source: Author's own studies

If we select as an optimal solution, i.e. the use of the minimum cost criterion, our decision
concerning a limit of admissions denotes value in Fig. 12, which is specified as the selected
solution.

7. SUMMARY AND CONCLUSIONS

The model proposed of the management of an academic institution through the determination
of costs and budgeting makes the following possible:
- an analysis of the costs of the subject conducted, of the field of studies, the
  organizational entity, the faculty, the academic institution,
- provision of data for the management of an academic institution concerning
  estimation of costs on the basis of the variables possessed, and also with the level of
  the university's budget being specified,
- an estimation of the impact of the creation of new fields of studies on the costs of
  conducting of the existing fields of studies.

Directions of further research:
- an extension of the model to include issues of the comparison of data foreseen with
  the realization,
- determination of the costs of the specific operations in an academic institution,
- implementation of a system to support decision making in the management of an
  academic institution.

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