PERFECTION OF PROCESS MANAGEMENT IN A UNIVERSITY

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ABSTRACT

The objective of the research work was to implement a procedure to improve the management of strategic processes at the University of Cienfuegos and has been rethought at other universities such as the Metropolitan of Ecuador. It began with a documentary analysis to study management models and preparation procedures, the planning of activities and the design is based on the basic management cycle of Deming. It is applied to the Science, Technology and Innovation process that we identify with the transmission of knowledge in all its forms and dissemination of knowledge from the consequent interaction between universities or their professors and researchers with the industry or the community. In the methodology, systemic modeling stands out, consulting managers and techniques such as the debate with specialists and executives of the University for the evaluation of changes in the object under investigation. The application of the procedure using the Suppliers-Inputs-Process-Outputs-Customers (SIPOC) diagram made it possible to easily understand the indicators that make up the planning of the process. The favorable criteria of the managers who manage the process and the results in the indicators, Relevance, Relevance and Impact confirm the validity of the procedure.

KEYWORDS: Management; Quality; Processes; Science; Technology; Innovation.

INTRODUCTION

A University needs to comply with the principles of quality management and within them and very significantly the process approach for management. This is confirmed by authors such as Veliz-Briones (2016), Carballo Ramos (2016) and Borges Oquendo (2016). The process approach for management is an essential principle to exercise a good management practice, constituting in turn, a premise of the models of excellence that in investigations like González Cruz and Hernández Pérez (2010) warned about the idea of assuming the University

in an environment with multiple processes; with an active vision that allows to organize it in services towards society and the company.

In accordance with the above, universities must generate improvement in the quality of their management and socioeconomic impacts to meet the fulfillment of their strategic objectives. Therefore, the effects and impacts in a certain sphere of a socioeconomic nature will be the visible aspects of managerial work at the University, valued in the transfer of technologies and changes that are promoted socially, as Rodríguez (2015) states. In this sense, to demonstrate the effectiveness of a procedure that induces change in management, current results are compared with the previous ones, visible transformations that can be assessed by means of criteria and main indicators of the process being transformed, a principle assumed in other universities as the Metropolitan of Ecuador to develop processes based on the experience of changes in management process innovation, evident in the balanced scorecard (CMI) used by the University.

In this regard, what is proposed by Hinojosa (2006) is the National Technology Award in Mexico;

> "Process innovation is the implementation of a new or significantly improved method in the production or distribution of products and services. It includes significant changes in the team, tools, organization or a combination of them. Process innovation can be derived from new knowledge adapted to the company" (Hinojosa Martínez, A. 2006, p. 13)

It supports the idea of assuming changes and transformations by understanding that a University provides new services and articulates with society through the productive sector. It is also based on the ideas of Ostroff (2000) which are reaffirmed by Mallar (2010) by stating that each company must seek its balance according to their own needs and possibilities based on their characteristics. In another application of the necessary changes in process management, a proposal of indicators is proposed, the authors Vega de la Cruz and Lao (2017), propose the internal control management index for a hospital entity based on multicriteria modeling in conjunction with the detection of weaknesses through the Petri nets; of which the use of modeling is of interest, since it reaffirms its usefulness to transform processes based on specific management indices.

In 2014, the University of Cienfuegos initiated changes in the management of the main processes, which connote the university nature of the management assumed as antecedent. In this way, in the research work, we started with the documentary analysis of the processes and the evaluation of the results from the use of standardized indicators. The most significant as a result confirms the lack of documentation that allowed describing key processes and at the same time evidenced the scarcity of socialization. Another negative result was the lack of tools to achieve the preparation of documentation for the process in question, not having a standardization of work procedures, failures in the implementation of indicators facilitators of

the evaluation of performance in the processes in a preventive way. The general shortcomings detected coincide with those found in the strategic process of Science, Technology and Innovation in the university, which is confirmed by comparing the results in indicators for the performance of this process during the period 2010 - 2014. This is how it is assumed transform this process and raised as a question: How to contribute to the improvement of the management of the strategic process Science, Technology and Innovation belonging to the University of Cienfuegos? It was assumed as a purpose, to implement some way, procedures or guide for the management of Science, Technology and Innovation process belonging to the University of Cienfuegos in correspondence with the current requirements of Higher Education.

DEVELOPMENT

The first step in this work was to make an analysis of the regional literature, with the aim of pointing out that procedures and forms are used to improve management by processes in general, since process management in organizations is essentially part of the business world. In such a case, as noted by Mallar (2010), the changes that have occurred since 2000 increase ideas and approaches such as those of added value or net benefit for owners of capital, transformations occur in the management of Porter's value chain (2006) within the framework of a trend towards the search for economic value and points out that they take into account the principles of total quality. Mallar (2010) highlights the existence of a displacement of the center of interest, from the structures to the processes, becoming important the so-called Management by Processes. According to the author, the structured method for improving performance focuses on the disciplined design and careful execution of all the processes of an organization; but in our case we analyze a University and consider it as an organization that offers services, which impact on the society that delivers technological and scientific results to the business sector of a country. On the other hand, for Rodríguez Ponce and Pedraja Rejas (2015) Research Management in the university environment is associated with the quality of the services of the same since the scientific publications and their results reveal the progress. They explicitly state "It is discovered that higher quality universities have academic resources to carry out research work, even if it is at minimum levels or focused on certain areas of knowledge that are predefined institutionally" (Rodríguez Ponce, E. and Pedraja Rejas, L., 2015, p. 656) also mark the importance of improving management.

Although experiences are identified in this regard, the management of their internal processes is also an approach that is confirmed even for public institutions. This is the case of countries such as Cuba where there are new experiences and advances in the conception of models and procedures for Higher Education institutions, at least this is confirmed in the works of Villa González del Pino (2006); Gimer Torres (2010); Prado Alfaro (2011); González Cruz

and Hernández Pérez (2014); Ortiz Pérez (2015); Veliz-Briones (2016); Carballo Ramos (2016); Borges Oquendo (2016); all agree in maintaining new expectations for improvement, establishing internal changes in procedures. As a significant piece of information, the study developed by Cejas and Alfonso Robaina (2013) was identified, where 34 sources were consulted on university management in which models, methodologies and techniques are exposed, which were evaluated taking into account 40 characteristics to compare similarities between the proposals consulted. Having these sources of information allowed us to assume key aspects in the investigation; focus on the indicators and consider changes in their rationale. All unlike the analysis conducted by González Cruz and Hernández Pérez (2014), which analyze a total of 22 sources from the same logic, but we believe that it does not fully satisfy a new vision of management. From the antecedents in the University of Cienfuegos, the developed investigations that use the approach to processes stand out, namely: Villa González del Pino and Pons Murguía (2006); Alfonso (2013); Martínez Trujillo (2015). Of vital importance is the identification of the key processes and design of indicators, which facilitate the evaluation of the performance of the processes. Using the comparison of the models and procedures Martínez Trujillo (2015), the difference between the phases or stages could be evidenced, which led to think about which of them could support the improvement of the management.

As a result of the analysis, it is affirmed that there are no differences in the criteria issued regarding process management and what happens in practice. Evidence the interest to improve the management by processes focusing the attention in the most important processes of a University. Another significant aspect is the existence of models and procedures of which we consider using the procedure that has as background the design and validation in the University of Cienfuegos itself (developed by Villa González and Pons Murguía, 2006) which is shown in the following Figure No. 1. The procedure is articulated with a sequence of four stages, eleven steps and suggests a set of tools that facilitates the development of each of the steps, its focus is continuous improvement.

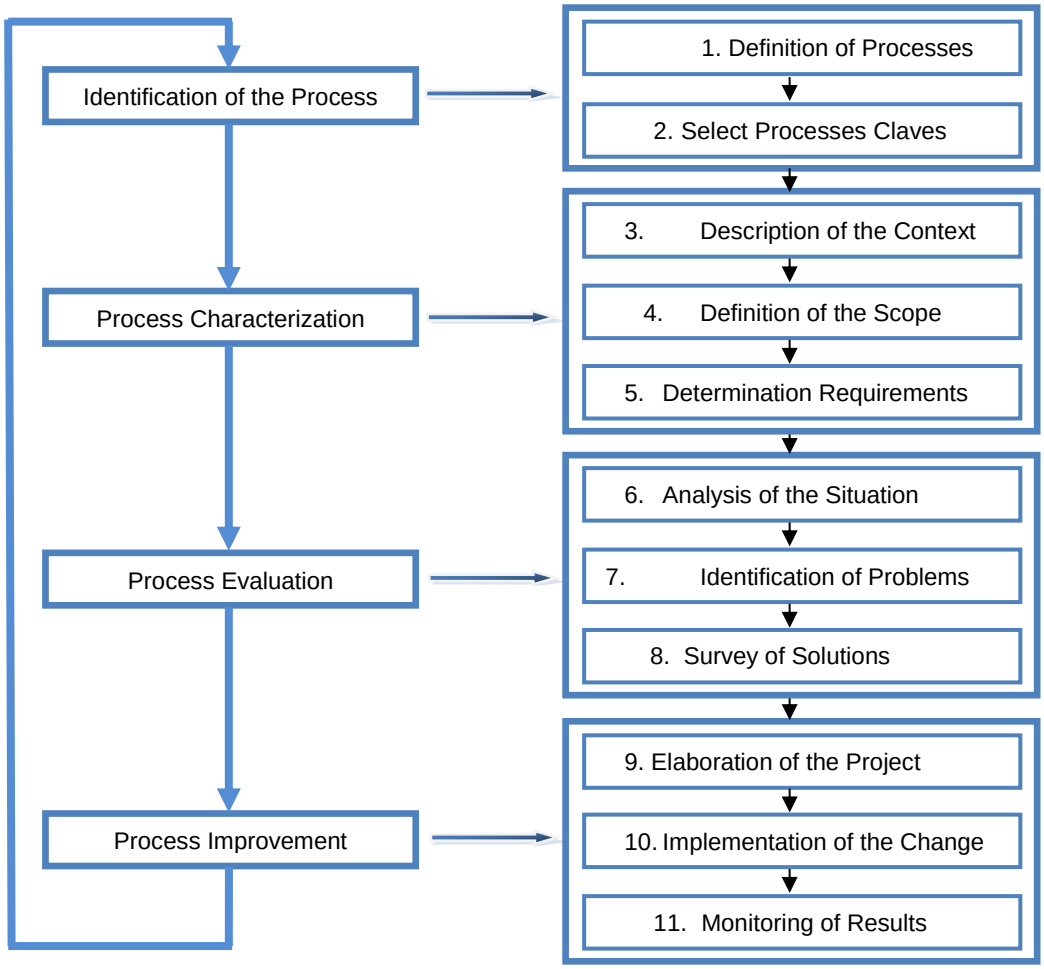

Figure N° 1. Sequence of steps of the Procedure for Process Management
Source: Villa and Pons Murguía (2006)

It is based on the basic management cycle of Deming and is the result of the experiences and recommendations of prestigious authors in this field, such as: Cosette Ramos (1996), Juran (2001), Cantú (2001), Pons and Villa (2006), which in one way or another conceive process management with a focus on continuous improvement, as applied by the most modern management practices, in the style of the Six Sigma improvement methodology, called DMAIC (Define, Measure, Analyze, Improve, Control).

The Science, Technology and Innovation process is defined as any interaction between the universities or their professors and researchers and the industry or community, which leads to the transmission of knowledge in all its forms; It includes not only the transmission of new knowledge but also the dissemination of existing knowledge, projects are used for the organization, execution, financing and control of activities related to scientific research. Its direct relationship with research management Rodríguez Ponce and Pedraja Rejas (2015) stands out, and it also combines with university extension management when research

projects with a socioeconomic impact are conceived. It will explain the operation, the use of the procedure, which were the results in the process under study, Science, Technology and Innovation process at the University of Cienfuegos as part of the management, they are described in stages.

Stages of the procedure

The four stages of the procedure shown above are applied in the processes that make up the University of Cienfuegos. It goes through three key processes, two support and two strategic. The process is considered strategic because it is characterized by being an articulator of the activities of Science with respect to Technology and Innovation in the University; it is based on the development of research projects from which socio-economic impact research results are promoted, publications among other outputs. We show then each stage developed.

Stage 1. Identification of processes. Formation of the work team: The work team responsible for this activity is composed of the Rector, Directors, Vice Presidents, Deans, Vice Deans and the technical team made up of members of the Planning and Statistics Department of the University of Cienfuegos, who will be responsible of the improvement of the Process Map, as well as the elaboration of all the documentation of each process.

Definition and selection of processes: In this stage several sessions were held with the work team mentioned above, using the document review, brainstorming, opinion and consultation of experts in Industrial Engineering.

The Process Map allows a global vision of the organization, it is a model or diagram in which the strategic, core and support processes are represented and identified, where the University is conceived as a network of interconnected processes, depending on the mission, objectives, inputs (input) and outputs / services (output), starting from the client's needs to their satisfaction. To identify the processes of an organization, the institutional mission must be taken into consideration, from which the core processes originate and those that should be developed to achieve the vision of the future. It is the stage that allowed to assume the management process of Science, Technology and Innovation at the University of Cienfuegos.

Stage 2. Characterization of processes: Descending at the level of analysis we arrive at the diagrams or diagrams of the processes, which visualize the tasks and activities to be carried out, sequentially with beginning and end, depending on the scope of each process. The technique used for the design of the process map was the SIPOC diagram (suppliers, inputs, process, outputs, and customers) that allowed to visualize or graphically represent the processes in a simple way, identifying each one of the involved parties. In the SIPOC map and the flow chart, the nature of the Science, Technology and Innovation process was taken as a condition. It is a process that is characterized by the interaction between universities or their

professors and researchers with each other and with the industry or community. Another element is what generates the particular process; the knowledge, its transmission in all its forms to be able to transfer to the contexts, apply, innovate and transform with a short medium or long term of permanence in the time, which takes to the technologies and the innovation.

Stage 3. Evaluation of the process. Analysis of the Science Process Technology and innovation: From the results of the application of the surveys of the Vice-Rector for Research and Postgraduate Studies, the review and analysis of the annual Balances and interviews with the Director and specialists from the Department of Science, Technology and Innovation, verify the existence of a predominance of a functional approach in the management of the process studied, so there is a high probability of incurring errors and wasting human and material resources, due to the presence of a great diversity of activities and the high level of complexity of the process. It was evidenced that verticality can affect the synergies between processes and the need for horizontal interconnections of the process analyzed with the others; need for greater recognition of the relevance, relevance and impact of science. At this stage, the proposed indicators that are based on the characterization of the process obtained in Stage II are given importance. It works in three dimensions, each one has indicators of Relevance, Relevance and Impact of Science. They are analyzed in the reports of annual balance of the faculties and departments, reports of fulfillment of objectives of the Strategic Management of the University and records sent to the Ministry of Higher Education of Cuba (MES), related to the results of the Science, Technology process and Innovation. These indicators are presented in technical files to develop the monitoring and evaluation of the results of the process and compare the current status of the process with those obtained in the last four years and that can be redesigned according to the evaluated process. The Relevance indicator includes the awards and recognitions obtained by the University at the International, National and Provincial levels, its calculation method takes into account for each of these the number of prizes obtained among the number of prizes planned. The Pertinence Indicator refers to the research projects and their structure in the University, its scope and efficiency which is determined in three nominations of projects, the institutional ones, those associated with national and international programs and the business ones, these last two are considered of greater weight due to its possible socioeconomic impact. Within this indicator of Relevance is considered the number of books and monographs obtained in a year, the indexing of the journals of the University seeking greater visibility and impact. Another sub-indicator of relevance is the number of publications by teachers, who must achieve greater visibility of scientific production according to the level of indexation in which it is published; In this sense, four groups of indexed journals are taken into account, those of group I are the publications obtained in journals indexed in SCOPUS and the Web of Science, the remaining indexations of journals and groups are distributed to Latindex. The registrations and patents as well as the scope of the events in

which teachers participate are also considered within this indicator of relevance. The indicator closes the evaluation with the SCImago Index and the positioning of the University in the international rankings. Finally, there is the Impact of Science indicator, which is calculated based on the relevance of the impact results of international, national Science, Technology and Innovation and the territory.

When concluding using them, it was considered that the process during 2016 complies with the established standards. In the categories of Excellent it has 6 indicators, in the category of Good it has 2, Regular it has 3. Therefore the evaluation of it can be classified as satisfactory.

Identification of the problem: To achieve this objective, the results of the analysis made in the previous step are compared with the criteria of researchers and specialists; the criteria that are considered in the indications to develop the Balances are consulted; that is, how the main indicators used to measure progress in the process or not behave, what are the main results and weaknesses, in the case that concerns us the Science Technology and Innovation process and the Annual Balance of the Objectives of Works indicated to the Universities that is requested by MES. This allowed identifying a set of strengths (12) and the main weaknesses shown below:

Weaknesses: insufficiencies in the Internal System of Industrial Property governed by Resolution No. 21/2002 of the Ministry of Science Technology and Environment (CITMA), a name that is assumed in Cuba for the Ministry that governs Science and its development.

The composition of the cloisters needs a preparation to achieve improvements in the scientific culture to give response to the demands of institutional development; the preparation of the cloisters in the Municipal University Centers (CUM) is insufficient to respond to local development projects and initiatives; insufficiencies in the innovative process University-CUM-Business Sector. Once the existing problems in the process have been identified, the UTI Matrix is applied to define the improvement priorities of the same. The results of the application of this tool in the Science, Technology and Innovation process are shown in Table 1.

Table Nº 1. Matrix UTI for the establishment of opportunities for improvement for the process of Science Technology and Innovation

Main problems identified in the process	Urgency	Trend	Impact	Total	Priorities
Insufficiencies in the Internal System of Industrial Property governed by Resolution No. 21/2002 of CITMA	10	7	7	24	3
The composition of the cloisters needs a preparation to achieve improvements in the scientific culture to respond to the demands of institutional development	10	8	8	26	2
The preparation of the cloisters in the CUM is insufficient to respond to projects and initiatives of local development	10	8	8	26	2

Insufficiencies in the innovative process University-CUM-Business Sector	10	9	9	28	1

Source: Self Made

As shown in the table, it is decided through work with the experts, to prioritize the first three opportunities for improvement for the purposes of this research, which are in order of priority as follows: as priority number 1 are the shortcomings in the innovative process University - (CUM) - Business Sector, as number 2 and with the same order of priority, the preparation of the cloisters in the CUM is insufficient to respond to projects and initiatives of local development and as priority number 3 and not being the last least important, there are the insufficiencies in the Internal System of Industrial Property governed by Resolution No. 21/2002 of the Ministry of Science Technology and Environment CITMA.

Survey of solutions: When prioritizing the first opportunities for improvement, the possible solutions for each of them are identified, which are shown below:

1. Insufficiencies in the innovative process University-CUM-Business Sector.

Improvement proposal:

- Applying new innovative management procedures.
- Managing the change in University-CUM-Business Sector relations.

2. The composition of the cloisters needs a preparation to achieve improvements in the scientific culture to respond to the demands of institutional development.

Improvement proposal: Through the processes of academic formation, changes of category teachers, scientific exchanges, courses, trainings.

3. The preparation of the cloisters in the CUM is insufficient to respond to local development projects and initiatives.

Improvement proposal: Mediante the processes of academic formation, changes of category teachers, scientific exchanges, courses, trainings.

4. Insufficiencies in the Internal System of Industrial Property governed by Resolution No. 21/2002 of the Ministry of Science Technology and Environment (CITMA).

Improvement proposal: establishing the organization of intellectual property activities, both internal and external, according to the Cuban Office of Industrial Property (OCPI).

Stage 4: Improvement of the process: Once the main problems were identified, the improvement project was elaborated.

Preparation of the project: The project was organized through action plans, using the technique of the 5Ws (What, Who, Why, Where, When) and 1H (How). These action plans (improvement) for the three prioritized improvement opportunities of the Science, Technology and Innovation process.

Table No. 2 shows an example of an action plan for priority No. 1 identified in Stage III developed in this investigation.

Table N° 2. Action plan for the opportunity for improvement 1

Opportunity for Improvement 1: Insufficiencies in the innovative process University-CUM-Business Sector					
Goal: Redesign the innovative system					
WHAT	WHO	HOW	WHY	WHERE	WHEN
Redesign the innovative system University-CUM-Business Sector	CTS Chair	Through new procedures of innovative management and through the change in relations University-CUM-Business Sector	Because the innovative system university-CUM-Business Sector is inefficient	Faculties, departments, CUM and Business Sector	September 2016 to August 2017

Source: Self Made

The next steps would be the implementation of the change and the monitoring of results:

Implementation of the change. In the implementation of the change it is not possible to foresee in advance the exact behavior of the elements that are involved in it and even less in a change where people of different strata are involved, it is necessary to consider that until now only some members of the organization have find themselves involved in this process.

During the whole process in the organization transformations are taking place, but not all will do so at the same pace; some are more receptive and have the ability to perform it, while others may be slower to accept and execute it.

From the analysis carried out in the previous steps, it becomes evident the need to implement the proposed improvements. Which must be developed by the directors, specialists and teachers involved in each of the actions proposed in the improvement program.

Monitoring of Results. The monitoring of the results was carried out with the frequency established in the cards, taking into account all the elements set in the cards with an essential emphasis on the current value of the indicator compared with the historical and the goal.

This analyzes the latency index, which is the potential difference that exists between the current value and its maximum or excellence value and that must have a zero trend.

In the analysis, several instruments were used, such as the survey of graduates, survey of employers, professional training survey and personnel related to the different processes, among other instruments that we do not describe here when considering it as a complement to the final information.

A fundamental factor in the monitoring process of the indicator of control is the understanding of the variation, since it is necessary that the improvement actions that are undertaken as a result of the behavior of the indicators are based, on the one hand, on the precise knowledge of the trend that the indicator shows and the specific knowledge of the conditions and factors that affect the behavior of the variable under analysis. The proposed indicators should be used in this step of the procedure.

Here the knowledge and intuition of the management team at its different levels played a fundamental role, to put in the hands of the management of the organization a truly useful report for decision making, which must include the Control Indicator Evaluation Matrix (see table 3). The purpose of this matrix was to help the Board of Directors of the entity to refine the system of indicators of the Science Technology and Innovation process, based on the analysis of each one regarding the objectives and processes that are carried out.

Table N° 3. Indicator Evaluation Matrix for Strategic Control at UCF

Indicators	Work Objectives				Processes			Levels			Nature		Validity		Add value	Remain
	Objetives 1	Objetives 2	Objetives 3	Objetives 4	Strategic	Missions	Support	1	2	3	Efficiency	Efficiency	Temporary	Permanent		

Source: Self Made

Its great utility is that it helped eliminate those indicators that do not add value or that have lost their validity; This corresponds to the level of strategic alignment that the indicators must guarantee with the organization's strategy, which can be modified if its external or internal conditions are modified.

As a final result after the presentation to the University Management Board, an improvement actions plan must be generated for the entity. We then point out how the closing of the final assessment process occurred, indicating the main results by applied technique or investigative method.

Participant observation. It was possible to appreciate how the planning of the Science, Technology and Innovation process is developed at the University of Cienfuegos, which features the process; What was confirmed in the meetings with the 14 participants, Vice-deans of research of the faculties and deputy directors of university centers (CUM) to show the vision they have of the process and how they consider that it should be improved in the following scales: very much in agreement, in agreement, I have no criteria, in disagreement, strongly disagree. In the sessions regarding the procedure, the selection by theme and random, 10 participants showed strongly agree, two disagreed and two strongly disagreed, which we consider appropriate taking into account the complexity of the phenomenon and any evaluation process that is planned with the agreement of the participants and teachers.

Group discussion In the group discussion it was possible to verify that the elaboration of a new proposal for the management is necessary, since in essence the process was not well founded, it lacked tokens and SIPOC diagram which placed a vacuum at the moment of

evaluating the entries and outputs of the process. Of the 14 participants in the 12 discussion, the category agrees strongly, one disagrees and one strongly disagrees in assuming adjustments in the process input, its further development and betting on a special meaning in the outputs, mainly products that they can be used in production, technologies that can be conceived for social development in communities.

Figure 2 shows the variations resulting from both instruments applied to the 14 so-called experts, actors in the change process, note that there is a coincidence regarding disagreement in the changes in the process inputs in both applied instruments. which connotes reliability in the answers in Strongly agree and disagree.

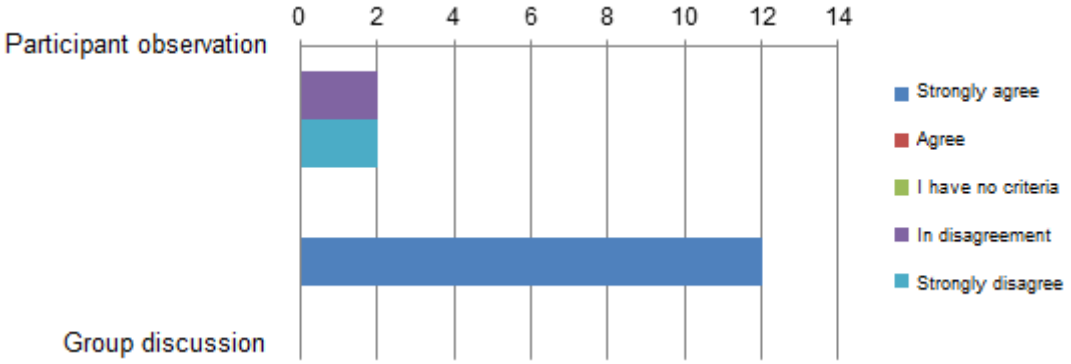

Figure Nº 2. Comparison of results in participant observation and group discussion

Source: Self Made

Synthetic analytical. The results of the ordering of documents in four stages corresponding to the procedure, ensure to strengthen the foundation, so that it was sought to favor their collection by analyzing their essences and making them correspond in their results with the process as such. The procedure for process management selected is based on the basic management cycle of Deming and is the result of the experiences and recommendations of prestigious authors in this area, such as: Cosette Ramos (1996), Juran (2001), Cantú (2001)) Pons and Villa (2006), who in one way or another conceive process management with a focus on continuous improvement, as applied by the most modern management practices, in the style of the Six Sigma improvement methodology, called DMAIC (Define , Measure, Analyze, Improve, Control).

The modeling The SIPOC diagram and the flow diagram for the seven selected processes that are represented in Fig. 3, highlight the results of this stage for the Science, Technology and Innovation process. The experience and the level of the experts that make up the work team were useful; Another element is the legislation issued by the Ministry of Higher Education, documents established by the Ministry of Science, Technology and Environment (CITMA), manuals and indicators prepared by governing bodies and those prepared in previous stages in the University that we would assume to deal with object of the investigation the process. For this reason, for the preparation of this documentation, the nature of the Science, Technology and Innovation Process was taken as a premise, which can be defined as any interaction between the universities or their professors and researchers and the industry or community, leading to the generation of knowledge, its transmission in all its forms, to be able to transfer to the contexts, apply, innovate and transform with a short medium or long term of permanence in time. The projects seek the organization, execution, financing and control of activities related to scientific research, with the presence of scientific research groups of different structure or appointment.

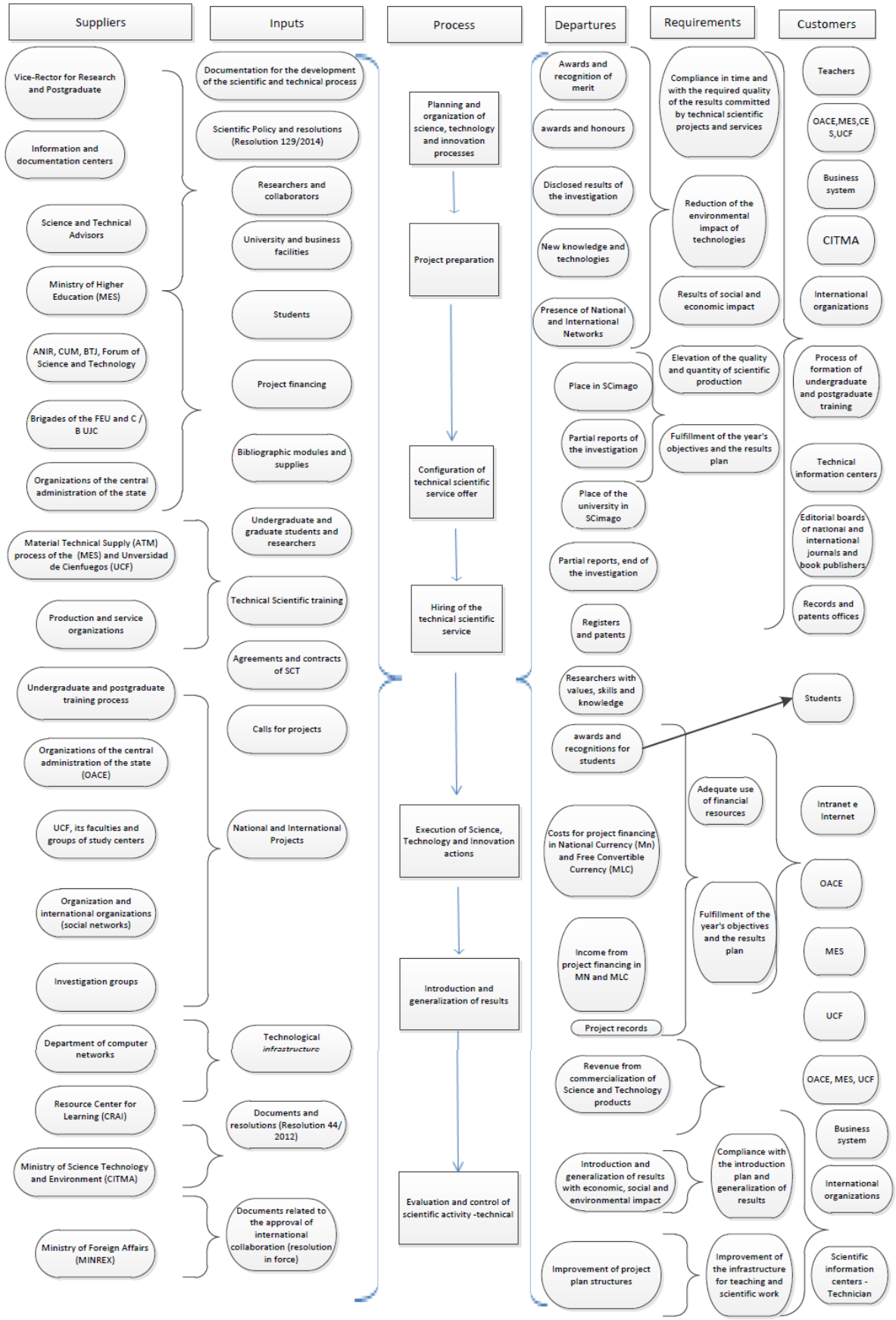

Figure Nº 3. SIPOC diagram of the Science, Technology and Innovation process
Source: Self Made

It was assumed that the flow diagram was drawn up in the same period, which can be seen in Fig. 4 and the process record of each of these is established. They highlight its contents such as the mission, responsible, actors, maps and diagrams mentioned above. It also contains the indicators that allow the performance of the process to be measured in a preventive manner. Complying in this way what is established in ISO 9000: 2015.

This confirms that the purpose of any process is to offer the client / user a service or product that meets their needs and that meets their expectations with the highest level of performance in service and quality. Therefore, in the SIPOC map and the process file elaborated in this research, the requirements indicated by the clients and for each exit of the process are identified.

A proposal of indicators designed for the Science, Technology and Innovation process was made. It was designed a technical sheet of the indicator that allows to establish aspects such as: Calculation form, reference levels, responsible for the measurement, location of the information to proceed to the calculation of the indicator, historical behavior of the indicator. For this purpose, four perspectives were established (Relevance of awards and recognitions, relevance, Impact of science and Human Capital) and within these indicators were inserted.

Based on the documentation mentioned above, the first two stages of the procedure for the development of the Process Management approach at the University of Cienfuegos are implemented.

Validation of the Process Map. The proposed documentation that is the Process Map of the University, as well as the SIPOC diagrams in Fig. No. 3 and the flow diagrams visible in Fig. No. 4. In any case, the process cards of the seven processes analyzed are disclosed in the blog of the university and presented in the Board of Directors of the University and board of directors of the Faculties. Some faculties and central agencies sent a response, validating the Process Map and others presented observations that were analyzed by the technical team, making the relevant modifications to the document.

Having elapsed the time established to send the observations to the document, the team considered that the agencies that did not submit observations agree with it.

The flow diagram fig. 4, is of vital utility for the description of the activities of a process. Note that at the beginning the planning is placed depending to a large extent on the research projects and the scientific technical services demanded by society. The dynamics of Process Management are changed by considering in the planning projects that are a priority of the nation, identified as international, national and business collaboration, placing the institutional third option of approval.

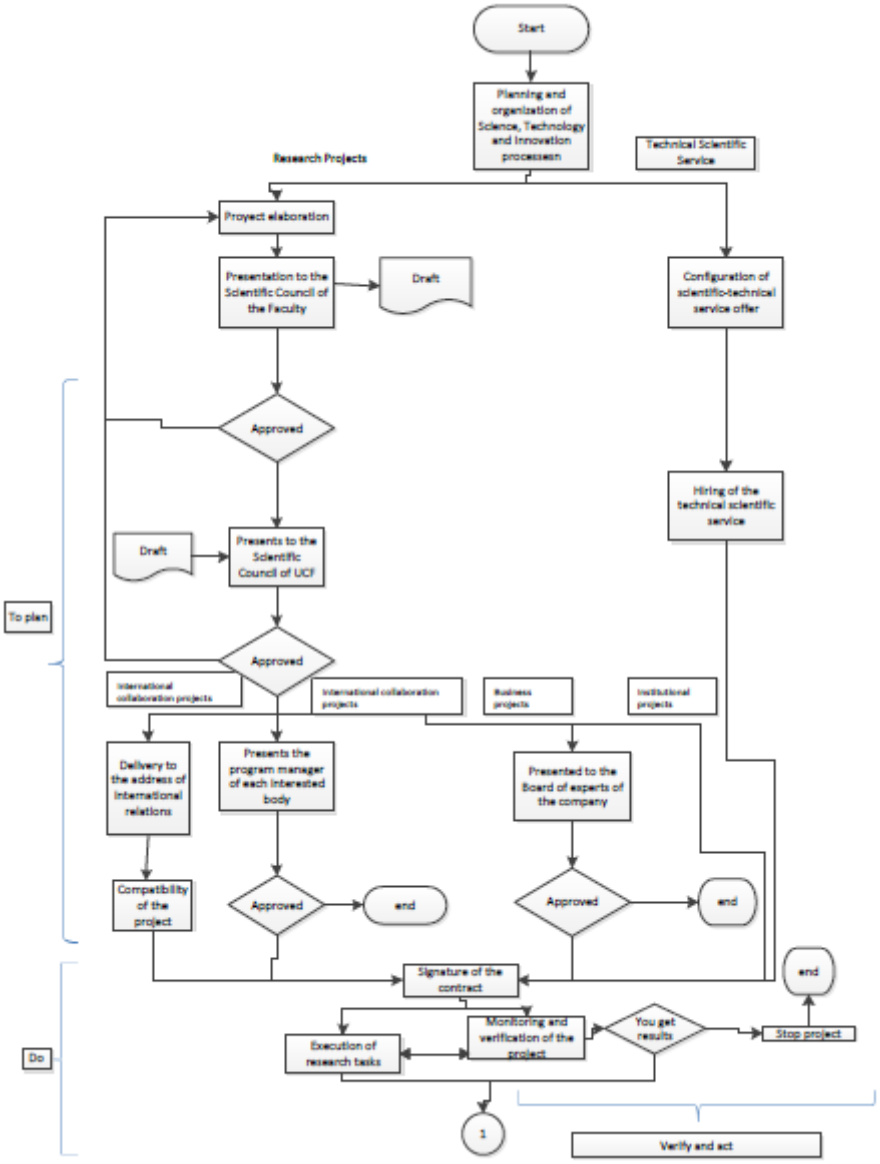

Figure Nº 4. Flow diagram of the Science, Technology and Innovation process

Source: Self Made

Development of the Expert Method. From the work team that participated in the preparation of the documentation, 11 experts were chosen who give their opinion individually, among whom are specialists, workers (teachers and non-teachers) with vast experience, as well as professors who investigate in the subject of Management by processes belonging to the university, with the aim of statistically validating the documentation of each process.

For this, it is decided to carry out an expert method to check the consistency of the criterion and the preferred community among them.

From the documentation presented, criteria such as: Compliance with the legislation of the MES and the National Accreditation Board (JAN) were validated; applicability to the institution; clear and readable; integration with other processes; that provide opportunities for improvement; compliance with process diagram requirements; possibility of generalization to

other Institutions of Higher Education (IES); delimitation of input variables, output variables, requirements and responsible for activities.

To verify whether the experts' judgment is consistent or not, the statistical package SPSS version 20.0 is used, the results of which show that asymptotic significance (0.000) is lower than the confidence level (0.05), and the hypothesis test is also used. 2, in which the critical region is met ($\chi^2_{Calculated}$ =45,009>$\chi^2_{Tabulated}$ =14.10). Therefore it is concluded that the judgment of the experts is consistent, so it can be said that all experts agree that the documentation of each process has the characteristics required by them and is in line with the current activities developed in each from them. It is obtained as a result of this stage, the criterion that most affects fulfillment of the legislation, consistent result to be governed by Resolutions and Instructions issued by the National Accreditation Board and the Ministry of Higher Education and by the institution itself.

The results. The monitoring of the results is done with the frequency established in the sheets designed for the indicators (Stage 3), taking into account all the elements set in it with an essential emphasis on the current value of the indicator, compared with the historical and the goal. At this moment the causes of the behavior must be analyzed by breaking them down to the minimum expression. In this step, it is proposed to use the Control Indicator Evaluation Matrix. This matrix aims to help the Board of Directors of the institution to objectify the system of indicators based on the analysis of each one with respect to the objectives of the strategic plan and processes that are underway. These indicators can also be assessed using criteria related to Management Control, which refers to the actions the institution carries out to ensure that the tasks performed in it are aimed at achieving its objectives. It is possible to understand that these objectives are previously established. It can be used as a tool in this case a balanced scorecard, to be focused on the performance of the process.

The new design of the process Science, Technology and Innovation caused in the scientific community concern for improving the structure of projects. The same began to change in a sustained manner from actions intended by the university board, made it possible to find with more coherence and clarity the need to strengthen the organization of Science and start to try new actions in the research groups.

The indicator Relevance with sub-indicator in the Institutional, Business and National Projects, which is observed in Fig. 5, connotes the efficiency of the use of the procedure and the design of the management process. When following the logic of the planning and making process, see also Fig. No. 4. We proceed to present the projects that are necessary for the country and to order the steps from its presentation until its approval or not, avoiding delays and better quality. of the project in each category, takes the approval of experts from international relations such as the business sector and national programs for the development of the body concerned, institutional, respond to internal problems of the university organization.

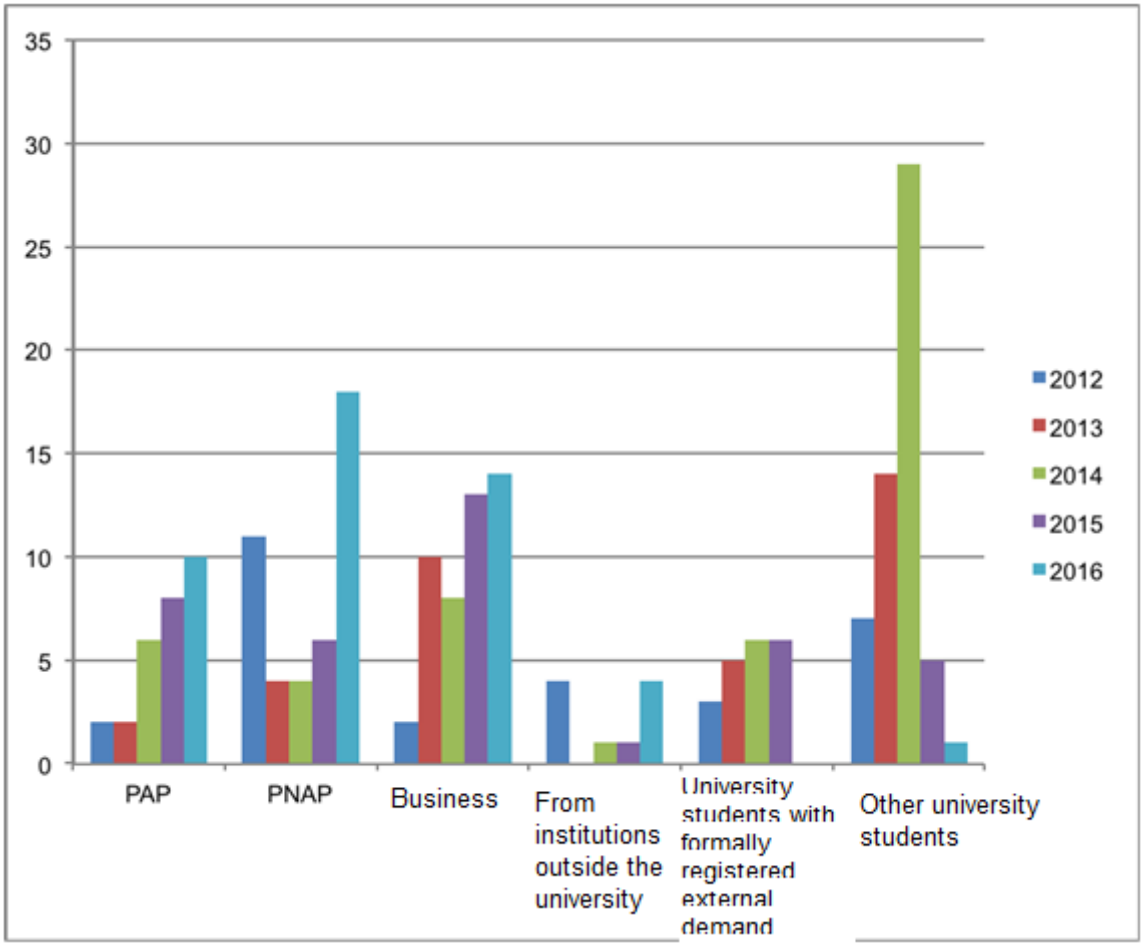

Figure Nº 5. Behavior of the Projects

Source: Self Made

The increase in Business Projects is evident, after going through the approval steps described in the flow chart, not being the same behavior for the rest of the evaluated ones, there being variations in the result of the same, in spite of that the indicator it is evaluated as Excellent by the experts in the case of the three projects.

The evaluations of students, employers and social sectors reaffirm as customers that the proposal is viable; if we compare these valuations with the policies established by the Cuban Ministry of Higher Education, which establishes that universities must comply with the following management indicators: impacts of science, number of scientific publications in impact journals, number of registrations and patents and awards obtained; We consider accepted the changes promoted by the procedure in the process studied. But efficiency can also be assessed in the case of the University of Cienfuegos based on the behavior of some of the mentioned indicators. Publications in impact journals is one of the indicators, which is verified by the location of the University in the international web rankings where the University of Cienfuegos, with respect to other Cuban universities with certified categories, present similar results and progress. In this sense, from place 251 of the ranking in Latin America in 2014

occupied by the aforementioned University, it went down to place 201, a favorable situation for its visibility according to QS University Rankings: LatinAmerica 2015.

Linked to this point, it is necessary to specify that the scientific leadership of the University has been maintained with publications in the areas of Sciences such as Energy, Environment and Social Sciences with more than 71 documents published in the Web Of Science and Scopus.

CONCLUSION

Due to the above, it is considered that the implementation of the Villa and Pons Murguía procedure (2006) constitutes a practical contribution for the management of processes in the Universities since it managed to modify the daily modes of action of the managers, obtain reliable information from valuing the results for the new process management indicators. Based on the identified problems, proposals for improvements to the Science, Technology and Innovation Process are made, with the aim of improving their performance and that of the University of Cienfuegos to achieve the defined objectives and the Relevance, Relevance and Impact indicators. of the science.

By implementing the procedure it was possible to elaborate the documentation of the process based on: SIPOC diagram, flow chart, process file, technical data sheet of indicators and key process variables. So it can be said that this research has an eminently practical contribution. This documentation is validated with the support of the existing technological infrastructure at the University of Cienfuegos (blog UCF) and from a statistical perspective. The diagnosis of the process that allows an evaluation of the current behavior of the process, obtaining a positive evaluation when finding only indicators evaluated as Excellent, 6 and Good, 2. In turn, 12 strengths and 4 weaknesses were identified, for which they were proposed. actions and organized the way to carry out the improvement of the process.

The advantages of the procedure were demonstrated, based on its adaptability with the Strategy / CG / Strategy Support, which facilitated the permanent development of readjustment capacity to specific conditions and to changes in the environment, both external and internal. process; the improvement approach resulting from the effective succession of quantitative to qualitative changes, from daily administration to strategic administration; the pertinence, given by its actuality and adaptability, the procedure possesses the necessary conditions to be applied in all its conception in the university management, proactive character is the effect of the approach of permanent improvement that sustains it.

The Parsimonia principle was confirmed given that the integration of clearly designed support procedures and tools, such as the SIPOC and flowchart presented in a simple manner, are subject to the general procedure, with an open system approach, allowing a complex

process to be understood and applied with relative ease; It allowed integrating and renewing the management of the studied process, which is transferable to others.

The proposal of indicators allows the performance of the process to be measured in an appropriate manner, due to the fact that it responds to the current context based on the actions developed in the process, the strategic plan and the current legislation in place.

The results fostered greater capacities of managers to present proposals in the institution and achieve the goals proposed during the management. The criteria of Veliz Briones (2016) are confirmed by referring to management as a process and the need for teamwork to be able to modify it and the approaches of González Cruz and Hernández Pérez, (2014) regarding the need to adjust the changes in process management in higher education, in each work cycle, at least five years. The criteria of Rodríguez (2015) are valid on the need to find an adequate balance of the structure of projects in universities as a management indicator, which should be oriented to satisfy priorities established in the country of origin or region. where the University is located.

REFERENCES

Please refer to articles in Spanish Bibliography.

BIBLIOGRAPHCIAL ABSTRACT

Please refer to articles Spanish Biographical abstract.