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COMPETITION FORUM

Volume 17 (1) **2019**

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A Proposed Conceptual Model Relating Knowledge Management and Management of Innovation in a Public Research Organization as a Booster of Competitiveness in Mexico

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EXECUTIVE SUMMARY

This paper proposes a construct relating four main factors, Knowledge Management (KMG), Management Innovation (MGI), Key Performance indicators of a Public Research Organization (KPIPRO) as boosters of the National Competitiveness Model (NCM) in firms who serve the PROs in Mexico. The methodology is based on a literature review used to determine the indicators proposing the Delphi Panel with Analytic Hierarchy Process (AHP) among researchers of CIATEJ, its clients, and CUCEA located in Guadalajara, Mexico, during July 2019-July 2020. The initial results pointed to 104 indicators of the model as work in progress.

Keywords: Knowledge Management; Management of Innovation; Public Research Organization; Competitiveness

INTRODUCTION

Since 1985, the National Council on Science and Technology (CONACYT) has represented more than 25 of the Public Research Organizations (PRO) in Mexico. The main PRO's actions consist of conducting research activities; forming highly specialized human resources, mainly through graduate programs; transferring knowledge to promote the modernization and improvement of productive, public and social sectors; and communicating to society the technical and scientific information derived from the investigations (PRO, 2019). The PROs seek to contribute significantly to Mexico, increasing its levels of productivity and competitiveness and consolidating it as a tool of the State to solve national problems and promote its economic development through its contributions to science, technology, and innovation. (For ease of reading, please see the abbreviations and their descriptions in the appendix).

An example of a PRO mentioned above, Centre for Research and Assistance in Technology and Design of the State of Jalisco, A.C (CIATEJ), founded in 1976, a member of CONACYT, with 1439 clients served up to 2011 (CIATEJ, 2013) emerged with the mission of developing scientific-technological activities, providing technical services, training human resources and transfering technology for the agricultural, food, health and environmental sectors, with emphasis on the innovative application of biotechnology, thereby contributing to the sustainable development of Mexico. As you see, knowledge management (KMG) and management of innovation (MGI) are concepts inherent and principal actors in the CIATEJ process. Vut how are they interacting to get make their clients more competitive?

The question is whether the Key Performance Indicators of the PRO (KPIPRO) are related to the National Competitiveness Model (NCM), which is aimed at all Mexican companies that are PRO´s clients and that aspire to the National Quality Award (NQA, 2019). However, it is only in recent years (since 2013) that PROs have implemented KPIs to probe the effectiveness of their research practices and, hence, it is necessary to design the proposed model that involves and explains them.

The proposed model is based in an exploratory effort to collect several indicators involved in the main factors of this research, such as KMG, MGI, KPIPRO of a PRO (CIATEJ) and NCM as clients of CIATEJ. It is divided into problem, hypotheses, and rationale of the study; literature review; methodology; results; conclusions and limitations and future studies.

PROBLEM, QUESTIONS, AND RATIONALE OF THE STUDY

Our problem is described in a research question: What are the main variables of the KMG and MGI that are capable of interacting with the KPIPRO to increase the competitiveness level of the clients based on the NCM during the period of July 2019-July 2020? To solve this, it is necessary to propose a construct based on those four variables. Hence, we have proposed the following specific questions: SQ1: What is the methodology to solve it? SQ2: What are the indicators and variables of the proposed model? and SQ3: What is the scheme involving indicators and variables of the model? The rationale of this study is based on figuring out the level of the PROs results over the clients' competitiveness.

LITERATURE REVIEW

The literature review is based on documents describing the directives in Mexico based on the National Quality Award (NQA, 2019), the National Competitiveness Model (NCM), the directives on Management of Innovation (MGI) published by the European Commission (ECDGE, 2004), a previous CUCEA-CIATEJ work entitled *Management Innovation in Nanotechnology Sector. The First Insights in México* (Mejía-Trejo et al., 2017), Knowledge Management (KMG) published by the Organisation for Economic Co-operation and Development (OECD, 2003), the *Plan de Negocio de la Oficina de Transferencia de Conocimiento.CIATEJ, CONACYT* (CIATEJ, 2013), denominated in this paper as the Key Performance Indicators of a Public Research Organization (KPIPRO). This is a first effort to conciliate national and international work documents, related to our main variables as constructs for an academic model.

The National Competitiveness Model (NCM)

Competitiveness is the ability and performance of a company, sub-sector or country to sell and supply goods and services in a given market and the ability and performance of other firms, sub-sectors, or countries in the same market (IMCO, 2019; Kotler & Lane, 2006). As a part of the National Quality Award, Mexico (NQA, 2019) has designed its own National Competitiveness Model **(**NCM, 2018**)** adopted here in this study, with the following variables shown in Table 1:

TABLE 1. PRO's CLIENTS NATIONAL COMPETITIVENESS MODEL

Item	Indicators	Description
1	Leadership Transformer (**LDT**)	Leaders reflect on their behaviours and commitment to achieve the mission of an organization, change, and innovation; they communicate with their staff, motivate them in their development and overall well-being; they are aware of and they respond to their growth opportunities.
2	Customer Value Generation (**CVG**)	The organization knows its clients intimately, knows what creates its value and responds with innovative proposals that ensure a memorable experience, follow the evolution of their needs, and establish the basis for a constant alignment with them
3	Strategic Planning (**STP**)	The organization ensures the fulfilment of its vision and mission, analysing their environment, understanding their challenges, setting priorities, defining strategic objectives, aligning their resources and capabilities to ensure their execution, monitoring and evaluating expected results.
4	Guidance to change, innovation and continuous development (**CICD**)	The values of the organization lay the foundation for developing a culture focused on change, innovation and continuous improvement that is reflected in the way staff organize and engage to generate new ideas to respond to the challenges they face.

5	Social Commitment (**SCO**)	The organization assumes responsibility for the social and environment in which it operates. This commitment is reflected in its initiatives to reduce its environmental footprint, promote the integral well-being of its personnel and respond to the social needs of its community.
6	Wellness and Inclusion (**W&I**)	The organization ensures the integration of all of its staff through the creation of a shared identity and responding to their physical and emotional needs in the workplace, as well as in the communities where they live.
7	Knowledge (**KNW**)	The organization collects, organizes, shares and analyses knowledge through the use of its resources and the skills of its staff, thereby generating the intellectual capital of the organization it capitalizes on for the improvement and innovation of its products, services, and processes.
8	Agility (**AGY**)	The organization responds quickly, adaptively, and flexibly to the changes that occur in its internal and external environment.

Source: NQA (2019) with own adaptation

The Management of Innovation (MGI)

According to OECD (2005) innovation is "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations." Innovation aims at improving a firm's performance by gaining a competitive advantage.

The competitiveness recognizes the potential of innovation, which is defined as an implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations and it involves the innovation of product, service, marketing, process, and organization (OECD, 2005). So, the importance of a model for MGI is defined as a set of tools for managers to design and implement with a common understanding of processes and goals for a company. It allows the organization to respond to external or internal opportunities and use its creativity to introduce new ideas, processes, or products (CIATEJ, 2013). By utilizing the set of tools, MGI can trigger and deploy the creative capabilities of the workforce for the continuous development of a company. It is not relegated only to R&D; it involves workers and managers at every level, contributing creatively to a company's product development, manufacturing, and marketing.

Common tools may include brainstorming, virtual prototyping, product lifecycle management, idea management until TRIZ, QFD, Phase–gate model, project management, product line planning, and portfolio management, etc. According to the European Commission Directorate-general for Enterprise (ECDGE, 2004), we have 10 groups of MGI techniques with 43 particular techniques shown in Table 2.

TABLE 2. TYPES OF MANAGEMENT OF INNOVATION TECHNIQUES AS INDICATED BY (CIATEJ)

Group	Innovation Management Techniques Group as variables	Particular Techniques
1	Knowledge Management Techniques (**KMT**)	(1) Knowledge Audit; (2) Knowledge Mapping; (3) Document Management System; (4) Intellectual Property Rights
2	Market Intelligence Techniques (**MIT**)	(5) Technology Watch; Patent Analysis; (6) CRM (Customer Relationship Management); (7) Geo-Marketing; (8) BIS (Business Intelligence Systems)
3	Cooperative and Networking Techniques (**C&NT**)	(9) Team-Building Approaches;(10) Groupware Technologies;(11) SCM (Supply Chain Management); (12) Industrial Clustering
4	Human Resources Management Techniques (**HRMT**)	(13) Online Recruitment Tools; (14) Corporate Intranets;(15) Teleworking Techniques; (16) e-Learning Techniques; (17) Groupware Tools
5	Interface Management Techniques (**IMT**)	(18) Concurrent Engineering; (19) R&D/Marketing Interface
6	Creativity Development Techniques (**CDT**)	(20) Brainstorming; Lateral Thinking; (21) TRIZ (Inventive Problem-solving); (22) SCAMPER method; (23) Mind Mapping
7	Process Improvement Techniques (**PIT**)	(24) Workflow Management; (25) Business Process Re-engineering; (26) JIT (Just-in-Time); (27) TQM (Total Quality Management); (28) Lean Process Technology

8	Innovative Project Management Techniques (**IPMT**)	(29) Pre-project Management Phase; (30) Development Project Management Phase; (31) Management Phase; (32) Learning From Experience; (33) Project Portfolio Management
9	Design Management Techniques (**DMT**)	(34) Design Management Expanding in Scope; (35) CAD systems; (36) RP (Rapid Prototyping); (37) Usability Approaches; (38) VA (Value Analysis)
10	Business Creation Techniques (**BCT**)	(39) Virtual Incubators; (40) Spin-Off from Research to Market; (41) Computer-Aided Business Simulation Games; (42) Entrepreneurship; (43) The Business Plan

Source: ECDGE (2004) with own adaptation

Knowledge Management (KMG)

The Knowledge Management (KM) is the process of creating, sharing, using, and managing the knowledge and information of an organization (Girard & Girard, 2015). It refers to a multidisciplinary approach to achieving organizational objectives by making the best use of knowledge. The KM efforts typically focus on organizational objectives, such as improved performance, competitive advantage, innovation, the sharing of lessons learned, integration, and continuous improvement of the organization (Gupta & Sharma, 2004). Several works of Prusak (Prusak, 2001; Cohen & Prusak, 2001; Davenport & Prusak, 1998; Lesser & Prusak, 2000) have commented that the need for knowledge management practices arose with firm size and that those firms with fewer than 250 employees were less likely to employ these business practices. Hence, the importance of measuring the knowledge mainly, in the business sector. See Table 3.

TABLE 3. KNOWLEDGE MANAGEMENT MEASUREMENT (KMG) INTO THE PRO (CIATEJ)

Item	Variable	Indicator
1	Leadership (**LEA**)	Knowledge management practices were the responsibility of managers and executives
		Knowledge management practices were explicit criteria for assessing worker performance
		Knowledge management practices were the responsibility of non-management workers
		Knowledge management practices were the responsibility of the knowledge officer or knowledge management unit
2	Knowledge Capture and Acquisition (**KC&A**)	Captured and used knowledge obtained from other industry sources, such as industry associations, competitors, clients and suppliers
		Captured and used knowledge obtained from public research institutions, including universities and government laboratories
		Dedicated resources to detecting and obtaining external knowledge and communicating it within the PRO
		Encouraged workers to participate in project teams with external experts
3	Training and Mentoring (**T&M**)	The firm encouraged experienced workers to transfer their knowledge to new or less experienced workers
		Provided informal training related to knowledge management
		Encouraged workers to continue their education by reimbursing tuition fees for successfully completed work-related courses
		Offered off-site training to workers to keep skills current
		Provided formal training related to knowledge management practices
		Used formal mentoring practices, including apprenticeships
4	Policies and Strategies (**P&S**)	Used partnerships or strategic alliances to acquire knowledge
		Policies or programs intended to improve worker retention
		Values system or culture intended to promote knowledge sharing
		Written knowledge management policy or strategy
5	Communications (**COMM**)	Workers shared knowledge by preparing written documentation, such as lessons learned, training manuals, good work practices, articles for publication, etc. (organizational memory)
		Workers shared knowledge by regularly updating databases of good work practices, lessons learned, or listings of experts

		Workers shared knowledge in collaborative work by project teams that are physically separated (*virtual teams*)
6	Incentives (**INC**)	Knowledge sharing was rewarded with monetary incentives
		Knowledge sharing was rewarded with non-monetary incentives

Source: OECD (2003) with own adaptation

The Public Research Organization (PRO)

A PRO under research is CIATEJ endorsed by the ISO 9001: Quality Management System Certification ISO 2008 (NMX-CC-9001-IMNC-2008). The value offered by this PRO to its clients and partners is based on the scientific, technological, and service of its staff, which is made up of 151 members: 13 administrative; 7 middle controls; 16 technicians; 17 engineers; 20 technologists; and 78 researchers.

The CIATEJ headquarters is located in the city of Guadalajara, Jalisco, and has regional offices in the cities of Apodaca, Nuevo León (*Research and Technological Innovation Park, PIIT Monterrey*); Zapopan, Jalisco (*Agave-Tequila Research Center*); and Mérida, Yucatán (*Yucatan Scientific and Technological Park*).

The research and development projects carried out in CIATEJ are a fundamental part of the organization's mission, since they represent a mechanism through which, together with the companies in the sectors that it serves, it manages to generate knowledge to obtain innovation in processes and quality products that generate added value. See Table 4.

TABLE 4. CIATEJ RESEARCH AND DIVISION AREAS

Group	Research areas	Division
1	Vegetal biotechnology	Micropropagation vegetable species
		Vegetable genetic improvement
		Plant pathology
2	Industrial biotechnology	Design, optimization, and application of biocatalizers
		Design and optimization of fermentative processes
3	Medical and pharmaceutical biotechnology	Vaccine development and evaluation
		Molecular diagnosis
		Development and analysis of drugs
4	Food technology	Development and quality of food and beverages
		Engineering and technology of food processes
5	Environmental technology	Treatment of water and solid waste
		Evaluation of water quality
		Consultancy services

Source: CIATEJ (2013) with own adaptation

Since 2013, **CIATEJ** has Keys Performance Indicators as a **PRO** (**KPIPRO**). These are shown in Table 5.

TABLE 5. CIATEJ KPIPRO AND TYPES

Indicator	KPIPRO variable	Type of indicator
1	Generation and appropriation of knowledge	Strategic (STG)
2	Documents on diffusion	Strategic (STG)
3	Arbitrated publications	Strategic (STG)
4	Patents requested	Strategic (STG)
5	Copyright	Strategic (STG)
6	Training of human resources	Strategic (STG)
7	Personal Science and Technology with a doctorate	Strategic (STG)
8	Personal Science and Technology members of the National Science Researchers (SNI)	Strategic (STG)
9	Graduate students enrolled	Strategic (STG)

10	Graduate students with ended studies	Strategic (STG)
11	Registered undergraduate students	Strategic (STG)
12	Support for regional socio-economic development	Strategic (STG)
13	R & D projects for regional development	Strategic (STG)
14	Jobs generated by regional development R&D projects	Strategic (STG)
15	Incomes generated by regional development R & D projects	Strategic (STG)
16	Strengthening the competitiveness of companies	Strategic (STG)
17	Customers who use laboratory services	Strategic (STG)
18	Laboratory service orders	Strategic (STG)
19	Income generated from the sale of laboratory services	Strategic (STG)
20	Companies with a contract for laboratory services	Strategic (STG)
21	People trained as services to the companies	Strategic (STG)
22	Linked R & D projects	Strategic (STG)
23	Companies technologically associated by agreement	Strategic (STG)
24	Patents licensed to the productive sector	Strategic (STG)
25	Incomes generated by linked R & D projects	Strategic (STG)
26	Creation of value for the institution	Strategic (STG)
27	Institutional growth (%)	Strategic (STG)
28	Growth in sales of laboratory services (%)	Strategic (STG)
29	Revenue growth for R & D projects for socio-economic development regional (%)	Strategic (STG)
30	Growth in revenues from the sale of linked R & D projects (%)	Strategic (STG)
31	Growth in financial self-sufficiency (%)	Strategic (STG)
32	Knowledge generation (number of arbitrated articles)	Institutional (INST)
33	Development of inventiveness (patents/rights applied for and granted)	Institutional (INST)
34	The Excellence of researchers (total number of researchers at National Science Researchers, SNI)	Institutional (INST)
35	Training of human resources (total number of students attended)	Institutional (INST)
36	Investment dedicated to R & D	Transfer of technology and knowledge (TTKCIATEJ)
37	Investment in R & D as% budget IGC	Transfer of technology and knowledge (TTKCIATEJ)
38	Researchers dedicated to R & D (full time)	Transfer of technology and knowledge (TTKCIATEJ)
39	Researchers dedicated to R & D (half time)	Transfer of technology and knowledge (TTKCIATEJ)
40	Support staff in R & D (full time)	Transfer of technology and knowledge (TTKCIATEJ)
41	Support staff in R & D (half time)	Transfer of technology and knowledge (TTKCIATEJ)
42	Graduate students assigned to R & D	Transfer of technology and knowledge (TTKCIATEJ)
43	Active R & D projects	Transfer of technology and knowledge (TTKCIATEJ)
44	Disclosures	Transfer of technology and knowledge (TTKCIATEJ)
45	Patents requested	Transfer of technology and knowledge (TTKCIATEJ)
46	Patents granted	Transfer of technology and knowledge (TTKCIATEJ)
47	R & D projects transferred	Transfer of technology and knowledge (TTKCIATEJ)
48	Projects via fund	Transfer of technology and knowledge (TTKCIATEJ)

49	Projects via links with companies	Transfer of technology and knowledge (TTKCIATEJ)
50	Projects via inventors	Transfer of technology and knowledge (TTKCIATEJ)
51	Total income by knowledge transfer	Transfer technology and knowledge (short term indicators. TTKSTI)
52	Cost of operation / total personnel	Transfer technology and knowledge (short term indicators. TTKSTI)
53	Net income/total staff	Transfer technology and knowledge (short term indicators. TTKSTI)
54	Investment in strengthening human capital	Transfer technology and knowledge (short term indicators. TTKSTI)
55	Investment in IT tools	Transfer technology and knowledge (short term indicators. TTKSTI)
56	Total customers	Transfer technology and knowledge (short term indicators. TTKSTI)
57	Frequent clients (hired services +1 occasion)	Transfer technology and knowledge (short term indicators. TTKSTI)
58	Evaluated projects (annual)	Transfer technology and knowledge (short term indicators. TTKSTI)
59	Projects in the technological portfolio (annual)	Transfer technology and knowledge (short term indicators. TTKSTI)
60	Formation of new business (spin-outs or spin-offs)	Transfer technology and knowledge (short term indicators. TTKSTI)
61	Number of consulting projects	Transfer technology and knowledge (short term indicators. TTKSTI)
62	Licensing projects number	Transfer technology and knowledge (short term indicators. TTKSTI)
63	Number of projects new business formation	Transfer technology and knowledge (short term indicators. TTKSTI)
64	Number of analytical services	Transfer technology and knowledge (short term indicators. TTKSTI)
65	Number of technological services	Transfer technology and knowledge (short term indicators. TTKSTI)
66	Licensing	Transfer technology and knowledge (short term indicators. TTKSTI)
67	Consulting	Transfer technology and knowledge (short term indicators. TTKSTI)
68	Average income for consulting work	Transfer technology and knowledge (long term indicators. TTKLTI)
69	Average income by licensing	Transfer technology and knowledge (long term indicators. TTKLTI)
70	Average income for new business formation	Transfer technology and knowledge (long term indicators. TTKLTI)
71	Average revenue for analytical service	Transfer technology and knowledge (long term indicators. TTKLTI)
72	Average revenue by technological service	Transfer technology and knowledge (long term indicators. TTKLTI)
73	Total revenue	Transfer technology and knowledge (long term indicators. TTKLTI)
74	Formation of collaboration agreements	Transfer technology and knowledge (long term indicators. TTKLTI)
75	Projects participating in the transfer process	Transfer technology and knowledge (long term indicators. TTKLTI)

Source: CIATEJ (2013) with own adaptation

The Office of Transference of Technology and Knowledge (OTTK)

CIATEJ has an office of transference of technology and knowledge (OTTK) with the main objective to offer a portfolio of knowledge transfer services to the internal R&D units; however, it also functions as an external interaction agent with potential buyers of the technologies generated in the CIATEJ with investors, strategic partners, and other members of the innovation system. The OTTK evaluates the technical and commercial feasibility of the internal research projects to strengthen or complement the relevance in their specific markets. Under this perspective, the research results are commercialized in a more effectively and efficiently. The OTTK operates o the organizational structure of CIATEJ, training its human resources, designing its model of technology transfer and knowledge, designing the specialized services that it offers inside and outside of CIATEJ, designing the business model to support its sustainability, and the marketing strategies. The OTTK reports to the CIATEJ Director and is made up of seven people distributed in five areas: attention to the clients; intellectual property; business agreement and legal issues; linking business office; staff (project management office; management of quality office; management office) and external experts (intellectual property, diffusion to promote the commercialization; valuation; training).

Technological development. The technology process starts with the generation of technology resulting from R&D work; two modalities are recognized: The first one, called *linking project*, arises from a contract with an external entity that invests and is interested in maintaining a percentage of the generated intellectual property that will require advancement of the R&D project in disclosure with the OTTK considering the protection and licensing stages, respectively. It should be noted that in those agreements where CIATEJ shares ownership of intellectual property, the CIATEJ may move from the promotion phase to the dissemination phase and to subsequent ones. The second option, called *project of funds*, refers to the developments that can be exploited in one of the licensing forms that are indicated in the *commercial development* phase of the transfer model. In the next step, the researcher or project manager will approach the OTTK to discuss its disclosure, as it is important that the person responsible for the technology understands the implications of the technology transfer process before starting work *formally*. At this stage, it is particularly recommended to evaluate the issues related to the budget available for the preparation of the necessary work in the technical and commercial evaluation process to be offered by the OTTK (described in the following section), including: (i) Quicklook study; (ii) technological evaluation using the ProGrid® software methodology and tools; (iii) market validation; and (iv) decision tree. This grouping of information and knowledge contributes to the formation of the next stage in the transfer process, the commercial strategy, which serves as a point of reference to make the first important decision in the process: go back to the working table to strengthen technology or go ahead with authorizing the investment of the project.

Commercial development. If the commercial strategy establishes that there is an interesting potential for the technology developed, it will proceed to start the commercial development phase with the protection of intellectual property. In this step, a complete study of the prior act is carried out and the method of protection that best adjusts to the commercial opportunity is selected. To start the next stage, called *diffusion*, it is not necessary to wait for the protection process to be completed, since there are mechanisms that allow this step to be taken without risking the intellectual property of the opportunity. One of these mechanisms is the brief description of the provisional process of patent and protection of intellectual property, as well as industrial secrecy. After the dissemination and promotion of the technology stage, it is expected that a new business opportunity will be generated or an associative scheme will be formalized to allow progress to be made in the process. These models are briefly described in Table 6.

TABLE 6. BUSINESS MODELS DRIVING THE OTTK

Business Models	Description
Spin-off	In this modality, the *new entity* maintains a close relationship with the *parent entity*, which in these cases support the operation of the business with human resources (researchers, students, and administrative staff), technology (purchase of materials and equipment), and economic resources (financing) during the stages of introduction and growth in the industrial life cycle, in order to ensure its sustainability. Hence, the generating institution receives payment for the contracted services, supports the strengthening of its human competencies, and in most cases keeps the researcher leader.
Joint Venture	The main components are: a client of CIATEJ participating, a business entity (new or established), and a third party that provides the first round of investment or *seed capital* (investor). The CIATEJ client grants the intellectual properties rights to the business entity and is responsible for executing the business model and

	bringing the product to the market, as well as complying with the commitments indicated in the commercial agreement. The goals and objectives are rarely the same in each case.
Start-up	The most convenient modality adopted by the transfer offices is the start-up. This model requires a new business entity that is formed around the product or benefits offered by the licensed technology. The CIATEJ client benefits through royalties or a global sum that is covered before the intellectual property allocation and is generally limited to one application or market, allowing the exploitation of the intellectual property by the CIATEJ client.
Associative scheme	This scheme, which consists of a collaboration between the CIATEJ and another entity or entities that are members of the innovation system, seeks to create new businesses through alliances, consortiums, or networks.

Source: CIATEJ (2013)

To support the commercial development of the products that are derived from the regarding technology, the OTTK will offer six services (see Table 7).

TABLE 7. SERVICES SUPPORTING THE PRODUCTS UNDER DESIGN BY THE OTTK

Service	Description
Identification study of additional applications	This study offers the opportunity not only to recognize an added value for the technology, but also to allow the OTTK to expand the potential generation of income generated by technology with multiple applications (called *technological platform*).
Market study	This study analyses the virtues of the technology and offers a plan of promotion and adoption in detail, describing how the product would reach the market and formulating a strategy of recognition and acceptance directed to the selected target market.
Patenting strategy	When technology has the potential to be protected, a study is carried out that will allow identifying the different options available for its intellectual protection, both in protection mechanisms and in geographical scope.
Business plan	The business plan will typically be developed for licensing, investment, collaboration, or expansion purposes. In the particular case of CIATEJ, it is recommended that a work plan be requested as part of the licensing requirements, which is the first step in the third stage of the transfer process. The OTTK must offer this service mainly to those researchers belonging to the entity that requires assistance in this step.
Business acceleration	This service is aimed to support established companies that seek to formulate a growth or expansion strategy that best fits their goals and capabilities.
Technological surveillance	This is a process that allows maintaining a clear vision of technologies that could compete, or be in conflict with the opportunity in development. Additionally, entities that could be infringing the use rights are identified.

Source: CIATEJ (2013)

It is important to highlight that the OTTK indicators are not separated from the CIATEJ indicators or KPIPROs.
Hence, the proposed conceptual model is shown in Figure 1.

METHODOLOGY

The proposed model consists of six stages detailed in the discussion section:

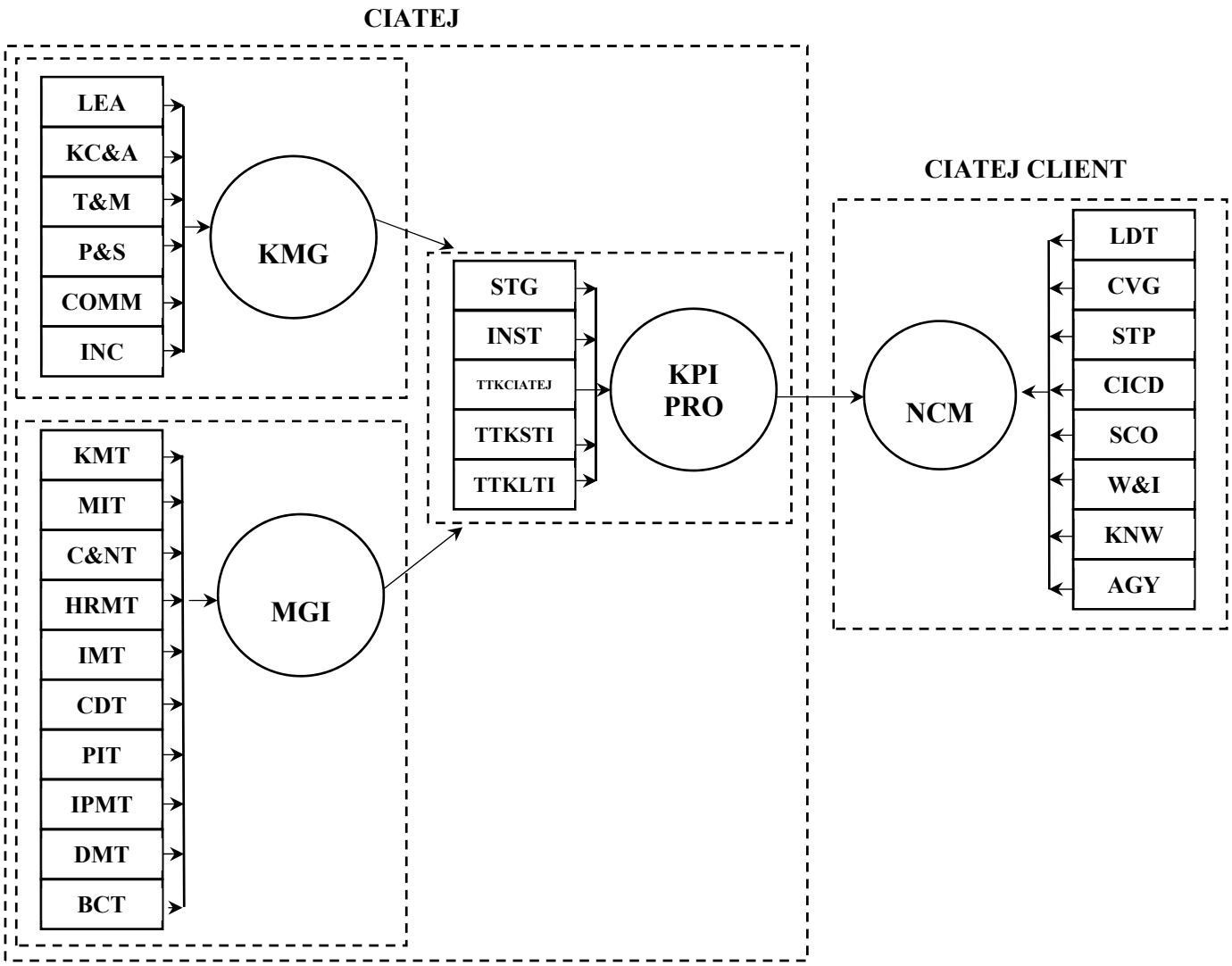
- Stage 1. Literature review of the main variables, according to the NCM National Quality Award (NQA, 2019)) and KPIPRO (CIATEJ, 2013) in Mexico; the KM, MGI in the Organisation for Economic Co-operation and Development (OCDE, 2003); and European Commission Directorate-General for Enterprise (ECDGE, 2004).
- Stage 2. The collection, review of data, and information on projects covers 2013 to the present.
- Stage 3. Analysis and reduction of data and information using a Focus Group with Delphi Panel and AHP. This is the Qualitative stage. The rest of them, are the Quantitative stages.
- Stage 4. Exploratory Factor Analysis (EFA).

- Stage 5. Structural Equation Modeling (SEM) and Confirmatory Factor Analysis (CFA).
- Stage 6. Use of multivariate dependent and interdependent analyses for several proposed cases understudy

RESULTS

The final proposed conceptual model *ex-ante*, relating the factors Knowledge Management (KMG), Management of Innovation (MGI), the Keys Performance Indicators of a Public Research organization (KPIPRO, in this case, CIATEJ), and the competitiveness achieved of its clients through the National Competitiveness Model (NCM) is shown in Figure 1.

FIGURE 1. THE PROPOSED CONCEPTUAL MODEL



Notes: KMG. Knowledge Management; LEA. Leadership; KC&A. Knowledge Capture and Acquisition; T&M Training and Mentoring; P&S. Policies and Strategies; COMM. Communications; INC. Incentives; MGI. Management of Innovation; KMT.

Knowledge Management Techniques; MIT. Market Intelligence Techniques; C&NT. Cooperative and Networking Techniques; HRMT. Human Resources Management Techniques; IMT. Interface Management Techniques; CDT. Creativity Development Techniques; PIT. Process Improvement Techniques; IPMT. Innovative Project Management Techniques; DMT. Design Management Techniques; BCT. Business Creation Techniques; STG. Strategic; INST. Institutional; KPIPRO. Keys Performance Indicators. TTKCIATEJ. Transfer of technology and knowledge CIATEJ; TTKSTI. Transfer of technology and knowledge short term indicator; TTKLTI. Transfer of technology and knowledge long term indicator; NCM. National Competitiveness Model; LDT. Leadership Transformer; CVG. Customer Value Generation; STP. Strategic Planning; CICD. Guidance to change, innovation and continuous development; SCO. Social Commitment; W&I. Wellness and Inclusion; KNW. Knowledge; AGY. Agility.

DISCUSSION

The methodology currently applied as work in progress to **CIATEJ** is described in stages, as follows:

Stage 1. Literature review, whose main function is to collect all the information related to the variables and indicators that better describe their practices, in two parts of the study:

The first one is CIATEJ with the factors Knowledge Management (KMG); the Management of Innovation (MGI); and the Keys Performance Indicators related to the PRO (KPIPRO). The second one corresponds to CIATEJ´s clients, involving the potential of competitiveness unleashed through National Competitiveness Model (NCM). This is a first effort to conciliate national and international work documents, related to our main variables, and consider them as constructs for an academic model.

Stage 2. The collection, review of data and information of projects involved, during the period January 2013 up to the present, that allows defining the variables and indicators that will intervene in the final proposed model. To achieve this, the CIATEJ part will consider the following preparations:

A group of specialists of CIATEJ according to Table 4, who will be consulted about Knowledge Management (KM) practices and processes of each one of their interest areas (see Table 3) related with each one of the projects under Management of Innovation (MGI) techniques in practice and the clients served. This is achieved by applying and relating the concepts involved in Table 2.

The CIATEJ´s client part will collect data through a questionnaire (see Table 1) based on the National Competitiveness Model (NCM) applied to its clients, all of the CEOs of the firms served during the mentioned period. All absences, outliers or errors in data, must be corrected.

Stage 3. Analysis and reduction of data and information. To achieve this stage, it is necessary to gather the same group of 5 specialists of CIATEJ and ask them about the KPIPRO, using *Focus Group by Delphi Panel* and *Saaty´s Theorem* or AHP (Analytic Hierarchy Process) (Saaty, 1997) to determine the first reduction of 75 KPIPRO´s shown in Table 5. This first reduction is necessary, due to the existence of several indicators that measure the same issue. The table of results appears as Table 8.

TABLE 8. FOCUS GROUP BY DELPHI PANEL AND AHP TO DETERMINE THE MAIN VARIABLES OF KPIPRO

Objective	KEYS PERFORMANCE INDICATORS OF PUBLIC RESEARCH ORGANIZATION (CIATEJ)			
	TOTAL ID	**Indicators**	**Frequency**	**AHP weighting (%) importance**
Alternatives	31	Strategic (**STG**)		
	4	Institutional (**INST**)		
	15	Transfer of technology and knowledge (**TTKCIATEJ**)		
	17	Transfer technology and knowledge (short term indicators. **TTKSTI**)		
	8	Transfer technology and knowledge (long term indicators. **TTKLTI**)		
TOTAL	**75**	**---**	**---**	**100%**

Stage 4. Exploratory Factor Analysis (EFA). This is the second reduction of indicators applying the principal component analysis by using the Varimax technique to discard and/or confirm the new group of variables depicting the CIATEJ KPIPRO as the construct of the final model. With this technique, it is possible to analyze the interrelationships among all the 75 KPIPRO indicators to explain these indicators in terms of their common underlying dimensions (variables or factors). The objective is to find a way of condensing the information contained in a several original variables into a smaller set of such variables (factors). By providing an empirical estimate of the structure of the variables considered, EFA becomes an objective basis for creating summated scales.

Stage 5. Structural Equation Modeling (SEM) and Confirmatory Factor Analysis (CFA). The SEM is a technique that allows separate relationships for each of a set of dependent variables. In its simplest sense, structural equation modeling provides the appropriate and most efficient estimation technique for a series of separate multiple regression equations estimated simultaneously. It is characterized by two basic components: (1) the structural model and (2) the measurement model. The structural model is the path model, which relates independent to dependent variables. In such situations, theory, prior experience, or other guidelines enable the researcher to distinguish which independent variables predict each dependent variable. Models discussed previously that accommodate multiple dependent variables (multivariate analysis of variance and canonical correlation) are not applicable in this situation because they allow only a single relationship between dependent and independent variables. The measurement model enables the researcher to use several variables (indicators) for a single independent or dependent variable.

For instance, in our proposed conceptual model, the dependent variable KPIPRO is a concept represented by a summated scale of its components, for instance, the strategic (STG). In a CFA, the researcher can assess the contribution of each scale item, as well as incorporate how well the scale measures the concept (reliability). The scales are then integrated into the estimation of the relationships between dependent and independent variables in the structural model. This procedure is similar to performing an EFA of the scale items and using the factor scores in the regression.

Assume that CIATEJ, with this proposed conceptual model (see Figure 1) identified several factors that affect the KPIPRO: STG, INST, TTKCIATEJ, TTKSTI TTKLTI. In addition to this relationship, CIATEJ noted a separate relationship wherein indicators of TTKSTI and TTKLTI were the unique predictors. Hence, they had two separate, but interrelated, relationships. TTKSTI and TTKLTI not only affected KPIPRO directly, but it had possible indirect effects through the relationship with the rest of the predictors, which were also a predictor of KPIPRO. In attempting to assess these relationships, CIATEJ also could develop multi-item scales for each construct TTKSTI and TTKLTI. SEM provides a means of not only assessing each of the relationships simultaneously rather than in separate analyses, but also incorporating the multi-item scales in the analysis to account for measurement error associated with each of the scales.

Stage 6. Use of multivariate dependent and interdependent analyses. According to Hair et al. (2014), probing previously reliability, validity, and linearity on the final conceptual model, we shall be able to apply different multivariate dependent and dependent techniques, for example:

a. The design of a predictive model through *multiple linear regression* explaining the correlation among the variables. Multiple regression is the appropriate method of analysis when the research problem involves a single metric dependent variable presumed to be related to two or more metric independent variables. The objective of multiple regression analysis is to predict the changes in the dependent variable in response to changes in the independent variables, supported with the Pearson correlation. This objective is most often achieved through statistical rule of least squares. In our case, according to Figure 1, CIATEJ could be able to probe the correlation between KM and KPPIPRO, MGI, and KPIPRO or KPIPRO and NCM.

b. *Multiple discriminant analysis and logistic regression* are used to determine for all the dichotomous single dependent variables, in this case, if the gender of the chief researchers per area shows some level of influence in KM and MGI practices over the KPIPRO to produce a level of competitiveness in the CIATEJ´s clients through the NCM. The Discriminant analysis is applicable in situations in which the total sample can be divided into groups based on a nonmetric dependent variable characterizing several known classes. The primary objectives of multiple discriminant analysis are to understand group differences and to predict the likelihood that an entity will belong to a particular class or group based on several metric variables.
In our case, it might be used to distinguish the innovators from non-innovators according to the practices of MGI techniques (see Table 3 and Table 4), or other applications distinguishing, for instance, the *formation of new business (spin-outs or spin-offs)* or *number of projects new business formation* (indicator number 60 or 63 from Table 5), males from females CEOs, *Formation of collaboration agreements* or *Projects participating in the transfer process* (indicator number 74 or 75 from Table 5) with some result of certain client with a reinforcement of competitiveness (NCM) in Table 1 with some kind of practices of MGI Technique (see Table 2), and KM (see Table 3). It is possible to use discriminant analysis to compare the *average revenue by technological service* (indicator number 72 from Table 5) with a composite, hypothetical project (at different income levels) to identify the most promising returns of investment.

c. Another multivariate dependent model is the *logistic regression model*, well known as *logit analysis*. This method is a combination of multiple regression and multiple discriminant analysis. This technique is similar to multiple regression analysis in that one or more independent variables are used to predict a single dependent variable. What distinguishes a logistic regression model form multiple regression is that the dependent variable is non-metric, as in discriminant analysis. The non-metric scale of the dependent variable requires differences in the estimation method and assumptions about the type of underlying distribution, yet in most other facets it is quite similar to multiple regression. Thus, once the dependent variable is specified and the appropriate estimation technique is employed, the basic factors considered in multiple regression are here used as well. Logistic regression models are distinguished from discriminant analysis primarily in that they accommodate all types of independent variables (metric and non-metric) and do not require the assumption of multivariate normality. However, in many instances, particularly with more than two levels of the dependent variable, discriminant analysis is the more appropriate technique.

Hence, in our model, assume financial advisors were trying to develop means of selecting emerging firms for *spin-off investment,* corresponding to the MGI Techniques Group 10, *Business Creation Techniques (BCT), (40) Spin-Off from Research to Market.* **Table 2.** A regard of *formation of new business (spin-outs or spin-offs)* as KPIPRO in Table 5. To assist in this task, it is possible to review past records and place firms (clients of CIATEJ) into one of two classes: successful over a five-year period, or unsuccessful after five years. For each firm, they also had a wealth of financial and managerial data. They could then use a logistic regression model to identify those financial and managerial data that best differentiated between the successful and unsuccessful firms to select the best candidates for investment in the future.

d. *Canonical correlation analysis* can be viewed as a logical extension of multiple regression analysis. Recall that multiple regression involves a single metric dependent variable and several metric independent variables. Wit canonical analysis the objective to correlate simultaneously several metric dependent variables and several metric independent variables. Whereas multiple regression involves a single dependent variable, canonical correlation involves multiple independent variables. The underlying principle is to develop a linear combination of each set of variables (bot independent and dependent) in a manner that maximizes the correlation between the two sets. Stated differently the procedure involves obtaining a set of weights for the dependent and independent variables that provide the maximum simple correlation between the set of dependent variables and the set of the independent variables.
In our case, assume that CIATEJ collects information on its services based on answers from Table 5 metrically measured questions. This study could use all the metric questions, for instance, from indicator 54 *investment in strengthening human capital* and it might be included a benchmarking information on perceptions of the service quality of world-class PROs as

well as the client for which the research is being conducted. The canonical correlation could be used to compare the perceptions of the world-class PROs on the questions with the perception of the same PRO. Such a study could conclude whether the perceptions of the PRO are correlated with those world-class PROs. The technique would provide information on the overall correlation of perceptions as well as the correlation between each of the questions metrically designed.

e. Another multivariate dependent model is the *multivariate analysis of variance and covariance* (MANOVA-MANCOVA). This is a statistical technique that can be used to simultaneously explore the relationship between several categorical independent variables (usually referred to as *treatments*) and two or more metric variables. As such, it represents an extension of *univariate analysis of variance* (ANOVA). *Multivariate analysis of covariance* (MANCOVA) can be used in conjunction with MANOVA to remove (after an experiment) the effect of any uncontrolled metric independent variables (known as *covariates*) on the dependent variables. The procedure is similar to that involved in *bivariate partial correlation,* in which the effect of a third variable is removed from the correlation. MANOVA *is useful when the researcher designs an experimental situation* (manipulation of several non-metric treatment variables) to test hypotheses concerning the variance in group responses on two or more metric dependent variables. In our case, assume CIATEJ wants to know if indicator 5, *social commitment* (SCO) in Table 1 from (NCM) of a client of CIATEJ is present in the projects with its indicator 49, *Projects via links with companies* in Table 5, in some research area (see Table 4), with a certain indicator 6 *kind of incentives* (INC), in Table 3 from (KM) into CIATEJ and is related with a some practice of MGI Technique (see Table 2), for instance the indicator 6 *Business Creation Techniques* (BCT) *(42) Entrepreneurship.* After seeing indicator 5, *social commitment* (SCO) (see Table 1), the employees of CIATEJ involved would be asked to rate it in several dimensions, such as if there is a *social commitment* (SCO) (indicator, Table 1) or *not* in the services provided to its clients. In other words, MANOVA would be the technique to use to determine the extent of the statistical differences among the perception of CIATEJ clients who saw *social commitment* vs. those who saw the opposite.

f. *Conjoint analysis* is an emerging dependence technique that brings new sophistication to the evaluation of objects, such as new products, services, or ideas. The most direct application is in a new product or service development, allowing for the evaluation of complex products while maintaining a realistic decision context for the respondent. The market researcher can assess the importance of attributes as well as the levels of each attribute while consumers evaluate only a few product profiles, which are combinations of products levels.

Assume that CIATEJ has a product concept as indicator 2 *Market Intelligence Techniques* (MIT) of MGI (see Table 2) in particular technique *(5) Technology Watch* belonging to the Group 4, research area: *Food Technology* in Division*: Engineering and technology of food process* (see Table 4). Such product profile has three attributes (price, quality and color), each at three possible levels (red, yellow, and green). Instead of having to evaluate all 27(3x3x3) possible combinations, a subset (9 or more) can be evaluated of their attractiveness to consumers and the researcher knows not only how important each attribute is but also the importance of each level (the attractiveness of red vs. yellow vs. blue). Moreover, when the client evaluations are completed, the results of the conjoint analysis can also be used in product design simulators, which show costumer acceptance for any number of product formulations and aid in the design of the optimal product. This data could be compared with the indicator 8 Agility (AGY) from Table 1 (NCM) and variable 5 *Communications* (COMM), indicator *Workers shared knowledge in collaborative work by project teams that are physically separated (virtual teams)* if CIATEJ wants to know the scope to the collaborative work according to the attribute of the new product under design.

g. *Cluster analysis* is an analytical interdependent technique for developing meaningful subgroups of individuals or objects. Specifically, the objective is to classify a sample of entities (individuals or objects) into a small number of mutually exclusive groups based on the similarities among the entities. In cluster analysis like discriminant analysis, the groups are not predefined. Instead, the technique is used to identify groups. This technique usually involves at least three steps. The first is the measurement of some form of similarity or association among the entities to determine how many groups exist in the sample. The second step is the actual clustering process, whereby entities are partitioned into groups (clusters). The final step is to profile the persons or variables to determine their composition. Many times this profiling may be accomplished by applying discriminant analysis to the groups identified by the cluster technique.
Let's assume that CIATEJ wants to know whether the clients are requiring its services for different reasons. Data could be collected on perceptions of a certain group of research area in some division (see Table 4) related to variable 4 *Policies and Strategies* (P&S), indicator *written knowledge management policy or strategy* from Table 3 (KM) related with Group 4 of MGI techniques, in particular technique : *(17) Groupware Tools* (see Table 2), related at the same time with indicator

67 *consulting* from KPIPRO (see Table 5). The resulting groups could be compared with the different levels of competitiveness based on the indicators from NCM (see Table 1).

h. *Multidimensional scaling* is an interdependent technique where the objective is to transform the client judgment of similarity or preference (certain attributes of a product under design or service) into distances represented in multidimensional space. If objects A and B are judged by respondents as being the most similar compared with all other possible pairs of objects, this technique will position objects A and B in such a way that distance between them in multidimensional space is smaller than the distance between any other pairs of objects. The resulting perceptual maps show the relative positioning of all objects, but additional analyses are needed to describe or assess which attributes predict the position of each object.

Let's assume again that some client of CIATEJ wants to know about some attributes of the product to the Group 3 Research area: *Medical and Pharmaceutical Biotechnology* belonging to the Division: *Vaccine development and evaluation* (see Table 4) whether a strongest competitor is A or B in its sector. A sample of customers is given in a survey and asked to rate the pairs of competitors, from most similar to least similar. The results could be that competitor A is most similar to competitor B, so the client of CIATEJ know that the stronger competitor is competitor B because it is thought to be the most similar. As you see, this technique can identify what attributes influence perceptions of similarity or dissimilarity. Moreover, the resulting data could be related to estimated calculations on average revenues or income indicators (for instance: 68. *The average income for consulting work;* 69. *The average income by licensing;* 70. *The average income for new business formation*, 71. *The average revenue for analytical service*, 72. *The average revenue by technological service*) from KPIPRO (see Table 5). Those data could be placed in a perceptual map containing for instance the indicator 2 *Customer Value Generation* (CVG) from Table 1 (NCM), beside the indicator 6 *Creativity Development Techniques* (CDT) from MGI based on a particular technique (20) *Brainstorming*; see (Table 2) and with some kind of item like 3 with variable: *Training and Mentoring* (T&M) with indicator: *Firm encouraged experienced workers to transfer their knowledge to new or less experienced workers* and be related with an item 1 Variable: *Leadership* (LEA), Indicator: *Knowledge management practices were a responsibility of managers and executives* from (KM) (see Table 3). This would explain what kind of customer value added is associated with what kind of creativity technique in a similar product from the closest competitor and what kind of leadership is practiced as KM into CIATEJ team of researchers.

i. *Correspondence analysis.* It is a recently developed interdependence technique that facilitates the perceptual mapping objects (products, persons, etc.) on a set of non—metric attributes. Researchers are constantly faced with the need to *quantify the qualitative data* found in nominal variables. This technique differs from the interdependence techniques discussed earlier in its ability to accommodate both non-metric and non-linear relationships. In its most basic form, correspondence analysis employs a contingency table, which is the cross-tabulation of two categorical variables. It then transforms the non-metric data to a metric level and performs dimensional reduction (similar to EFA) and multidimensional scaling. Correspondence analysis provides a multivariate representation of interdependence for non-metric data that is not possible with other methods.

j.

Assume that CIATEJ, as a part of its competitive intelligence service, has respondents´ nutritional preferences through different brands from Group: 2, *Research area: Industrial biotechnology,* Division: *Design and optimization of fermentative processes*, (see Table 4) can be cross-tabulated on demographic variables (gender, occupation) by indicating how many people preferring each brand fall into each category of the demographic variables. Through correspondence analysis, the association or *correspondence* of brands and the distinguishing characteristics of those preferring each brand are then shown in a two or three-dimensional map of both brands and respondent characteristics. Brands perceived as similar are located close to one another. Likewise, the most distinguishing characteristics of respondents preferring each brand are also determined by the proximity of the demographic variable categories to the brand's position. Additional data related is, for instance, the indicator 13 *R & D projects for regional development* from KPIPRO (see Table 5), with item 2 Variable: *Knowledge Capture and Acquisition* (KC&A) from Table 3 (KM) and Group: 8, Technique. *Innovative Project Management Techniques* (IPMT) from GMI (see Table 2) and item 6 Indicator: *Wellness and Inclusion* (W&I) from Table 1 (NCM). This would explain, based on demographic data of how can these influence the decisions of clients of CIATEJ, to decide an investment of R&D for wellness and inclusion regarding knowledge of the customers.

CONCLUSIONS

This paper proposes a construct relating the factors: Knowledge Management (KMG), Management Innovation (MGI), Key Performance indicators of a Public Research Organization (KPIPRO) as boosters of the National Competitiveness Model (NCM) in the firms who serve the PROs in Mexico. The methodology is based on a literature review to determine the main indicators proposing the Delphi Panel with Analytic Hierarchy Process (AHP) among researchers of CIATEJ, its clients, and CUCEA located in Guadalajara, Mexico during July 2019-July 2020. The initial results point to 104 indicators and the four variables describing the constructs of the model as a work in progress.

This is due to the absence of the follow up on indicators that allow us to assess the extent of their interrelation. Hence, we showed the first insights of the work in progress into CIATEJ and the relationship with its clients and CUCEA as a support group. Thereby:

1. What are the main variables of the KMG and MGI capable of interacting with the KPIPRO to increase competitiveness levels to their clients, based on the NCM? It is solved, when we determined the methodology to apply (SQ1); the indicators and variables of the proposed model (SQ2); and the scheme involving indicators and variables of the model (SQ3).
2. The main factors: the Knowledge Management (KMG), Management Innovation (MGI); and the Key Performance indicators of a Public Research Organization (KPIPRO) as boosters of competitiveness of the clients who serve the PRO in Mexico look compatible and feasible to be implemented, but there are some considerations in order to develop a strong predictive model, there is necessary to clarify:
   -Whether the permissions into CIATEJ and its clients for asking the indicators have been granted.
   -Whether the CIATEJ clients follow up on the recommendations of the National Competitiveness Model (NCM). (See Table 1)
   -Whether CIATEJ researchers know all the Management of Innovation Model (MGI) techniques suggested by ECDGE (2004) and their implications. (See Table 2)
   -Whether CIATEJ clients follow up on the Knowledge Management Model (KM) as is suggested by OECD (2003). (See Table 3)
   -Whether the researchers of CIATEJ know their own 75 indicators as suggested by CIATEJ (2013) and their implications. Several of them repeat themselves.
   - Why the OTTK indicators are into the 75 indicators suggested by CIATEJ (2013), because several of them are necessary to be included, for instance: indicators of Quality of Service; indicators of Organizational Satisfaction to work.
3. If the proposed model is implemented and data are collected (today, as work in progress) we showed and discussed all the scope of the proposed studies that would be able CIATEJ to do, to get more competitiveness for itself and for its clients.

LIMITATIONS AND FUTURE STUDIES

The first and main limitation is all the unclear issues of point 2, but CIATEJ and CUCEA are still working to solve it.

The second limitation and very desirable to achieve is to update the concepts of OECD (2003) about KM and the MGI by ECDGE (2004) due to the internet social network, the use of smartphones, and the wireless connectivity for e-KM and e-Innovation, just to mention possible substantial implications.

The third limitation, for PROs like CIATEJ in Mexico is the absence of *social benefits due to the technology* (not only for firms as CIATEJ clients), including for instance food improvement for the people; poverty, improvement of water quality, air; improvement of urban social coexistence; attractiveness of the culture of peace for development, etc.

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APPENDIX

Abbreviations and their description in order of appearance

Abbreviation	Description
KMG	Knowledge Management
MGI	Management Innovation
KPIPRO	Key Performance indicators of a Public Research Organization
NCM	National Competitiveness Model
PROs	Public Research Organization
AHP	Analytic Hierarchy Process
CIATEJ	Centre for Research and Assistance in Technology and Design of the State of Jalisco, A. C., Mexico
CUCEA	University Centre of Economic and Administrative Studies (**CUCEA**), University of Guadalajara (**UdeG**), Mexico
CONACYT	National Council on Science and Technology, in Mexico
KPI	Key Performance Indicators
SQ1….SQN	Specific question 1…N
LDT	Leadership Transformer is a variable belonging to the National Competitiveness Model. (See Table 1)
CVG	Customer Value Generation is a variable belonging to the National Competitiveness Model. (See Table 1)
STP	Strategic Planning is a variable belonging to the National Competitiveness Model. (See Table 1)
CICD	Guidance to change, innovation and continuous development is a variable belonging to the National Competitiveness Model. (See Table 1)
TRIZ	Tieoriya Riesheniya Izobrietatielskij Zadach
QFD	Quality Function Deployment
SCO	Social Commitment is a variable belonging to the National Competitiveness Model. (See Table 1)
W&I	Wellness and Inclusion is a variable belonging to the National Competitiveness Model. (See Table 1)
KNW	Knowledge is a variable belonging to the National Competitiveness Model. (See Table 1)
AGY	Agility is a variable belonging to the National Competitiveness Model. (See Table 1)
KMT	Knowledge Management Techniques is a variable belonging to the National Competitiveness Model. (See Table 2)
MIT	Market Intelligence Techniques is a variable belonging to Management of Innovation Techniques into The **PRO** (**CIATEJ**). (See Table 2)
C&NT	Cooperative and Networking Techniques is a variable belonging to Management of Innovation Techniques into The **PRO** (**CIATEJ**). (See Table 2)
HRMT	Human Resources Management Techniques is a variable belonging to Management of Innovation Techniques into The **PRO** (**CIATEJ**). (See Table 2)
IMT	Interface Management Techniques is a variable belonging to Management of Innovation Techniques into The **PRO** (**CIATEJ**). (See Table 2)
CDT	Creativity Development Techniques is a variable belonging to Management of Innovation Techniques into The **PRO** (**CIATEJ**). O (CIATEJ). (See Table 2)
PIT	Process Improvement Techniques is a variable belonging to Management of Innovation Techniques into The **PRO** (**CIATEJ**). (See Table 2)
IPMT	Innovative Project Management Techniques is a variable belonging to Management of Innovation Techniques into The **PRO** (**CIATEJ**). (See Table 2)
DMT	Design Management Techniques is a variable belonging to Management of Innovation Techniques into The **PRO** (**CIATEJ**). (See Table 2)
BCT	Business Creation Techniques is a variable belonging to Management of Innovation Techniques into The **PRO** (**CIATEJ**). (See Table 2)
LEA	Leadership is a variable belonging to Management of Innovation Techniques into The **PRO** (**CIATEJ**). (See Table 2)
KC&A	Knowledge Capture and Acquisition is a variable belonging to the Knowledge Management Measurement (KMG) Into The **PRO** (**CIATEJ**). (See Table 3)

T&M	Training and Mentoring is a variable belonging to the Knowledge Management Measurement (KMG) Into The **PRO** (**CIATEJ**). (See Table 3)
P&S	Policies and Strategies is a variable belonging to the Knowledge Management Measurement (KMG) Into The **PRO** (**CIATEJ**). (See Table 3)
COMM	Communications is a variable belonging to the Knowledge Management Measurement (KMG) Into The **PRO** (**CIATEJ**). (See Table 3)
INC	Incentives is a variable belonging to the Knowledge Management Measurement (KMG) Into The **PRO** (**CIATEJ**). (See Table 3)
STG	Strategic is a variable belonging to **CIATEJ KPIPRO** and types. (See Table 5 and Table 8)
INST	Institutional is a variable belonging to **CIATEJ KPIPRO** and types. (See Table 5 and Table 8)
TTKCIATEJ	Transfer of technology and knowledge is a variable belonging to **CIATEJ KPIPRO** and types. (See Table 5)
TTKSTI	Transfer technology and knowledge (short term indicators) is a variable belonging to **CIATEJ KPIPRO** and types. (See Table 5 and Table 8)
TTKLTI	Transfer technology and knowledge (long term indicators) is a variable belonging to **CIATEJ KPIPRO** and types. (See Table 5 and Table 8)
MANOVA.	Multivariate Analysis of Variance
ANOVA.	Univariate Analysis of Variance
MANCOVA	Multivariate Analysis of Covariance
OTTK	The Office of Transference of Technology and Knowledge
EFA	Exploratory Factor Analysis
SEM	Structural Equation Modeling
CFA	Confirmatory Factor Analysis

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