Article

Transference of Scientific Research Results of Universities through Company Incubators

Transferencia de resultados de la investigación científica universitaria a través de las incubadoras de empresas

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ABSTRACT

Aim: To propose a methodological design to transfer the results of scientific research through company incubators, which may improve the opportunities to create ties between universities and organizations.

Methods: Systematic bibliographic review, triangulation, case study, user criteria.

Main results: A management methodology was designed for transferring the results of scientific research of universities through company incubators. A system of procedures was created, which allowed for the implementation of the proposal in sales and transferring, the completion of research cycles, and the promotion of new projects in business incubators.

Conclusions: The feasibility of business incubators was demonstrated as an interface of university-company ties. A system of procedures was generated; it was

associated to the stages of result transference management. Opportunity matrices for transference were designed from indicators of project selection results, which formed a portfolio of opportunities to create ties with the business sector. The design of the methodology for result transference process management was validated through a set of 118 impact research studies at the University of Oriente, Cuba.

Key words: transference of research results; university business incubators; university-company ties.

RESUMEN

Objetivo: Proponer un diseño metodológico para la transferencia de los resultados de la investigación científica a través de incubadoras de empresas, que mejore las oportunidades de vinculación entre la universidad y las organizaciones.

Métodos: Revisión bibliográfica sistemática, triangulación, estudio de caso, criterio de usuarios.

Principales resultados: Se diseñó una metodología de gestión para la transferencia de los resultados de la investigación científica de las universidades hacia las incubadoras de empresas. Se obtuvo un sistema de procedimientos que permitió implementar la propuesta en la actividad de comercialización y transferencia, potenciar el cierre de ciclo de los proyectos de investigación y estimular la realización económica de los proyectos en las incubadoras de empresas.

Conclusiones: Se demuestra la factibilidad de las incubadoras de empresas como interfaz en la vinculación universidad-empresa. Se obtuvo un sistema de procedimientos asociados a las etapas de la gestión de la transferencia de resultados; se diseñaron matrices de oportunidades de transferencia a partir del empleo de indicadores de selección de resultados de proyectos, que conformaron una cartera de oportunidades de vinculación con el sector empresarial. Se validó el diseño de la metodología de gestión del proceso de transferencia de resultados,

mediante un conjunto de 118 investigaciones de impacto de la Universidad de Oriente.

Palabras clave: transferencia de resultados de investigación; incubadoras universitarias de empresas; vínculo universidad-empresa.

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INTRODUCTION

University exchanges with other socioeconomic actors have increased since the 1990s, due to the growing momentum of business universities in the United States (Smilor, Dietrich, & Gibson, 1993), entrepreneurship universities in European countries (Etzkowitz, 1998), developmental universities in Latin America (Arocena & Sutz, 2005), and more recently, glocal universities (Roessler & Hachmeister, 2015). The direct participation of universities in collaboration and exchange networks that enhance their role as providers of solutions, is considered today as "the most striking organizational innovation associated to the diffusion of a new knowledge generation pattern, which connects technological innovation and development directly, within the context of application" (Lastres and Cassiolato, 2007, p. 106).

The interaction of universities with the business fabric opens new channels of collaboration, allows for policy updating, science and innovation strategies, designs specific more oriented processes to the diffusion and introduction of scientific research results in other scenarios, and favors the so called knowledge enhancement. The university model that has been established in many countries since recent decades confers high importance to the generation, diffusion, and

application of knowledge, which is part of its “third mission” (Etzkowitz, 1983). Along with its traditional teaching and researching, this has favored the deployment of a set of actions that link university to society.

University business incubators play an essential role in spreading innovative process results. Internationally, these entities have been created since the last two decades of the Twentieth Century, becoming instruments to promote innovation of results of scientific research (Correa and Versino, 2015). Conceived as institutional structures to facilitate and promote the productive utilization of knowledge generated in the academic context, they support the creation of small companies, based on their participation in the design of economic development models (Passos, Terra, Furtado, Vedovello & Plonski, 2012), the formalization of informal businesses, and the creation of companies in business unit pools by sectors (Devol & Lee, 2017). However, studies done by (2018), Chía (2017), and González and Batista (2017), refer to little involvement of company specialists in university projects, inconsistencies in identification of demands, and their correspondence with the expected results, which often causes no implementation of the budget for this activity, noncompliance with the delivery deadlines, and abrupt termination of fundamental research stages, fostering negative influences on future alliances.

The bibliography consulted (Alpizar, Robaina, and Dentchev, 2018; Rubio, 2016), and the practical experience of researchers, offer some of the most general aspects that hinder the development of university business incubators, in terms of transferring scientific research results, which are linked to:

1. Insufficient knowledge of management processes, and the lack of feasibility studies so that the transference of research results is more successful.
2. The absence of business models, and sale and result transfer strategies capable of validating and tone reduce functions of organizational structures engaged in promoting links between companies and society.
3. The poor interrelation of activities and integration processes of technological management and transference of results with other strategic processes of the

university, that add value to the chain of inter-institutional ties, especially the company-university tie.

The above leads to a question: How to manage the business incubator to transfer the results of scientific research at the universities? Accordingly, the aim of this paper is to explain the general elements that permit the design of a methodology that enhances managing business university incubators to transfer the results from scientific research, grounded in the entrepreneurial character of universities. This article stems from the main causes and circumstances that originate low transference of scientific results within the university context, and to acknowledge the role of university business incubators in dynamizing the processes of transferring these results.

DEVELOPMENT

Universities, by definition, are institutions in charge of producing scientific-technological knowledge, and key actors of social innovation processes. Currently, they are being revalued as to their potential contribution to the economic development of society. Therefore, they are complex, flexible, resilient, and dynamic entities that need constant integration, building, and re-configuration of science results, as valuable resources capable of meeting demands among the troubling context they operate in.

In turn, companies are driven by the need to introduce new products and services in the market, to have advantages over their competitors. Through this interaction, they seek to associate their research and development tasks to other social actors, making optimum use of human resources from public organizations, who are engaged in scientific and technological research. These processes acquire several forms of social structuring, based on the contexts they interact in. Thus, in general terms, if developed countries see this as a diagnosis of the situation, in Latin

American countries this situation, is especially presented as a regulating speech (Romero, 2016).

Innovation policies are usually driven by government; they focus on promoting interaction between companies and knowledge-generating institutions, such as universities. University-society relations are designed from this level, in order to favor the interactions of scholars with industry and business people from different companies and technological processes. In addition to the previous, they try to extend the support to these ties, including other sectors, like services, public administrations, and other social agents, thus adding a social dimension that promotes culture in the intra- and extra-university community, as part of their contribution to cultural development (Nunes & Machado, 2018).

1. Business incubators in the process of transferring results from scientific research

Science is a social system that should be managed through factual elements. They include diagnosis of knowledge and capacities, the existence of policies and regulations regarding the use and application of knowledge, procedures that standardize and evaluate research, governance modes, the projection of scenarios, and technological prospects to plan the cycles of I+D+i, and others.

Knowledge transference emerged in the 1990s as a process through which research was pushed into the market. The definitions of Argote and Ingram (2000) permit a close glimpse into the process of knowledge transfer, as the manner through which an organization is affected by the experience of others, influencing on the organizational behavior, routines, competences, and dynamic capacities.

The act of technology transfer involves knowledge (Pinto & Guerreiro, 2018), and timely management. According to Lage (2013), knowledge management means identifying it when it is generated, to capture or fix it in patents of products or process regulations to perform evaluation, and spread it in an organized way at the different stages of a project life cycle. The abilities and techniques used in knowledge management have been tackled from several different perspectives,

models, and approaches. Some of them are Project Management Body of Knowledge [PMBOK], 2017), UNE Standard 166002:2014 Management of R+D+i: Requisites of R+D+i management (Spanish Association of Standardizaton and Certification [AENOR], 2014), and UNE Standard 166008:2012 Management of R+D+i: technology transfer (AENOR, 2012). Based on the process management approach, these regulations allow for a closer look into the structure of research as a creative act, and permits modeling stages and phases that support inter-organizational ties, which take place and are strengthened from substantive processes, with the participation of University- Company- Government.

To perform the previous, the support of inter-phase structures, like The Offices for Transference of Research Results, is vital. They go beyond the traditional boundaries of institutions and university functions (Callaert, Van Looy, Foray & Debackere, 2008). These structures have fostered an entrepreneurial spirit among teachers and researchers, now seeking economic realization of knowledge in association efforts, transference contracts, and specialist exchanges between the academy and industry, one intrinsic element of strategic planning in almost all the contemporary universities (Fini, Rasmussen, Siegel & Wiklund, 2018).

According to Hermans and Castiaux (2007), the knowledge generated in universities not only contributes to education of future professionals and employees, but also to the development of research, and its dissemination. It implies process management that complement these actions through different channels or modalities. To ensure the above, policies and strategies related to university innovation should foster and encourage the implementation of research projects centered on “--the transference of results from scientific research, and turn them into commercial applications for public use and social benefit” (Ritter & Vitale, 2013, p. 97). That is the way universities are leading the transit of territories from simple productive enclaves to innovating environments; they favor this projection toward the multiplication of interactive spaces of learning, and orient innovation as a way to solve relevant social problems (Soulary, 2015).

Technology transfer is a specific way to link the university to the business sector. It covers processes and systems through which knowledge, experience, and science results are implemented, with ensued innovating improvements, that can become an innovative force of development in universities as well as in territories. The third mission of universities, which is included in its driving principles, points to the transference of technologies and knowledge, and to off-campus endeavors. These actions represent the foundation of the university ties with the business sector, the best way to generate economic value, and social and environmental impacts, based on the application of innovations. Thus, they have become the dynamizing force of development in universities as well as in the territories where they are located.

The Ibero-American manual of university association to the socioeconomic environment (Ibero-American Network of Science and Technology Indicators [RICYT], 2017) considers that the actions related to the transference of results in the third mission are linked to:

1. The generation of knowledge and capacities, in collaboration with non-academic agents, and the creation of legal and cultural frames that orient the opening of universities to that scenario.
2. The use and application of other capacities existing outside the university academic environment include training, service provision, advisory, and consulting.

Likewise, this Manual establishes that the transference of results comprises these modalities:

a) Technological ties; industrial and intellectual properties; entrepreneurship (creation of companies).
b) Student stays, staff mobility, extracurricular courses and education, creation of networks whose results contribute to scientific research.
c) Sale of scientific research results.

d) Research contracts, advisory and consulting based on research projects.
e) Nonacademic dissemination

Within the university-company bond (UCB), Etzkowitz (2016) defines the transference of results as a bidirectional flow from university to industry, and vice versa, with different levels and forms of academic engagement, in which the modalities below coexist:

1. The product is originated at the university, but its development takes place in companies.
2. The commercial product is originated outside the university, but seeks academic knowledge to enhance the product.
3. The university is the source of the commercial product, and the researcher is directly engaged in sales through a new company.

Based on systematic reviews, this research considers that the transference of research results is a transitional stage throughout the sales process, and it is part of the value chain, that comprises research through the transformation of that result into improved products or services, which respond to social problems. The above-mentioned implies that transference is a process, and as such, can be divided into inputs, actions, and outputs. Although this process is typically linear, most of the literature reviewed includes identification of the knowledge created, its protection by some modalities of intellectual property, plus agreement discussions _generally through tangible asset licenses_, conceptualization of sale strategies through business models that assume several mechanisms of transference, and finally, planning of socialization and Getting Started of results, which includes education and training, as part of knowledge transference.

The issue of business incubators goes back to the 1950s, mainly in the United States and Western Europe (Lalkaka, 2002). Today, incubators have become a university development line due to their importance for economic progress of countries. Ratinho and Henriques (2010), and Devol & Lee (2017), acknowledge that incubators can be described as knowledge developing and driving entities of

knowledge and research, sources that generate inter-institutional networks, strategies that back up the results from scientific research in certain sectors, angel investors. They ensure the formalization of informal businesses, and pools of companies into business units, by sectors.

The great challenge of developing university business incubators as inter-phases of scientific research results, is to articulate the actors that intervene in transference processes, assure research project incubation that contributes to institutional development and the welfare of society, and to integrate them into strategies through which their roles and scopes can be materialized. Another interesting challenge to the new governance models of UCB is the need to implement diagnostic actions to evaluate ex-prior, prior, and ex-post events moments of processes that take place in research project development; contribute to the methodological rationale of knowledge management processes and technologies; and suggest a strategy that mediates as a management instrument in the transference of results of research projects ready for the productive sector and society in general.

2. Methodology to transference scientific research results of universities through company incubators

A methodology results from the expression of the method, which functionally and operationally allows for the transformation of an object, the desired initial state, through a logical sequence of procedures and steps (Eyssautier de la Mora, 2006). The aim of the methodological proposal presented is to contribute to a stronger role of business incubators in UCB, based on the identification and valorization of scientific research results that can be transferred to third parties, and meet their demands.

The proposal facilitates the integration of strategic processes that surround science and technological innovation projects, and ensures the fertilization of value chain of project management processes, and transference of results. Feedback, control, and continuous improvement guarantee the identification of the result from

scientific activity as a potential opportunity of association, it can be transferred as a result that meets certain requisites that valorize it, thus stimulating the whole R+D cycle, the sustainability of science and innovation indicators of the university, and the efficiency and competitiveness indicators of the company.

The new proposal considered the limitations and divergent elements of some manuals for evaluation of the activities of the third mission used by Latin American countries (Jaramillo, Lugones & Salazar, 2001; Ibero American Network of Science and Technology indicators (RICYT), 2017). The theoretical and methodological foundations of this proposal stem from the systematic use of the background principles of the theory of inter-organizational relationships, the logic and administration of organizations, the concept of dynamic capacity materialized in innovating and off-campus activity capacity of the university. The premises that set boundaries of the intentionality of the methodology, and establish the conditions for its application are below:

1. The transfer of scientific research results is a strategic process stated in the social object of the university. This nationally established priority that encourages universities to take a key role within science and innovation policies.
2. The academic community has the will, commitment, and leadership to carry out the different stages of the process of transferring scientific research results, and the decision makers have validated the transference of results as the closing of the project cycle.
3. Managing the transference of scientific research results guarantees the accomplishment of the social responsibility of the university, and contributes to the improvement of science and technological innovation indicators.
4. The methodology may be generalized to other institutions of higher education to standardize the whole set of stages, processes, and activities related to transference and sale of scientific research results to other economic actors.

The following principles become distinctive elements of the methodology proposed:

1. Flexibility and integration: a quality of the methodology that allows for the integration of other processes and activities to science and technological innovation projects.
2. Resilience: this methodology allows for a continuous reconfiguration of resources and competences, which have a favorable impact on the improvement of academic capacities, so they can adapt and evolve naturally, in fast-changing environments.
3. Participation and learning: the capacity of the methodology to facilitate joint participation and bidirectional learning, fertilize the management process of scientific research transference of results, and provide feedback, seeking optimization, pertinence, and updating.

This proposal shows the interaction and interdependence of four stages that comprise six main activities, which receive feedback, and execute transversal monitoring and control. The stages and activities evolve naturally if the requisites for the input elements of each stage are accomplished. It facilitates the continuity of the conformation process of results, until a transferable salable product can be obtained in the application context demanded. The methodology is deployed at the time impact results of science and technological innovation are produced, by establishing the input requisites and conditioning the dynamic flows between stages in a recursive way (Fig.1).

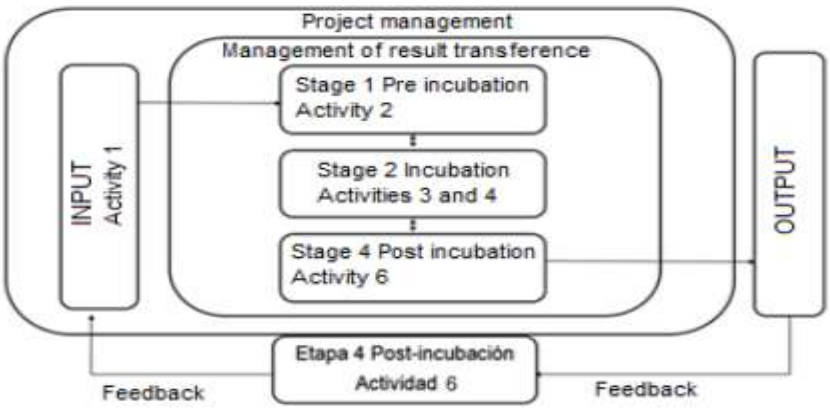

Fig.1. Model for managing the transference of results

Iterativeness is a trait of the methodology that is manifested in the manner in which the different stages are combined and conditioned, providing the flexibility required in this activity, due to its dynamisms and exchange level among the actors engaged in each stage. The possibility of incorporating the company from the very first phase, when the result is pre-incubated, before transference, confers reciprocity and exchange to every action taken at different phases of the methodology, since companies also approach universities and involve them in joint development of solutions, seeking solutions to their demands.

All the above elements permit operationalization of the methodology, and have been conceived from the utilization of methods, techniques, and scientific tools, which make the integration of three strategic processes possible: project management, management of result transference, and sales. This integration favors the natural cycle assumed as a result, when its evolution is encouraged outside the laboratory. The benefits of the application of the model suggested are given by:

1. Physical space for development of transference actions with shared infrastructure and basic inputs, access to information and technological services, in a scenario where the strategic units can share their experiences and results, reducing the risks that come along the beginning of the incubation process.
2. Acquisition of theoretical and practical foundations needed for the process of transference and incubation, in topics like legality, organization, management, technical support, financial and commercial planning, design and communication, sources of funding, strategic planning, entrepreneurial behavior, advertisement tools, etc.
3. Incorporation to association and institutional support processes to access financial sources and communications.
4. Management support to access external funding sources, outside the university.

5. Creation of tools that allow for development of an entrepreneurial attitude, related to business plans, the search for new markets, and future investors.

3. Description of stages and activities that make up the methodology

The stage, its objectives, main processes, activities, outputs, methods, and techniques that back it up, and the benefits of each stage suggested, are shown in Table 1.

Table 1. Stages, objectives, activities, and methods used to design the methodology

Stage	Objective	Process	Activities	Output	Methods and techniques	Benefits
Input	Study the results sheet.	Debugging	A1: To evaluate the results from scientific research according to selection criteria established by a team of experts.	List of results for transference	Literature review	To haves access to an initial list of results for their potential transference.
Pre-incubation	To select the impact results with a potential for transference.	Filtrate	A2: To make a matrix of potentially transferable research results.	Map of opportunities	Literature review User opinions Direct observation	To design a map of potentially transferable results. Design of a product or result sheet for socialization
Incubation	Valorize the matrix of opportunities.	Valorization, selection, and business discussions	A3. To set up a portfolio of transference opportunities. A4: To create a transference file including the research results.	Portfolio of transference opportunities of the sector of interest Transference file including the research results.	Feasibility analysis Literature review Expert opinion Direct observation	Creation of a multidisciplinary work group for transference. Business plan design oriented to result transference. It fertilizes the value chain of the process of result transference.
Transference	To transfer the result according to the modality agreed.	Transference	A5: To design a transference timetable, and establish conditions.	Transference modality Contract	Literature review Expert opinion Risk map and matrix	It make transfer of results possible for absorption by the business sector.
Post-Incubation	To provide advise during the process of result absorption and assimilation.	Feedback	A6: Control and improvement	Report of process closure Indicators Map of risks	Literature review User opinions	It makes feedback, scientific, and technological exchanges possible. It allows for identification of process risks. It strengthens the role of the university as provider of knowledge and solutions.

3.1 Inputs The whole of scientific research results achieved through university projects, and the demands of economic and social sectors.

Activity 1 (A1). To evaluate the results from scientific research, according to selection criteria set by a team of experts.

The results achieved through research projects are evaluated as a whole, within a given period, based on the following selection criteria established by the team of experts, which consider international references and practical experience of the participants in the process: technological maturity of the solution, technical and economic feasibility studies, and the existence of intellectual property rights. These criteria are the basis to estimate their level of transference. A list of results considered the starting point of the methodology, is made.

3.2 Stage I. Pre-incubation: It consists in selecting the scientific research results, which have been validated as achievements by the Scientific Council of the university, and meet these conditions:

1. They have been applied.
2. Their economic, social, and other impacts have been proven for the set national priorities.
3. They are the consequence of the application and generalization of results from research, accomplished in every faculty, research unit, or university.

Activity 2 (A2). To design a matrix of research results that can be potentially transferable.

The team of experts will review the results from research, and will perform a case evaluation which could generate any transference or sale actions, considering the priority stated by the business sector. The list ensures the generation of a map of opportunities, which is the threshold to the next stage.

3.3 Stage II Incubation It comprises a set of actions directed to the creation of a file of transference of results, by defining the elements of the business model for each research result. It comprises the activities below:

Activity 3 (A3). To set up a portfolio of transference opportunities. It complements activity A2, and focuses on the establishment of possible results to advertise, sell, or transfer by sector, considering the results of: a) the technical and/or economic feasibility study; b) the request of intangible assets record or that the result is considered potentially salable know-how; c) the test stage of the concept, and

definition of the requisites for introduction of the research result. The result is a matrix of transference opportunities by sector of interest.

Activity 4 (A4). To prepare a research result transference file.

This activity allows for visualization of results, the accomplishment of the above requisites, and estimation of the value proposal, communication channels, relations with customers, income sources, key activities and relations with suppliers, resources, and costs.

3.4 Stage III Transference: This is the first step into research result sales. It includes the design of familiarization and assimilation actions of the research results, and the timetable for implementation of technical and training activities needed to make the transference of results possible. It is considered a non-linear stage within its conception; that is, there may be moments in the timetabled implementation when activities are iterative, with constant feedback and optimization, based on the process of result assimilation in the concrete business or social context.

Activity 5 (A5) To design the transference timetable, and set up its conditions.

This activity includes training and preparation at the workplace, of subjects who will assume the transference of the research result within the company scenario. It will include technical assistance during the period agreed by the participant parties. The activities related to the process are recorded in a transference memoir, and follow-up and monitoring actions are designed, which might unleash other mid- or long term actions with the same company. The contract and invoicing procedures, backing the transference of the result, are signed, according to the modality convened, which includes licensing, leasing or selling products and services.

3.5 Stage IV Post-Incubation: It is intended for improvement and optimization of the incubation process. Indicators are assigned and applied, and the risks threatening the normal performance of transference activities are estimated. It includes the satisfaction level of the business and social sectors, and makes mid or long-term business discussions of other actions with the participating organizations.

Activity 6 (A6). Control and improvement

It consists in documenting the improvements introduced and the potential funding from the interaction with the beneficiaries of the result transferred. The changes suggested can make up the bases of potential requests for co-authorship, if they have been achieved through shared efforts. A report is made when the process is closed.

4 Validation of the technology

The objective of validation is to check if the methodology suggested corresponds to the system behavior in a real scenario, and if it satisfies its beneficiaries. It permits optimization of the design, better interaction of elements, and encouragement of flexibility and resilience.

To validate the proposal, the following methodological scheme was followed:

1. Presentation of the conceptual grounds in a methodological workshop, to 13 experts whose level of competence was determined through software Decisiones® (version 1.0), as shown in Fig. 2.

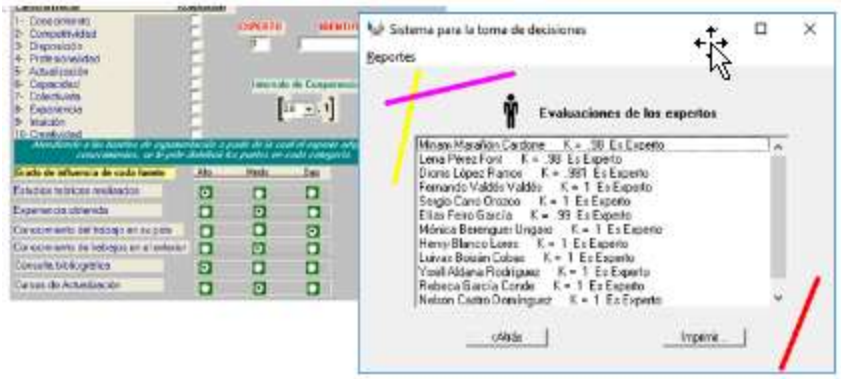

Fig 2. Screenshot of software Decisiones ® (version 1.0) for evaluation of expert competences

2. Validation of the methodological premises in a workshop with the experts identified, and 35 specialists and actors engaged in science and technological innovation processes. The method of user opinion, which has a qualimetric nature, and has been adjusted from the Design of User Experience, for computer

programming, was used (Garret, 2011; Kuniavsky, 2003). The matrix describing the results was made in Excel calculation sheet, Office 2016 (Table 2)

Table 2. Results of evaluation of premises

Premises	1		2		3		4		5		Mid
	Votes	Value	Votes	Value	Votes	Value	Votes	Value	Votes	Value	
Premise one: There is a political will from the state that favors the participation of higher education institutions in the updating of the Cuban model for economic development.							3	12	10	50	4.77
Premise two: The transference of scientific research results is part of the social responsibility of the university.					1	3	3	12	9	45	4.38
Premise three: Will power, commitment, and leadership in the academic community to implement the different stages of scientific research result transference.					2	6	2	8	9	45	4.08
Premise four: the company demands new research challenges from universities that contribute to critical problem solutions.					1	3	8	32	4	20	4.00
Premise five: Valorization and introduction of legitimate scientific research results validates end of the project cycle, and favors its economic realization.					2	6	5	20	6	30	3.85

3. A methodological workshop was held with the presence of specialist, who answered a survey to validate the parameters needed for the methodology to be implemented: 1) practical usefulness; 2) operationalization; 3) flexibility; 4) adaptability; 5) integration; 6) compatibility; 7) rationality, which were evaluated at three levels: high, mid, and low. The results were summarized and tabulated, using SPSS (version 22) (Table 3), in which the Cronbach Alpha value was 0.824, to prove the validity of the instrument.

Table 3. Results of expert validation of parameters

Parameters	High	Mid	Low
Practical usefulness	30	5	0
Operationalization	32	3	0
Flexibility	33	2	0
Adaptability	32	3	0
Integration	33	2	0
Compatibility	27	8	0
Rationality	34	1	0

4. As a result of this validation, the Ladov test was suggested for implementation and evaluation of the proposal (Fernández and López, 2014). This instrument was useful to estimate the validity, pertinence, and viability of a methodological proposal, and obtain the group satisfaction index (GSI) from experts. The importance and methodological usefulness of the methodology suggested was evaluated (Table 4).

Table 4. Ratio between individual and group satisfaction (GSI), based on the application of the Ladov test to experts

Scale	Significance		Individual satisfaction	Results
+ 1	A	I like it a lot	30	85.71%
+ 0.5	B	I like it more than I dislike it	5	14.28%
0	C	I don´t mind	0	0
-0.5	C	I dislike it more than I like it	0	0
- 1	E	I don´t like it	0	0
		TOTAL	35	100

GSI calculation

$$GSI = \frac{\mathrm{A}(+1) + \mathrm{B}(+0.5) + \mathrm{C}(0) + \mathrm{D}(-0.5) + \mathrm{E}(-1)}{\mathrm{N}}$$

$$GSI = \frac{30(+1) + 5(+0.5) + 0(0) + 0(-0.5) + 0(-1)}{35}$$

$$GSI = 1$$

CONCLUSIONS

Business incubators are a widely, internationally used inter-phase to manage transference of research results. However, in the Latin American context, managing studies and the related literature in terms of good practices are not abundant, which creates a compelling need to develop local management models that fertilize science and technological innovation.

The methodology proposed is a useful tool to close project cycles, valorize scientific research results, and to transfer products and services to the business sector that demands them.

The validation of the methodology in two methodological exercises that involved groups of experts and specialists, who are users of the proposal evaluated in this study, was helpful to check its pertinence and feasibility, process iteration, and the flexibility of the phases included, thus corroborating the quality of the results achieved. The utilization of risk matrices, and their timely identification may lead to new improvement actions aimed to obtaining better practices to establish university

ties with other socioeconomic actors, based on business incubators, and then fertilize the implementation of the third mission.

REFERENCES

Alonso, R. (2018). *La ciencia en Cuba, una mirada a sus retos y proyecciones*. [programa de televisión Mesa Redonda]. La Habana, Cuba: Cubavisión Internacional.

Alpízar, M. A., León, R. y Dentchev, N. (2018). Barreras para la comercialización de resultados en la relación universidad-sector empresarial en Cuba. *Retos de La Dirección*, *12*(2), 111–132.

Argote, L. & Ingram, P. (2000). Knowledge Transfer : A Basis for Competitive Advantage in Firms. *Organizational Behavior and Human Decision Processes*, *82*(1), 150–169. doi: 10.1006/obhd.2000.2893

Arocena, R. & Sutz, J. (2005). Latin American Universities: From an Original Revolution to an Uncertain Transition. *Higher Education*, *50*(4), 573–592. doi: 10.1007/s10734-004-6367-8

Asociación Española de Normalización y Certificación (AENOR). (2012). *Gestión de la I+D+i: Transferencia de tecnología UNE 166008:2012.* Retrieved from https://prevention-world.com/empresas/directorio/aenor-asociacion-espanola-de-normalizacion-y-certificacion/

Asociación Española de Normalización y Certificación (AENOR). (2014) *Gestión de la I+D+i: Requisitos del sistema de gestión de la I+D.* Retrieved from https://prevention-world.com/empresas/directorio/aenor-asociacion-espanola-de-normalizacion-y-certificacion/

Callaert, J., Van Looy, B., Foray, D. & Debackere, K. (2008). Combining the production and the valorization of academic research: a qualitative investigation of enacted mechanisms. In A. Mazza, C. Quattrone & P. Riccaboni (ed.), *European universities in transition: issues, models and cases*

(pp. 96–137). Retrieved from https://www.e-elgar.com/shop/european-universities-in-transition?___website=uk_warehouse

Chía, A. (2017). *Financiamiento de ciencia en Cuba*. La Habana, Cuba: Editorial Félix Varela

Correa, F. y Versino, M. (2015). Relaciones universidad-empresa : ¿y cuando la universidad es la empresa ? *Cuestiones de Sociología*, (*12)*, 1–12. Retrieved from http://www.bibhuma.fahce.unlp.edu.a

Devol, R. & Lee, J. (2017). *Concept to Commercialization The Best Universities for Technology Transfer*. Retrieved from https://milkeninstitute.org/sites/default/files/reports-pdf/Concept2Commercialization-MR19-WEB.pdf

Etzkowitz, H. (1983). Entrepreneurial scientists and entrepreneurial universities in American academic science. *Minerva*, *21*(2), 198–233. Retrieved from https://www.jstor.org/stable/41820527?seq=1

Etzkowitz, H. (1998). The norms of entrepreneurial science: cognitive effects of the new university–industry linkages. *Research Policy*, *27*(8), 823–833. doi:10.1016/S0048-7333(98)00093-6

Etzkowitz, H. (2016). The Entrepreneurial University: Vision and Metrics. *Industry and Higher Education*, *30*(2), 83–97. doi: 10.5367/ihe.2016.0303

Eyssautier de la Mora, M. (2006). *Metodología de a investigación. Desarrollo de la inteligencia* (5th. Ed.). Maidenhead, England: Cengage Learning.

Fernández, A. y López, A. (2014). Validación mediante criterio de usuarios del sistema de indicadores para prever , diseñar y medir el impacto en los proyectos de investigación del sector agropecuario. *Revista Ciencias Técnicas Agropecuarias*, *23*(3), 77–82. Retrieved from http://scielo.sld.cu/scielo.php?pid=S2071-00542014000300012&script=sci_abstract

Fini, R., Rasmussen, E., Siegel, D. S. & Wiklund, J. (2018). Rethinking the Commercialization of Public Science: From Entrepreneurial Outcomes to Societal Impacts. *The Academy of Management Perspectives*, *32*(1), 4–20.

doi: 10.5465/amp.2017.0206

Garret, J. J. (2011). *The elements of user experience: User Center Design for the web and beyond* (2nd. Ed.). Retrieved from https://www.cui.edu/en-us/index/rs/SEM-Always-On-Keywords-(brand)-University-Of-California?network=g&gclid=EAIaIQobChMIzY-5pbW_5wIVjoVaBR0M1wNwEAAYASAAEgKt_PD_BwE

González, O. y Batista, A. (2017). Gestión de la calidad del proceso extensionista en la Universidad de La Habana. *Revista Cubana de Educación Superior*, *36*(1), 94–108. Retrieved from http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0257-43142017000100009

Hermans, J. & Castiaux, A. (2007). Knowledge Creation through University-Industry Collaborative Research Projects. *The Electronic Journal of Knowledge Management,* *5*(1), 43–54. Retrieved from https://researchportal.unamur.be/en/publications/knowledge-creation-through-university-industry-collaborative-rese-2

Jaramillo, H., Lugones, G. y Salazar, M. (2001). *Manual latinoamericano de indicadores de innovación tecnológica*. Bogotá, Colombia: Red Iberoamericana de Indicadores de Ciencia y Tecnología, Organización de Estados Americanos y Programa CYTED COLCIENCIAS/OCYT.

Kuniavsky, M. (2003). *Observing the user experience: a practitioner's guide to user research.* New York and London, EUA: Morgan Kaufmann Publishers and Elsevier.

Lage, A. (2013). *La economía del conocimiento y el socialismo*. La Habana,Cuba: Editorial Academia.

Lalkaka, R. (2002). Technology business incubators to help build an innovation-based economy. *Journal of Change Management*, *3*(2), 167–176. doi: 10.1080/714042533

Lastres, H. M. y Cassiolato, J. E. (2007). Innovación, información y conocimientos: la importancia de distinguir el modo de la moda. In A. Gallina, J. Capecchi, J.

Núñez y L. F. Montalvo Arriete (Eds.). *Innovaciones creativas y desarrollo humano* (pp. 101–117). Retrieved from https://rucforsk.ruc.dk/ws/portalfiles/portal/4339590/Innovaciones_creativas.pdf

Nunes, A. M. y Machado, M. B. (2018). Enseñanza superior y sociedad : un estudio exploratorio sobre prácticas de la tercera misión en la Universidad Estadual de Campinas (Unicamp). *Journal of Management Innovation*, *13*(4), 94–104. doi:10.4067/S0718-27242018000400094

Passos, A. S., Terra, R. C., Furtado, A. T., Vedovello, C. & Plonski, G. A. (2012). Improving university-industry partnership: The Brazilian experience through the scientific and technological development support program (PADCT III). *International Journal of Technology and Globalisation*. Retrieved from https://www.researchgate.net/journal/1476-5667_International_Journal_of_Technology_and_Globalisation/3?sortBy=hash

Pinto, H. & Guerreiro, A. (2018). Resilience, Innovation, and Knowledge Transfer: Conceptual Considerations and Future Research Directions. In H. Almeida & B. Sequeira (Eds.). *The Role of Knowledge Transfer in Open Innovation* (pp. 281–299). doi: 10.4018/978-1-5225-5849-1.ch014

Project Management Body of Knowledge (PMBOK). (2017). *A Guide to the Project Management Body of Knowledge.* (6th. ed.). Retrieved from https://es.scribd.com/book/359259046/A-Guide-to-the-Project-Management-Body-of-Knowledge-PMBOK-Guide-Sixth-Edition

Ratinho, T. & Henriques, E. (2010). The role of science parks and business incubators in converging countries : Evidence from Portugal. *Technovation*, *30*(4), 278–290. doi: 10.1016/j.technovation.2009.09.002

Red Iberoamericana de Indicadores de Ciencia y Tecnología (RICYT). (2017). *Manual Iberoamericano de indicadores de vinculación de la universidad con el entorno socioeconómico.* Retrieved from http://www.ricyt.org/category/manuales/

Ritter, M. E. & Vitale, A. L. (2013). Technology transfer and innovation: The role of

the Brazilian TTOs. *International Journal of Technology Management & Sustainable Development*, *12*(1), 89–111. Retrieved from https://www.researchgate.net/publication/270146046_Technology_transfer_and_innovation_The_role_of_the_Brazilian_TTOs

Roessler, I., Duong, S. & Hachmeister, C. D. (2015). *Teaching, Research and more?! Achievements of Universities of Applied Sciences with Regard to Society*. Retrieved from https://www.che.de/wp-content/uploads/upload/CHE_AP_183_Third_Mission_at_UAS.pdf

Romero, G. A. (2016). Desempeño reciente y lecciones no aprendidas: las perspectivas económicas para América Latina y el Caribe. *Economía y Desarrollo*, *156*(1), 73–89.

Rubio, A. (2016). Algunas consideraciones sobre la reorganización de la actividad científica en las universidades del Ministerio de Educación Superior de Cuba. *Revista Cubana de Educación Superior*, *35*(1), 85–98. Retrieved from http://scielo.sld.cu/scielo.php?script=sci_abstract&pid=S0257-43142016000100008&lng=es&nrm=iso

Smilor, R. W., Dietrich, G. B. & Gibson, D. V. (1993). The entrepreneurial university-the role of higher-education in the United-States in technology commercialization and economic-development. *International Social Science Journal*, *45*(1), 1–11. Retrieved from https://researchers.dellmed.utexas.edu/en/publications/the-entrepreneurial-university-the-role-of-higher-education-in-th

Soulary, V. S. (2015). *Contribución de la ciencia, la tecnología y la innovación universitarias a la dinamización económica local*. (Tesis de Doctorado). Universidad de Camagüey, Camagüey,Cuba.

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The authors declare that this manuscript is original, and it has not been submitted to another journal. The authors are responsible for the contents of this article, adding that it contains no plagiarism, conflicts of interest or conflicts of ethics.

Author contribution statement

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Rosario León Robaina: Redaction of results and abstract, review of all the content.
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