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OPTIMIZATION OF THE UNIVERSITY PROMOTION PLAN

This paper provides a methodology for university promotion planning, directed towards a target group of potential students. An important aim is to point out the possibility of modeling the university promotion, as well as optimization of the plan for specific promotional activities. The predominant problem researched was how to create an accurate timetable for visiting high schools, with the aim of promoting the university with the same goals, content and expected effects, but at a different location. An original Goal Programming (GP) model was developed, a decision-making model for organizing visits to high schools, as target groups, with the aim of promoting a university. The model allocates participants of promotion to high schools, while the basic criterion is an equal distribution of the load. The proposed model was applied on the case study of organizing promotion of the University of Belgrade, Faculty of Organizational Sciences, with a target group of high school students as potential users.

Keywords: goal programming, promoting, universities, faculties, timetabling.

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ОПТИМІЗАЦІЯ ПЛАНУ РЕКЛАМУВАННЯ НАВЧАЛЬНОГО ЗАКЛАДУ

У статті представлено методологію планування рекламування університету, направлену на цільову групу потенційних студентів. Виділено можливість моделювання завдання рекламування, а також оптимізації плану специфічних рекламних заходів. Основна проблема дослідження — як створити точний розклад візитів в школи з метою рекламування університету, з тими ж цілями, вмістом і очікуваними ефектами, але в іншому місці. Розроблено оригінальну модель цільового програмування для організації візитів у школи у вигляді цільових груп, з основним критерієм рівномірного розподілу навантаження між учасниками рекламування. Модель була застосована для організації рекламної кампанії Белградського університету (факультету організаційних наук) серед учнів шкіл як потенційних студентів.

Ключові слова: цільове програмування; рекламування; університети; факультети; складання розкладу.

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ОПТИМИЗАЦИЯ ПЛАНА РЕКЛАМИРОВАНИЯ УЧЕБНОГО ЗАВЕДЕНИЯ

В статье представлена методология планирования рекламирования университета, направленная на целевую группу потенциальных студентов. Выделена возможность моделирования задач рекламирования, а также оптимизации плана специфических рекламных мероприятий. Основная проблема исследования — как создать точное расписание визитов в школы с целью рекламирования университета, с теми же целями, содержанием и ожидаемыми эффектами, но в другом месте. Разработана оригинальная модель целевого программирования для организации визитов в школы в виде как целевых групп, с основным критерием равномерного распределения нагрузки между участниками

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рекламирования. Модель была применена для организации рекламной кампании Белградского университета (факультета организационных наук) среди учеников школ как потенциальных студентов.

Ключевые слова: целевое программирование; рекламирование; университеты; факультеты; составление расписания.

1. Introduction. Under modern business conditions, it is impossible to make business decisions without considering the conditions of market environment, regardless the activities of an organization. For a long time it was believed that the terms such as market, customer, competition, marketing and public relations, were only related to business. University and faculty executives believed that it was only necessary to develop a good study programme, which would spontaneously enroll a certain number of students each year. Such a management philosophy could operate in the environment of a complete monopoly. However, with Serbia's shift from a centrally planned economy to a market one, strengthening of private sector, opening of the borders as well as gradual termination of government subventions, many higher education organizations have been marginalized since they did not realize the necessity for market orientation on time. Numerous factors point to the necessity for planned communication between higher education organizations and their environment (Kostic et al., 2011): education reform; changes in the sources of financing (the introduction of self-financing student status, for students who fully bear the costs of their studies); higher scholarships; establishment of private universities; expansion of university activities (participation in projects; cooperation with the economy; research; seminars etc.); a tendency of hiring youth after their graduation from high school, due to the decrease in the standards of living.

The aim of this paper is to point to the necessity for the introduction of a communication strategy within the business strategy of a university and a faculty. Furthermore, the aim of the paper is to prove the hypothesis that it is necessary to plan promotional activities at universities within the communication strategy, in addition to service planning, determination of optimum sale price, and definition of the ways to provide services. The extent and form in which a university will plan and systematically conduct promotional activities, depend on the factors such as: competition; the quality of service; the manner in which a university responds to changes in the environment; the level of management responsibility; organizational structure, available resources, current image and reputation etc (Petrovic et al., 2011; Rusu, 2011).

In this case, the authors observed the allocation of university representatives, delegated as university and faculty promoters at high schools, to high school students as potential customers. In order to solve the problem of timetabling, the participants in the promotion of a university, an original mathematical model of Goal programming (GP) (Schneiderjans, 1995) was developed. That model will be presented in this paper.

The problem of timetabling was previously resolved with GP as well. GP models which could be used for making timetables for college and university courses were described in (Badri et al., 1998) and (Mirrazavi et al. 2003). The problem of time dis-

tribution and balancing sports events on several locations and its modelling with GP was described in (Urban&Russell, 2003). Kwak&Lee (1997) and Azaiez (2005) develop GP models for the distribution of medical staff, while Mathirajan&Ramanathan (2007) also deal with the problem of allocation of employees with GP, but in the field of marketing. In the field of public relations, Kostic-Stankovic, Makajic-Nikolic and Slijepcevic developed GP model of the decision-making process regarding the selection of the optimal public relations campaign implementation method (Kostic-Stankovic et al., 2011). Kalpic et al. (1995) present a GP model for the optimization of a timetable for production processes, which provides maximum productivity and minimum duration of resource employment. Due to the specific nature of the problem of timetabling promotion participants which is considered in this paper, the problem of timetabling was formulated as a system of distinct representatives (SDR) (Anderson, 2002).

2. Description of the problem. The process of planning communication activities of higher education organizations requires constant improvement and advancement, until certain quality standards are reached. Quality standards are considered to be reached when target groups are defined and precisely profiled, when there is a well defined plan of business communication activities within the organization, and when the consistency of implementation and communication programme control is provided. When planning communication activities of higher education organizations, there are various tools of marketing and corporate communication at one's disposal: advertising, sales improvement, personal communication and communication through the Internet, as well as public relations.

Considering the nature of the activities of higher education organizations, the specifics of the services they provide and the relationship they establish with the environment, it can be concluded that the concept of integrated business communication is the most suitable for the organization of communication activities, with equal development of marketing and corporate communication tools (Kostic-Stankovic, 2011).

In general, bearing in mind the specifics of the offer of higher education institutions, the environment in which its business process develops, as well as the manner in which the functions of marketing and public relations at universities are commonly organized, the process of communication can be achieved within the following phases (Kostic et al., 2004):

1. Analysis of the university and its environment;
2. Identification of the target public;
3. Research and determination of the existing image and reputation;
4. Setting communication goals;
5. Formulation of a communication strategy;
6. Setting communication activities and tasks;
7. Evaluation and monitoring of the accomplished results, and evaluation of their effects.

Considering the topic of this research, phases 5 and 6 will be considered in more detail.

For the purpose of achieving the goals of the Faculty of Organizational Sciences, University of Belgrade, bearing in mind the information gathered in the analysis of

the University, the analysis of the environment, the identification of target groups and determination of the university's image with the public, it is possible to define the following strategies:

- Informing the public about the study programmes and extracurricular programmes, as well as the development of a positive image, will be established through corporate identity development, promotional material, special events organization, establishment and maintenance of good relationships with the media, as well as multimedia promotions.

- Development of a sense of belonging to the faculty in employees and students will also be established through the above mentioned activities, with intensive work on the improvement of formal and informal internal communication, as well as organization of various events which would positively influence interpersonal relations and satisfaction at the workplace.

Considering the fact that the budget for promotion is limited, in the case of state faculties, it is necessary to develop communication activities with a precisely defined target auditorium. With regard to this, the possibility of mass communication was not an option, in the promotion strategy of the Faculty of Organizational Sciences; therefore, the strategy of personal communication was applied. In this case, it was necessary to determine a database. When setting up a specific model in this paper, the most numerous potential users — high school students — were observed as the priority target group. High school students are becoming the target market for a greater number of faculties, both private and public.

It was necessary to identify an appropriate tactic for the implementation of a communication strategy of the Faculty of Organizational Sciences, University of Belgrade. In this case, the tactic is a list of activities, or tasks, which must be executed; and the persons in charge of executing these tasks, as well as the deadlines. Therefore, a tactical plan of activities should include answers to the questions: who; when; what; where; how and why.

The activities that needed to be conducted within the implementation of the communication strategy, within one academic year, are grouped as follows: development of corporate identity; organization of special events; design, publishing and distribution of informative and promotional material; internal communication; media relations and the promotion of the Faculty and its services. In addition, different approaches to particular activities have been established, depending on the development of the strategy for specific target groups of the public:

- Undifferentiated strategy — development of corporate identity.

- Differentiated strategy — communication adapted for various target groups of the public (students, seminar attendants, associates from business organizations), which, among other, includes the use of various informative and promotional material.

- Focus strategy — intensifying communication and promotional activities during the period when high school students are choosing a university (presentations in schools, Internet presentation, posters etc).

This paper pays special attention to one of the activities applied within the focus strategy: promotion in the form of a presentation of study programmes and extracurricular programmes of the Faculty of Organizational Sciences to high

school students in Serbia. At the operational level, this activity is performed by a designated group of university/faculty representatives (further — promoters), consisting of its employees. They should visit schools they attended, or those schools that are related to their profession or geographical origin. When doing so, attention is paid to making sure that they are equally loaded, considering the fact that, during the period of promotions, they have everyday work at the university/faculty as well.

The presumptions of the problem addressed in this paper are as follows:

1. A group of schools is observed, and a promotion must be held in each of them.
2. The group of promoters going to the selected group of schools is observed.
3. Each school receives the time of promotion.
4. Each promoter receives a group of schools where she/he can hold a promotion.
5. The time of each promoter should be in approximately equal intervals.
6. If it is not possible to fully comply with the listed presumptions, it is necessary to make a schedule of promoters which varies as least as possible.

3. Formulation of the model for participant allocation in a promotion. Prior to the mathematical model, the notations will firstly be presented, as well as the relations that define the previously mentioned assumptions. Let k be the number of the promoters participating in the promotion, and n the number of schools where the promotions are held. Each promoter is assigned a school where she/he can participate in the promotion, defined by parameter a_{is} , $i=1, \dots, k, s=1, \dots, n$:

$$a_{is} = \begin{cases} 1 & \text{if the promoter } i \text{ can go to the school } j \\ 0 & \text{otherwise} \end{cases}$$

By introducing variable:

$$x_{is} = \begin{cases} 1 & \text{if the promoter } i \text{ should go to the school } j \\ 0 & \text{otherwise} \end{cases}$$

it is possible to define the two following conditions:

$$\sum_{i=1}^k a_{is} x_{is} = 1, s = 1, \dots, n \tag{1}$$

$$\sum_{i=1}^k x_{is} = 1, s = 1, \dots, n \tag{2}$$

Equation (1) models the condition where in each school the promotion is held only on the days when it was possible, and equation (2) provides a promotion held in each school once.

Let $b_s, s=1, \dots, n$ be the parameter, which denotes the time (date) when the promotion is to be held in school s . The basic problem that needs to be solved is the setting of different times for each of the promoters. When doing so, attention needs to be paid to making sure that the load on the promoters is distributed equally, which is expressed by the condition that the interval between two rounds must be at least 5 days.

In accordance with the previously introduced notation, let y_{is} be the time (date) when promoter i will go to a school, $s, i=1, \dots, k, s=1, \dots, n$. This variable is not independent, and its value depends directly on the value of the variable x_{is} . The relation that connects these two variables is:

$$y_{is} - b_s \cdot x_{is} = 0, i=1, \dots, k, s=1, \dots, n \quad (3)$$

Now, the condition that the time interval between two rounds of each promoter is at least 5 days can be expressed as follows:

$$|y_{is} - y_{iq}|, i=1, \dots, k, s, q=1, \dots, n, s \neq q \quad (4)$$

Condition (4) is nonlinear. The formula/equation with an absolute value can be linearized in several ways. Here, this will be done by introducing an additional binary variable $\delta_{isq}, i=1, \dots, k, s, q=1, \dots, n, s \neq q$:

$$\delta_{isq} = \begin{cases} 1 & \text{if } 5 \leq y_{is} - y_{iq} \leq m \\ 0 & \text{if } -m \leq y_{is} - y_{iq} \leq -5 \end{cases}$$

where m is a large number, at least $n-1$. Now the non-linear condition (4) can be replaced with the following equivalent linear conditions:

$$\begin{aligned} y_{is} - y_{iq} - m\delta_{isq} + 5(1 - \delta_{isq}) &\leq 0 \quad i=1, \dots, k, s, q=1, \dots, n, s \neq q \\ y_{is} - y_{iq} - 5\delta_{isq} + m(1 - \delta_{isq}) &\geq 0 \quad i=1, \dots, k, s, q=1, \dots, n, s \neq q \end{aligned} \quad (5)$$

Input data, i.e. parameter α_{is} , can be such that it is not possible to make a time interval of 5 days for each promoter. Condition (4) will not be satisfied then. However, based on presumption 6, this condition can be receded. This is why deviation variables $d_{isq}^-, i=1, \dots, k, s, q=1, \dots, n, s \neq q$ are added, and their value will in fact show in which case and how much the set demand has varied. These deviation variables are also the reason why the mathematical model was formed as the model of goal programming.

Based on the previously introduced parameters, goals and conditions (1-5), the following mathematical model of mixed integer programming is proposed:

$$\min z = \sum_{i=1}^k \sum_{s=1}^n \sum_{q=1, q \neq s}^n d_{isq}^- + \sum_{i=1}^k \sum_{s=1}^n \sum_{q=1, q \neq s}^n d_{isq}^+$$

s.t.

$$y_{is} - y_{iq} - m\delta_{isq} + 5(1 - \delta_{isq}) - d_{isq}^+ \leq 0 \quad i=1, \dots, k, s, q=1, \dots, n, s \neq q$$

$$y_{is} - y_{iq} - 5\delta_{isq} + m(1 - \delta_{isq}) + d_{isq}^- \geq 0 \quad i=1, \dots, k, s, q=1, \dots, n, s \neq q$$

$$\sum_{i=1}^k a_{is} x_{is} = 1, s=1, \dots, n$$

$$\sum_{i=1}^k x_{is} = 1, s=1, \dots, n$$

$$y_{is} - b_s \cdot x_{is} = 0, i=1, \dots, k, s=1, \dots, n$$

$$y_{is} \geq 0, i = 1, \dots, k, s = 1, \dots, n$$

$$x_{is} \in \{0,1\}, i = 1, \dots, k, s = 1, \dots, n$$

$$\delta_{isq} \in \{0,1\}, i = 1, \dots, k, s = 1, \dots, n, s \neq q$$

$$d_{isq}^+, d_{isq}^- \geq 0, i = 1, \dots, k, s = 1, \dots, n, s \neq q$$

The dimensions of the model depend on the number of schools and the number of promoters.

The mathematical model has $k \cdot n^2$ binary and $k \cdot n \cdot (2n - 1)$ real variables.

4. Numerical results. The formulated model was tested using the GNU linear programming toolkit/GNU math programming language (GLPK/GMPL), an open-source program for solving problems of linear and mixed integer programming. The solution to the described problem of allocating 6 promoters to 16 schools will follow.

Table 1 shows the time when the promotion is scheduled at the schools. This time is the ordinal number of the date, during the period designated for all the promotions. Table 2 shows the parameter, i.e. the relationship between the promoters and the schools.

Table 1. Times of promotions in schools

School	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16
Time	5	12	2	9	15	7	4	10	3	8	20	17	21	1	23	19

Table 2. Connection of promoters to schools

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16
A1	1	0	1	0	1	1	1	0	1	1	0	1	0	1	1	1
A2	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0
A3	1	1	0	1	1	0	1	1	0	1	1	1	1	1	0	0
A4	1	1	1	0	1	1	1	1	1	0	1	0	0	0	1	1
A5	0	1	1	1	0	1	0	1	1	0	1	1	1	0	1	1
A6	1	0	1	1	1	0	1	1	0	1	1	0	1	1	0	1

Considering that the mathematical model, which was formulated for the given input data, is of large dimensions, it was not possible to obtain an optimal solution within an acceptable time. This is why the time of the execution has been limited to 3600 seconds, after which the solution shown in Table 3 was obtained.

Table 3. Optimal schedule of promoters

	S14	S3	S9	S7	S1	S6	S10	S4	S8	S2	S5	S12	S16	S11	S13	S15
A1					1							1				
A2						1					1					1
A3	1								1						1	
A4				1						1						
A5			1					1						1		
A6		1					1						1			
Time	1	2	3	4	5	7	8	9	10	12	15	17	19	20	21	23

Based on the obtained results, it is evident that the condition of distribution was met for all the promoters. The columns are sorted based on the last row of the table, which represents the time of the promotions, so that the condition of distribution could be more easily noted.

5. Conclusion. For conducting communication activities of the Faculty of Organizational Sciences, University of Belgrade, the following basic goals have been

defined: introduction of the Faculty to public (study programme, extracurricular activities programme, the existence of human and material resources for the realization of curricular and extracurricular activities) and the development of a positive image and reputation. Business communication goals formulated in such a manner and related to the target groups of the University and the faculty are further defined: improvement of relations with internal and external target public groups; improvement of the qualitative structure of students who are enrolled; creation of an idea of social responsibility of the faculty; introduction of the principle of positive business communication between the employees; a more formal correspondence with external target groups; formation of a positive culture and atmosphere at the faculty; formation of the feeling of belonging to the faculty, in both its employees and its students.

In order to achieve the defined goals, communication strategies have been identified. As a strategy for achieving a number of goals, the strategy for promotion of the Faculty of Organizational Sciences in Belgrade has been defined. In this case high school students were identified as the most numerous and strategically important target group, or potential students. While setting and identifying the specific activities within the promotion strategy, a clear need to plan the profile of the participants emerged, i.e. the promoters as well as the optimization problem of allocating the participants (promoters), depending on the need for a promotion at specific high schools. In order to solve this problem, a mathematical model of goal programming has been developed, and its application on the problem of scopes similar to real ones has been illustrated. The model can be further expanded by giving schools the opportunity to choose a period more suitable for promotion. Significant improvements could be made by including an analysis of the data on expected and/or wanted effects of the promotion, expressed through the number of expected students, as well as the data regarding the expenses of the promotion.

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