

Scientific Paper

Technology management in the university-Cuban state animal husbandry enterprise relation. Part I. Case study: foundation and proposal of a model

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Abstract

Technology management has become a fundamental activity since it allows the linkage of the productive sector with that of research-development, and one of the tools to boost this process are the technological management models. The objective of this study was to support the proposal of a technological management model in the relationship between the university and the Cuban state animal husbandry enterprise. For this purpose, 82,4% of the population of five departments at the University of Pinar del Río and 45,4% of managers in the Camilo Cienfuegos Genetic Animal Husbandry Enterprise were diagnosed. The technology management model was conceived as participatory, continuous and flexible, with a systemic and strategic approach; it shows four phases for its implementation. As an instrument for technology management in the university-Cuban state animal husbandry enterprise relation, this model is based on several premises and principles and has fundamental characteristics that distinguish it from others. The model is consolidated in the relationship between the university and the Cuban state animal husbandry enterprise, from the interaction of four components: university, state animal husbandry enterprise, scientific environment and Government. The interrelation between them is based on networking and multidisciplinarity as a distinctive quality, from the dialectics between the planned nature of the technology management process and the university-Cuban state animal husbandry enterprise relation.

Keywords: diagnosis, animal husbandry, research

Introduction

These times, characterized by the high rate with which changes occur, demand that higher education institutions are renovated and updated to respond adequately to the demands and challenges of the current world (Alfonso and Martínez, 2011). In this regard, Alarcón (2015) considered that the university will have to modify its current formulas of interaction with the surroundings, which becomes a challenge.

Alfonso and Martínez (2011) reported that the management of the university-enterprise relation in Cuba lacks a systemic and strategic approach, because the actions aimed at establishing links with the entrepreneurial sector are regularly characterized by spontaneity in their conception and execution. On the other hand, García *et al.* (2013) stated that technology and knowledge management in the productive basis is not effective yet and there are still gaps from the methodological point of view which are manifested in the competitiveness and productivity of organizations.

Pavón-Rosales (2014) reported that the main limitations in the technology management process from the university to the entrepreneurial sector are determined by the absence of diagnosis in the context, which has incidence on the fact that no research and innovation projects are designed from real needs of production; this is in addition to the lack of multidisciplinary approach to provide the results with the finishing degree they require (economic, social and environmental evaluation).

In the attempt to overcome these limitations, a group of technology management models in the university-enterprise relationship in the Cuban context has been designed, which includes: the result-oriented integrated science and technology management model for higher education institutions (Hernández *et al.*, 2006); the marketing approach for scientific activity (Gómez and González, 2006); the integrated model of science, technological innovation and knowledge management for the Agricultural University of Havana (Taboada, 2010); as well as a management system in the university-enterprise relation (Martínez, 2012).

The above-stated facts indicate that there are few organizational procedures to guarantee technology management in the university-enterprise relation in the animal husbandry sector. For such reason, this study approaches the foundation and proposal of a technology management model in the university-Cuban state animal husbandry enterprise relation –in a second part the methodology of implementation of the model and its validation will be presented.

Methodology

For the theoretical foundation of the model, the relationship of the technology management process between the University of Pinar del Río (UPR) and the Camilo Cienfuegos Genetic Animal Husbandry Enterprise (EPGCC, for its initials in Spanish) –Pinar del Río, Cuba– was analyzed. A diagnosis was made, through the non-probability convenience sampling method, on a representative sample of 89 professors-researchers from five departments linked to the agricultural sector (82,4 % of the net population), the nine directors of UEB (Basic Enterprise Unit, for its initials in Spanish) and the members of the management board of the enterprise (45,4 % of the net population).

As instrument a semi-structured survey was used for the university and the enterprise, besides personal interviews designed in correspondence with the object of study, both validated before their application to make the corresponding adjustments in their functionality.

These elements allowed to characterize the current status of the relation between the UPR and EPGCC and to elaborate the matrix of strengths, opportunities, weaknesses and threats (SWOT), with regards to: i) existence of technology management procedures in the university-animal husbandry enterprise relation, ii) the relations of the UPR with animal husbandry enterprises, iii) the main limitations that characterize the technology management process from the university towards the animal husbandry sector, iv) the technology management process of the EPGCC, v) the main limitations shown by the enterprise to establish relations with universities and research centers, and vi) the training on technology management in that enterprise.

Afterwards, the literature related to technology management process in the university-Cuban state animal husbandry enterprise relation was analyzed, which contributed elements to define the theoretical foundation and structural components of the model.

To develop the theoretical foundation of the technology management process in the university-Cuban state animal husbandry enterprise relation, a start was made from a set of contributions of the so-called integrated, dynamic and network models (Pérez, 2013; Castillo and Reyes, 2015); among them are: Sabato's triangle model, national innovation systems and triple-helix model. The last one is among the most widely used in Cuba, according to García-Cuevas (2016)¹ The characteristic traits of these models that are considered footholds for the proposal are:

- High importance is given to the holistic and interdisciplinary approach.
- The interdependent character takes precedence over the lineal or vertical one.
- Technology management, innovation and joint learning are considered essential elements; likewise, importance is given to the relations established among the components, in which the Government regulates and drives the demands that motivate project execution.
- The institutions are interconnected, contribute to the development and dissemination of new technologies, and contribute the framework within which the Governments carry out policies to influence the innovation process.

Among the practical antecedents of the model is the diagnosis, analysis of the SWOT matrix applied to the technological management process in the UPR and EPGCC, the studies conducted by Suárez (2003) and Martínez (2012), and the theoretical conceptualizations concerning technology management in the university-enterprise relation, at national as well as international level. The above-stated antecedents, along with the essential traits of classical models, supported the need to design and implement a technology management model that would contribute to the enhancement of the university-Cuban state animal husbandry enterprise relation.

It was considered that the university within the model participates in two directions: in one it arti-

¹Personal communication by José Luis García Cuevas, Ministry of Higher Education –Cuba–, September 6, 2016. In Cuba most of what has been done until now is based on the triple helix, with Dr. Maricela González (University of Pinar del Río), Dr. Jesús Suárez (Pasture and Forages Research Station Indio Hatuey) and Dr. Gilberto Hernández (Central University of Las Villas Marta Abreu) standing out.

culates the elements of the scientific environment, which makes it works as interface structure; and in the other, it facilitates advisory, training, introduction, generalization and follow-up of the research results in the state animal husbandry enterprise, with the participation of students and professors.

Results and Discussion

Diagnosis of the technology management process in the university-enterprise relation. Case study UPR-EPGCC

In the evaluation of the cognitive level about the technology management process in the UPR, 90 % of the professors-researchers expressed lack of knowledge about the existence of a technology management procedure in the university-enterprise relation for the farming sector. From them 79 % referred that the university (School of Forestry and Agronomy) established relations with the entrepreneurial sector for the technology management process; however, 94 % said that they were established personally.

The results showed a high percentage of exchange between the university and the entrepreneurial sector for technology management; nevertheless, 94 % of the answers considered such relations as not functional, because they lack legal contracts between the parties. This proved that there were initiation mistakes in the technology management process in the university-enterprise relation, because the main limitations were not analyzed among the specialists from both institutions.

Concerning these limitations, 85 % of the surveyed people expressed that the elaboration of R + D + i projects did not always derive from real productive needs. According to 64 % of them, the context was not diagnosed to determine the existing problematic situation, which causes the potential clients to ignore the results generated in the university and research centers (79 %); this motivated that most of the projects remain in the development stage and did not close the R + D + i cycle (74 %). Such results reaffirm the need to organize science from production needs; this process should be accompanied and advised by university professors-researchers to contribute to closing the research process cycle more successfully.

With regards to the cognitive level of the technology management process of the EPGCC, 100 % of the answers indicated that the technologies were adapted, while 30 % of the surveyed people

acknowledged the diffusion or transference of technologies developed in the enterprise towards other productive forms.

Among the main limitations of the enterprise to establish relations with universities and research centers the following were found: insufficient exchange spaces between the enterprise and the institutions (90 %), insufficient training actions associated to technology transference (80 %), long distance with regards to its geographical location (75 %), little knowledge of the offers provided (75 %), and difficulties in establishing and formalizing the contacts with these institutions (50 %). Such limitations hinder the development of technology management in the university-enterprise relation and, on the other hand, limit the advance of the research activity of undergraduate and graduate students and the expression of the maximum productive potential in the enterprise.

From the surveyed people, 65 % acknowledged that there was training for managers, technicians and specialists; however, 40 % stated that this training emerged from their own needs, and the rest (35 %), that it was proposed by universities and research centers.

In spite of the high percentage of answers related to training on the technology management process, it could be observed that it is still insufficient, because the actions contained in the reviewed plans are not in correspondence, mostly, with the workers' cognitive needs

From the results of the diagnosis the SWOT matrix of the technology management process in the university-enterprise relation was determined. This analysis showed that such process in the UPR-EPGCC relation was found in the reorientation quadrant, with an adaptive position.

The above-explained facts demand to assume a reorientation strategy aimed at the design of a technology management model in the university-Cuban state animal husbandry enterprise relation, which will be approached under the next headings, with a procedure that allows its implementation (which will be presented in part II of the paper).

Conception of the technology management model in the university-Cuban state animal husbandry enterprise relation

The proposed model is considered to be participatory, continuous and flexible (fig. 1), with a systemic, strategic and interactive approach, according to Campos *et al.* (2013). In this regard, Enríquez

(2014) considers that the interactive model, beyond its commercial character, has a wider social projection. This instrument, as scientific result, allows to go in depth into technology management, studies the essential relations between this process and the university-enterprise relation. It works through a sequence of phases and their corresponding steps, which are in correspondence with the classical elements of every management process (planning, organization, execution, evaluation and control).

The technology management model in the university-Cuban state animal husbandry enterprise relation, from the functional point of view, is integrated in the Strategic Planning of the Cuban Ministry of Higher Education: Innovative and Integrated University², in which it is stated that the Innovative University implies commitment, responsibility and social pertinence, articulation with territorial and national development, pertinent transformation of its substantive processes and systemic vision of its links with the innovation strategy of the enterprise and the society.

The characterization phase has as its main objective to diagnose the needs of the technology management process (TMP) in the university-Cuban state animal husbandry enterprise relation. The enterprise has a protagonist role in the identification of its needs, along with the university, which accompanies it in this process. In this phase the participation of specialists, managers and workers of the enterprise, and also of university professors and researchers, as well as using participatory methods for the diagnosis, is considered extremely important.

Once the needs of the TMP in the enterprise are identified, it is necessary to determine the possible alternatives (phase 2). This is achieved from the search for solution variants between the university and the enterprise.

In this phase the university acts as interface, through networking. Thus the innovation strategies of the university and the enterprise are re-elaborated, which respond to the local development strategy of the Government.

The third phase is related to the implementation of the actions of the technology management process in the university-Cuban state animal husbandry enterprise relation. These actions are materialized through the design and planning of development and

technological innovation projects and their execution, by means of training and advisory of the university and the scientific environment.

In R + D projects, the professors-researchers are protagonists of the process; while in innovation projects they become facilitators (González *et al.*, 2016). In the third phase a change should be generated in the functions of professors-researchers when innovation projects are developed. In this project type the enterprise assumes the protagonist role and the university accompanies the process through advisory and training; for such purpose the communication and commitment level reached in the relation between both institutions is important.

In the model evaluation and adjustment phase a group of indicators are suggested for the proposed dimensions (institutional feedback, economic-productive, environmental and social pertinence), which allow follow-up in each of the phases.

For the model adjustment performing annual workshops is proposed, in which the suggested indicators are analyzed, whose results would constitute the basis to establish a plan of feedback actions.

The connection among the phases constitute the model output, through the strategic planning in the relation between the university and the Cuban state animal husbandry enterprise.

Articulation among the model components

In the model (fig. 1) the following components were defined: university, enterprise, scientific environment and Government. The articulation among them allows to understand their functioning in the university-Cuban state animal husbandry enterprise relation.

The university executes Higher Education processes; while the enterprise is nourished from the university results, of the trained human capital as well as of the knowledge and technologies, to produce good and services according to the environment needs. The Government establishes a set of laws and regulations that determine their missions, functions, objectives, and regulates their management according to the environment demands and needs.

The systemic links between university, scientific environment and enterprise are manifested through concrete interactions related with each

²It refers to the instrument of the Ministry of Higher Education that contains the strategic objectives with their fulfillment criteria, for a certain period, which lead universities and research centers to the achievement of the mission and vision proposed

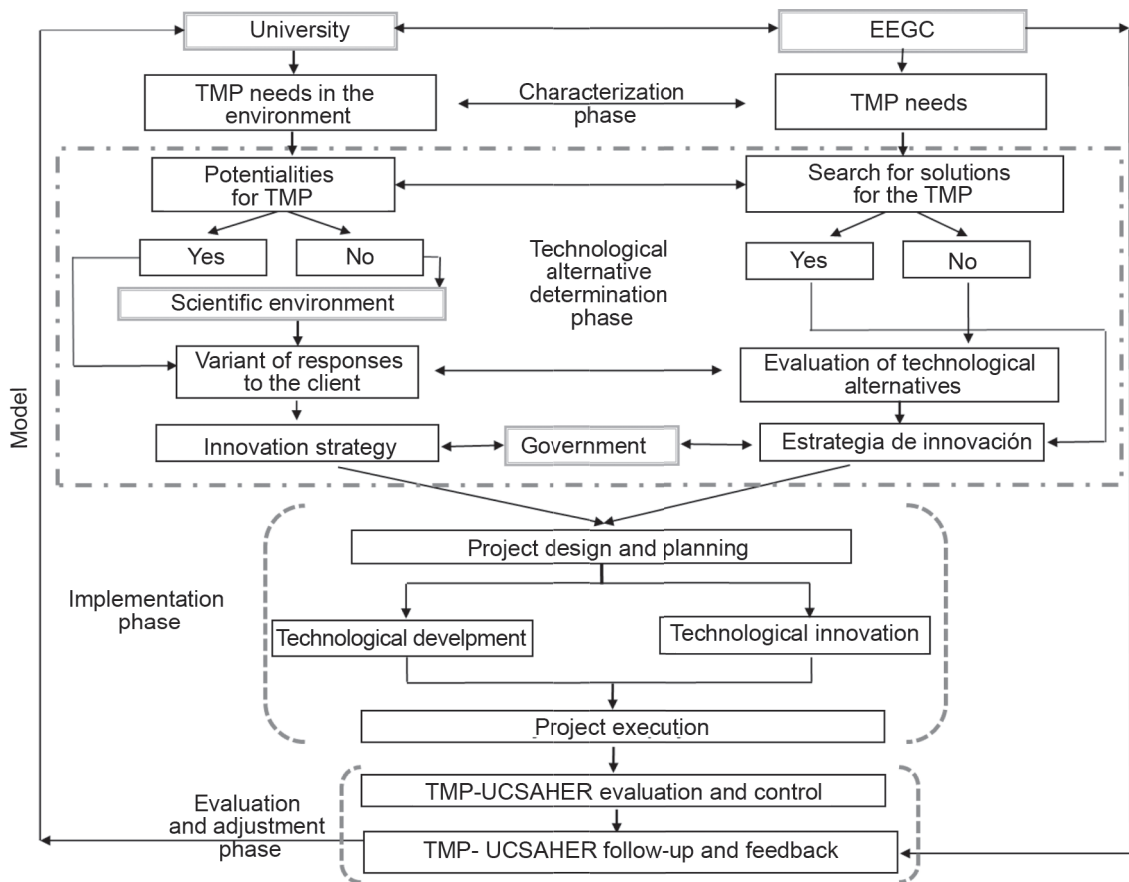


Figure 1. Technology management model to contribute to the enhancement of the university-Cuban state animal husbandry enterprise relation.

other. The university connects the scientific environment with the enterprise, as interface among the components. The interactions are given with strategic character, dynamism and normativity to obtain results with higher quality and social pertinence.

The technological, economic, juridical, political and environmental trends which are developed in the context influence the work objectives of the components, for which a change in them could originate transformations and modify the relations among them.

The interrelation among these four components is based on networking and multidisciplinary as distinctive quality of the model, from the dialectical relation between the planned character of the technology management process and the university-Cuban state animal husbandry enterprise relation.

Model structure. Main components

For the model structure common points and contributions referring to the denominations of the components of a model were determined; they

should be structured in a set of substantial elements: objective, principles, premises, components, essential relations and fundamental moments, according to Vargas (2013).

The objective of the model is aimed at facilitating the technology management process in the university-Cuban state animal husbandry enterprise relation, through the generation of knowledge and abilities and the learning, which would contribute to higher effectiveness in institutional feedback from contractual relationships.

Likewise, the fundamental principles that should rule the technology management process in the university-enterprise relation for the Cuban animal husbandry sector are:

- Flexibility: it allows each of the elements that compose the model to be adjusted, according to the characteristics of the university, the enterprise and the scientific environment in which it is developed, as well as adapted to the conditions of each moment (Taboada, 2010).

- **Integration:** it conceives an integrated approach in the processes and activities related to knowledge creation, planning, development, transference and utilization, with its effect not only on Higher Education processes, but also on the enhancement of knowledge and abilities and learning in the CSAHE. In addition, the improvement of this process is achieved in the integration of the model components (university, CSAHE, scientific environment and Government), in which the cooperation possibilities are utilized to develop the integration strategies.
- **Connectivity:** it is concreted in a necessary connection between the university and the CSAHE, to respond to the needs of the technology management process through projects.
- **That it is strategic:** it establishes the need of a proactive attitude towards changes in the environment, with the adoption of a strategic approach to the technology management process in the UPR- CSAHE. This is concreted in the university and the CSAHE as model components, to ensure the viability of knowledge and abilities and the learning that respond to the enterprise demands, according to the report by Heitor *et al.* (2014).
- **That is is systemic:** it expresses the cyclic and sequential character of the functions of the technology management process in the university-Cuban state animal husbandry enterprise relation, through the relations established among its components and feedback. This principle demands that the actions are related among themselves, go through different phases during their management, and are developed as a continuous, dynamic, participatory and flexible

process, so that the relation reaches its maximum development level.

The proposed model should consider the following premises:

- Political will for the technology management process in the UPR- CSAHE relation.
- Willingness and commitment by the actors implied in networking.
- That as a starting point the model responds to the needs of the technology management process in the university-Cuban state animal husbandry enterprise relation.

Model components

The analysis made from the results of the diagnosis and the study of the different theories related to technology management in the university- Cuban state animal husbandry enterprise relation allowed to define the model components (fig. 2).

In the model the university is supported on the substantive processes (teaching, research and extension work), which allows to manage technology with holistic and multidisciplinary approach, accompanied by professors and students.

The inputs of the model are conceived from the result of the diagnosis in the enterprise in interaction with the university, which is obtained with the application of different techniques and methods to compile and process the information. They mark the beginning of a set of phases and steps that lead to the model outputs, which would be incomplete without the criterion and active participation of workers, specialists and managers of the enterprise.

The Government, as one of the components, comprises the legal framework that regulates indi-

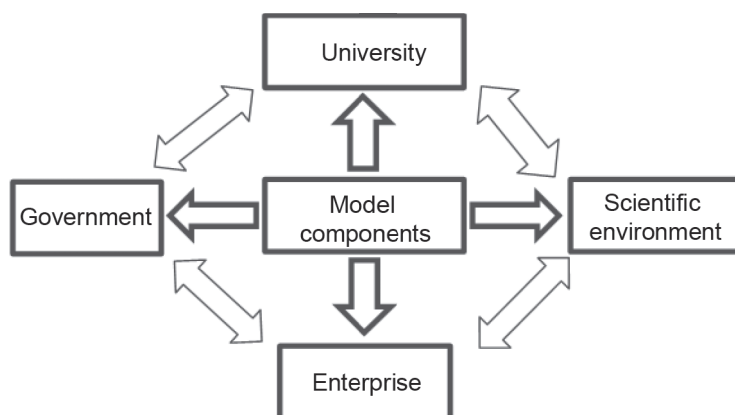


Figure 2. Model components.

vidually the university and enterprise actions; and becomes the regulating axis between the university and the enterprise, from its management with systemic, integral and sustainable approach that responds to a strategic vision.

The scientific environment, composed by other universities and research centers, is connected by the university, which makes it work as interface, and thus respond to the training, advisory, improvement and technology transference needs in the state animal husbandry enterprise.

Conclusions

Technology management in the relation between the University of Pinar del Río and the Camilo Cienfuegos Animal Husbandry Genetic Enterprise lacks systematization and spontaneity, which limits the improvements and technology transference in the enterprise.

The conception of a technology management model to contribute to enhancing the university-Cuban state animal husbandry enterprise relation is based on a group of procedures, developed from the functions of the management process (planning, organization, execution, evaluation and control), which constitute the basis of the methodology for its implementation. Likewise, this model is supported on several premises and principles and has fundamental characteristics that distinguish it.

The proposed model contemplates an integral, flexible and systemic approach of the technology management process in the university-Cuban state animal husbandry enterprise relation, as essential element to induce the desired change in the relation.

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