

Determination of Key Variables for the Program Proposal to Address Aspiring Undergraduate Programs in Public Universities

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Abstract

The use of brainstorming and MICMAC techniques is proposed for the determination of variable problems to be taken into account when formulating programmatic proposals in public universities. The methodology applied in the study was non-experimental type of descriptive transectional cut. For the data collection and obtaining of problems, the technique of brainstorming was used (in addition to a structural analysis); to reveal variables and interpret results, the Multiplication Applied Multiplication for a Classification (MICMAC) technique was used; the structural analysis was carried out on the Softprosp tool of the University of Cartagena. The results showed that the candidate's proposal should mainly include solutions to: Increase the number of plant teachers, update the content of the subjects, learn methodologies from other universities through student exchange, offer postgraduate scholarships, facilitate doctoral training at Teachers, financial support to research groups and improve the infrastructure of the university. It is concluded that the relationship between the problem variables and the context in which they are reflected or analyzed are determinant to find the way towards a better process of construction of programmatic proposals, besides

that the analyzes must adapt to a particular context for the purpose To see the actual results in each case.

Keywords: MICMAC, brainstorming, SoftProsp

Introduction

A government program is a collective pact that assumes a representation with its community through choice, it must promote proposals that aim to solve problems and take advantage of opportunities that respond to the majority interest [1]. In the case of public universities, the government program (programmatic proposal) is a requirement that must be presented to be nominated as a candidate for the university program management, it is prepared according to the principle of academic excellence and effectiveness in the management of the institution. Its dignitaries are the same academics, those who stand out in the fields of knowledge, govern the University to print the seal of their vision and ethics [2], these are elected by the vote of the educational community.

In addition to the knowledge that candidates have about problems in institutions, there are techniques that have been used to obtain information, identify key problems in different phenomena, such as the survey, structured interview [3] or in depth [4], and determine factors of student desertion; Regarding the survey, [5] applied it in order to improve the pre-conceptual scheme that was constructed to represent the management of academic programs. In addition, a documentary and bibliographic review are proposed, which was applied by [6] to identify some factors related to the low performance of students in the training program of the community integral doctor in the state of Trujillo, Venezuela.

For the determination of problems, in addition to sources of information, there are many techniques that provide the possibility of evaluating which are key in a participatory manner and with a vision for the future, In this way, variables can be obtained that, at the individual discretion, are not evident. For example the techniques Brainstorming and MICMAC: the first is a tool used to interactively generate new ideas around a specific topic during a face-to-face or virtual session with a working group [7], and the second seeks to identify from a list of variables, which of these are determinants in a system to classify them by dependence and influence. Likewise, they are identified through a plan in a structural analysis matrix. MICMAC provides an analysis with a view to the future, where it seeks to highlight problems in the system and identify the functionality of its dynamics [8]. The brainstorming technique has several applications, for example in the manufacturing sector a study was made which used the technique during a stage in the application of the Lean-Sigma methodology, to determine what was the cause of the problem in the process of potential energy cars assembly [9]. In the financial sector, [10] used this technique to collect information and manage the processes of continuous improvement, in a study where the quality of service perceived by customers in banks in Cuba is evaluated. [11] with the results obtained from this technique, n analysis is carried out to determine the main deficien-

cies at the level of diagnosis and improvement of the organizational climate in the company of Acopio and Benefit of Tobacco in Matanzas, Cuba.

The MICMAC technique, as well as the brainstorming, has been applied to perform various studies, such as in the analysis of problems presented at the time of implementing solar energy installations in India, these were classified based on the dependence and the starting power, in turn suggests ways to end them [12]. In another study on competitiveness factors of a tourist destination in Cuba, a conceptual analysis of the competitive level was executed, managing the techniques of expert criteria and structural analysis MICMAC [13].

[14] used this technique to define fundamental factors that lead to effective entrepreneurship in small and medium enterprises in Cali, Colombia; the conclusion of this investigation shows an introduction that considers the importance of these companies. Another research was carried out at the University Institute in Venezuela applying the MICMAC technique, to discover the variables that energize its processes, thus evidencing the strategic breakthrough lines necessary to achieve a level of efficiency, competitiveness and sustainability in the activities that inside of it are fulfilled [15].

Despite the multidisciplinary nature of these techniques, they have been little used in the preparation of programmatic proposals for the university program management. Therefore, this research proposes the use of brainstorming techniques and MICMAC, for the determination of variables that should be taken into account when formulating programmatic proposals, for which the systems engineering program of the University of Cartagena was taken as a case study. The results obtained after applying the techniques, demonstrated another perspective in the way of selecting the problems to build programmatic proposals, reflected in the achievement of seven key variables, in which the candidate must be based to propose solutions through the programmatic proposal. The research is justified in the global trend to reform education, motivated by the need for universities to reflect the future requirements of society [16], in addition to the institutions of greater global recognition mark behavior patterns considered as trends in institutional behavior [17].

Materials and methods

The brainstorming technique was used to obtain information on the problems presented, and perform a structural analysis. Likewise, the Michel Godet technique called Impact Matrix Crossed Multiplication Applied to a Classification (MICMAC) was used, which through the direct and indirect influence planes, reveals the variables and locates them in four zones (Conflict, Power, Independence and Exit) [18].

To apply the techniques described, the SoftProsp tool was used, which is a platform developed at the University of Cartagena by the GIMATICA research group. This is a web application that has several techniques integrated to support prospective studies.

Population

For this research, the systems engineering program of the University of Cartagena was taken as a case study, where three roles were identified: students (341), teachers (19) and managers (3).

Sample

The sample is probabilistic, because the same opportunity is given to the actors to participate in the process, for which it must be random. The sample size calculated was 181 students, 19 teachers and three employees of the administrative with a confidence level of 95%. Each selected actor was interested and willing to collaborate, so they were suitable candidates for this research.

The process

Previously, the candidate for the position of program director at a Colombian public university, to be able to construct the programmatic proposal and select the key problems, executed the process described in the Following three stages: A) An interview or survey to the educational community. The above are conducted randomly to students in classrooms or hallways. B) The candidate analyzes the results of the data collection and selects the problems. C) Based on the selected problems, it proposes solutions and builds the programmatic proposal.

To carry out the above process in a participatory manner, that is, it is not only the candidate who selects the variables, and that such selection is carried out in an appropriate manner, the following steps were proposed:

A. Identification of actors and determination of the population sample: For the execution of this stage, first actors of the academic community must be identified: the outstanding social actors of the behavior of higher education are the teacher and the student [17], and the administrative staff. The students of the program, are a fundamental part because they benefit from the solution of the problem and maintain a critical thinking of the problems they perceive. Teachers carry out their activities motivated by their vocation, this attitude allows them to offer comprehensive training. The administrative staff receives and stimulates the academic practices, according to their fluency, transparency and clarity of purpose. The principle that governs their activities is the commitment to university values, putting at their service, their commitment, training and efficiency [2]. Then, a sample is taken to carry out the next stage.

B. Application of brainstorming technique: Once the population sample of the actors in the educational community was determined, the brainstorming technique was applied as follows: the selected actors had to describe the problems that the university program presents, then the problems are homogenized, that is, those proposed repeated or similar problems are taken and unified, then they are put to a vote to classify from higher to lower those that are considered priority problems, this in order to perform a first filter to select the most relevant variables.

C. Application of the MICMAC technique: Initially, the matrix of influence and dependence is filled with the variables resulting from the previous stage, for which the influence exerted by one variable on another is taken into account, in addition to canceling the main diagonal because a variable does not influence itself. Then, a number between zero and four must be marked in the intersecting box of each variable, which represent the following levels of influence: zero, no influence; one, weak influence; two, medium influence; three, strong influence; and four, potential influence. Taking into account the above, each selected actor analyzes the degree of influence and dependence that each variable has to assess this matrix until a consensus is reached, with the objective of demonstrating which variables are key to the university program.

D. Interpretation of results: Once the matrices have an adequate level of consensus, the planes are graphed and the results analyzed. Finally, we obtain the variables to take into account to provide solutions through the programmatic proposals.

Results

The members of the sample, as experts, were given access to the SoftProsp platform, where each one proposed the problems presented by the systems engineering program. Once exposed (36 in total) were summarized, which resulted in 25 variables as shown in Table 1.

Table 1: Homogenized variables in the brainstorming technique

No.	Title	Description
1	Shortage of rooms	There are not enough rooms to teach.
2	Technological tools	Hardware technology tools are needed.
3	Software Licensing	Licensed software are required.
4	Internet connectivity	Greater connectivity to the Internet, WiFi zones are needed to guarantee access to information.
5	Air conditioner	The air conditioners pass damaged.
6	Plant teachers	Increase the number of plant teachers.
7	Content of subjects	The content of several subjects must be updated.
8	Pensum	There are subjects that are not necessary while others that should be, are not.
9	Improvement Platform	Optimize the platform to avoid problems with license plates.
10	Schedule	They are very dispersed, they are not flexible for irregular students.
11	Grade options	Enable more grade options
12	Incentives for low strata	Incentives to give opportunity to people of scarce resources
13	Academic routes focused on networks	There are no academic routes where they include network companies.
14	Student exchange	Know methodologies from other universities.
15	Practices in other areas (No programming)	Offer internship in other related areas
16	Postgraduate scholarships	They do not offer scholarships for studies of Postgraduate
17	Undergraduate scholarships	They do not offer scholarships for undergraduate studies
18	Doctoral training	Facilitate the training of doctorate for teachers
19	Financial support in investigations	Provide financial support to students and research faculty.

Table 1: (Continued): Homogenized variables in the brainstorming technique

20	Insecurity in corporate networks	More security on the university campus
21	Secure transport systems between venues	Establish a safe transport to other locations
22	Teacher internationalization	Allow international mobility of teachers
23	Clear policies of implementation, decree 1279	Clarity of the decree policies that govern the salary scale of teachers.
24	Research routes for teachers	Facilitate research routes for university teachers
25	Infrastructure	Elaborate study sites, laboratories, classrooms among others, to increase the academic level.

Once the 25 variables were defined, they were valued by the experts regarding the importance of each one, among which 14 points and 20 points were obtained as a lower score.

A study related to the application of brainstorming, was carried out by [19], where they developed a list of key issues of health technology management through the life cycle of medical devices, which produced as a result 298 key variables to improve the system, of which 29 were consolidated. The above shows an acceptable utility for brainstorming, however, more precise and more relevant variables can be obtained for the conclusion of the study through the application of other techniques such as MICMAC.

Of the previous variables, the high-scoring ones were selected, that is, those from 17 points to 20 points. As a result of applying the brainstorming technique, the 15 variables were obtained (Figure 1) that will serve as input to apply the MICMAC technique.

Variables		
Input variables for MICMAC		
No	Name	Description
1	Shortage of rooms	There are not enough rooms to teach
2	Technology	Hardware technology tools are needed
3	Connectivity	Greater connectivity to the internet, WIFI zones
4	More teachers	The number of plant teachers must be increased
5	Contents	The content of several subjects must be updated
6	Platform	Optimize the platform to avoid problems with fees
7	Grade options	Enable more grade options
8	Incentives	Incentives to give opportunity to people of scarce resources
9	Exchange	Exchanges must be made to know the methodologies of other universities
10	Post scholarships	They do not offer scholarships for postgraduate studies
11	Doctoral training	Facilitate the training of doctorate teachers
12	Support for researchers	Provide monetary support to students and research faculty
13	Transport	Establish a safe transport to other headquarters
14	Clear policies	Clarity of the policies of decree 1279 that governs the salary scale of teachers
15	Infrastructure	Elaborate sites, laboratories, classrooms and among others, to increase the academic level

Figure 1: Variables resulting from the application of the brainstorming technique.

After obtaining the results of the brainstorming technique, 10 experts from the sample were selected, who proceeded to fill the direct influence matrix. For this, the matrix was filled in iterations until a consensus was obtained regarding the degrees of influence (Figure 2), which in this case was achieved in the third iteration.

For example, in the case of the influence exerted by variable number 1 (row) on variable 2 (column), it is zero, because there is no influence relationship between the shortage of rooms and the lack of technological tools such as is shown in Figure 2. The characteristics of this matrix are: Size 15, quantity of numbers one 3, number of zeros 121, number of about 16, number of two 50, number of three 38, number of potentials 0.

Direct influences																	
Var	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Influence	
1	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	3	6
2	0	0	2	0	0	2	0	0	1	0	0	1	0	0	0	3	9
3	0	2	0	0	0	2	0	0	0	0	0	1	0	0	0	2	7
4	2	1	2	0	3	1	2	0	1	2	3	3	0	3	2	25	25
5	0	2	2	3	0	1	1	0	2	3	3	2	0	0	0	19	19
6	0	2	2	2	2	0	0	0	0	0	0	0	0	0	0	2	10
7	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	4	4
8	0	0	0	0	0	0	0	0	3	3	0	0	3	0	0	9	9
9	0	2	2	3	3	1	1	2	0	2	0	2	2	0	3	23	23
10	2	2	3	3	2	1	1	2	3	0	2	0	0	3	2	24	24
11	0	2	2	3	2	1	0	0	1	3	0	3	0	3	2	22	22
12	2	2	3	3	0	0	0	0	3	3	3	0	0	2	3	24	24
13	0	0	0	2	0	0	0	3	2	0	0	0	0	0	2	9	9
14	0	0	0	3	0	0	0	2	0	0	3	3	0	0	0	11	11
15	3	3	3	2	2	2	1	0	2	2	3	3	0	2	0	28	28
Dependence	9	18	21	28	16	11	6	9	19	18	15	20	5	10	25	230	230

Figure 2: Direct influence matrix

As a result of the direct influence matrix, the direct influence plane reveals 5 key variables located in the upper right area, 6 autonomous variables in the lower left zone, 2 determinant variables in the upper left zone and 2 outcome variables in the lower right zone (Figure 3).

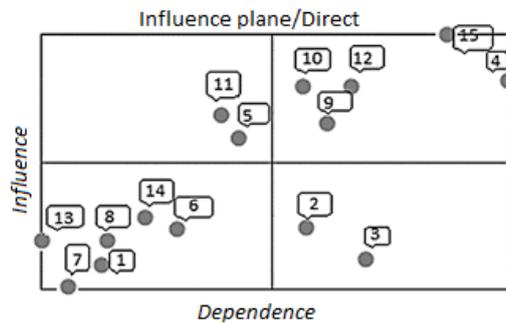


Figure 3: Direct influence plane.

However, with the matrix of indirect influence in the plane of indirect influence, there is a displacement of variables 11 and 5 that, in the plane were located in the area of power and then located in the conflict zone. The remaining variables, although they present displacement, remain in their respective zones, revealing as follows: 7 key variables, six autonomous variables, zero determinants and two results (Figure 4).

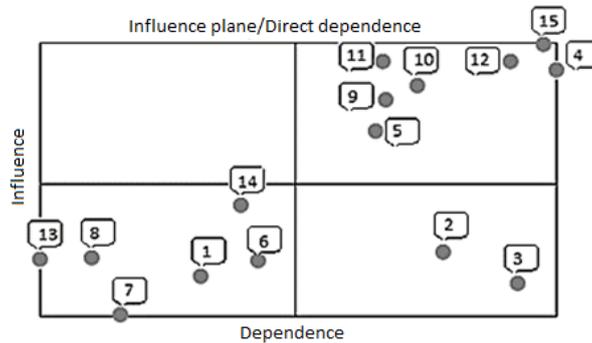


Figure 4: Plane of indirect influence resulting.

To explain in detail the location of the variables in the plane of influence resulting (Figure 4) based on the input variables of the MICMAC technique, the zones with their respective variables are described:

Power Zone: Located in the upper left part of the plane, no variable was revealed in this area.

Conflict Zone: Right upper part of the plane. In this area the key variables were revealed: increase the number of plant teachers (4), update the content of the subjects (5), know the methodology of other universities through the student exchange (9), offer postgraduate scholarships (10), facilitate doctoral training for teachers (11), financial support for research groups (12) and improve the infrastructure of the university (15).

The previous result is similar to the one presented in [20], where they apply MICMAC for the prospective study of the Faculty of Economic and Administrative Sciences of the ITM Medellín, Colombia. They locate the variables in the same zone (DIR EST), responding to the institutional philosophy, policies, development plan, strategic lines, corporate welfare, evaluation and accreditation. (REC END) creation of products and services that allow the production of income. (ALIAN) articulation of programs of the Faculty with other institutions and organizations on a national and international level. Design and relevance of curricular and program development, standardization, curricular flexibility, curriculum, regionalization, distance learning and multilingualism. (INV) development, management, commercialization and recognition of research projects. (DOC) teaching and learning methodologies, linking of processes, hiring, qualification, updating, scale and evaluation of teacher performance. (EST) admission process, requirements and quality of student retention, academic and social support, participation in various academic institutions. This allowed to define the strategic variables that will guide the strengthening of this institute to 2020.

Independent Zone: Bottom left of the plane. In this area the variables that do not constitute a challenge for the system were revealed, these are: shortage of rooms (1), optimize the platform to avoid problems with fees (6), enable more options of grade (7), incentives to give opportunity to people with limited resources (8), establish a safe transport to the rest venues (13) and clarity of the decree policies

that governs the salary scale of teachers (14).

Exit Zone: Bottom right of the plane. In this area two variables considered as result were revealed, they are descriptive indicators of the evolution of the system, these are: In this area the variables that do not constitute a challenge for the system were revealed, these are.

The results of the application of the MICMAC technique reveal that greater attention must be given to variables 4, 5, 9, 10, 11, 12 and 15 because they are highly influential and highly dependent, this makes them unstable and therefore they disrupt the operation of the system, making them the real challenge, that is, that the candidate must include in his proposal mainly solutions for: Increase the number of plant teachers, update the content of the subjects, know methodologies of other universities through student exchange, offer postgraduate scholarships, facilitate doctoral training to teachers, financial support to research groups and improve the university infrastructure.

Conclusion

The combination of the two techniques has allowed the variables with greater relevance for a candidate to university program management, be chosen as a basis for the construction of the programmatic proposal.

Through the methodology used, it is reduced the subjectivity of the actors in the selection of the essential variables for the analysis of the given system, since it considers different points of view of the problems.

It is important to understand the structure of the relationships that exist between management and administration processes of public universities because allows formulating better management strategies to achieve institutional quality and reveal the determining factors in the development of competitiveness.

Based on the above, it is necessary to take into account the peculiarities to determine which are the most relevant variables, taking into account the context in which they are analyzed.

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