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The development of ecosystems for technology transfer in Mexico: the role of Patenting Centers*

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In this article, we evaluate an initiative recently launched by the national government in Mexico to create 'Patenting Centers' in various universities and research institutions in diverse regions of the country. We focus particularly on elucidating how the installation of these Patenting Centers has augmented the number of national filings for intellectual property (IP) protection, and how the Centers have contributed to increasing the quality of IP applications. Furthermore, we analyze how the Mexican Patenting Centers have qualitatively contributed to fostering local cultures of innovation, for example through capacity-building activities directed towards scientific researchers. We also attempt to understand how the Patenting Centers have supported processes of technology transfer and commercialization, which we evaluate by examining a case study from the Northwest Biological Research Center (CIBNOR). Our findings indicate that the Mexican Patenting Centers have contributed to increasing IP protection activity in various regions of the country, and that they have augmented interactions between public research institutions and the productive sector. We conclude with suggestions for how the Patenting Center model may be further assessed in the future, to ensure that the government's mission of fostering endogenous innovation and the creation of a knowledge-based economy may continue to be realized.

Keywords: *Patenting Centers, intellectual property, public research centers, technology transfer*

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1 INTRODUCTION

In recent years, the Mexican federal government has become increasingly concerned with fostering innovation, with the expectation that an invigorated focus on technology development and transfer will result in economic growth. In this context, innovation can be understood as the creation of a new idea and its subsequent translation into practice.[1] Mexican institutions have come to associate this translational process as one whose ultimate aim is the commercialization of new technologies, an end that proponents believe portends benefits for multiple stakeholders.

The commercialization process is understood to hinge on the utilization of intellectual property (IP) rights by research institutions to protect new inventions, which can then be transferred to private enterprises for further development and marketing. While this model in some ways diverges from the historical conception of scientific research results as public goods, research institutions may now view commercialization as a means to generate social benefit in the form of access to new technologies.[2] Within this framework, an appropriate IP protection strategy is understood as an essential element of technology transfer, ensuring that the requisite time-limited exclusive rights for commercial exploitation of a new invention may be properly obtained and managed.[3, 4]

Given the centrality of IP rights in the modern technology transfer paradigm, over the course of the past decade the Mexican federal government has undertaken several initiatives designed to strengthen IP management capacities in the country's numerous research institutions. The present article endeavors to critically examine one of these national strategies – the creation of 'Patenting Centers' – in an attempt to elucidate the impact that this program has had on the innovation ecosystem in Mexico.

The contents of the article are organized as follows. Section 2 contextualizes the discussion by providing a brief conceptual introduction to the process of technology transfer, as undertaken at universities and public research institutions. This section also introduces the Mexican legal frameworks for IP protection, as well as some of the public policies that have been designed to foster innovation in the country. Subsequently, section 3 describes prominent international initiatives that have been launched in recent years, which are in some ways analogous to the system of Patenting Centers in Mexico. Section 4 builds on this discussion by detailing the Mexican Patenting Center strategy. Meanwhile, section 5 delves deeper by examining how this national policy initiative has been implemented, and how it has impacted local innovation ecosystems. Section 6 provides even more specificity by presenting a case study of technology commercialization that succeeded through the support of the Patenting Center at one particular Mexican research institution, the Northwest Biological Research Center (CIBNOR) in La Paz, Baja California Sur. Finally, section 7 extrapolates

1. Christopher M Kalanje, 'Role of Intellectual Property in Innovation and New Product Development' (World Intellectual Property Organization) <http://www.wipo.int/sme/en/documents/ip_innovation_development_fulltext.html> accessed 8 March 2018.
2. Martin Carree, Antonio Della Malva, and Enrico Santarelli, 'The Contribution of Universities to Growth: Empirical Evidence for Italy' (2014) 39 The Journal of Technology Transfer 393 at 396.
3. Donald Siegel, David Waldman, and Albert Link, 'Assessing the Impact of Organizational Practices on the Relative Productivity of University Technology Transfer Offices: An Exploratory Study' (2003) 32 Research Policy 27 at 28.
4. Lita Nelsen, 'The Rise of Intellectual Property Protection in the American University' (1998) 279 Science 1460 at 1460.

lessons from the Mexican experience, offering recommendations for how the Patenting Center strategy could be evaluated in the future to ensure continued success.

2 CONCEPTUAL INTRODUCTION TO INSTITUTIONAL TECHNOLOGY TRANSFER AND THE LEGAL FRAMEWORK FOR INTELLECTUAL PROPERTY PROTECTION IN MEXICO

Historically, most universities and public research institutions in Mexico and other countries have tended to conceptualize their role in society as primarily involving basic knowledge development and education. While this orientation continues to govern in many instances, it is also true that in recent decades investigative and higher-educational institutions have become increasingly focused on applied or 'translational' research as well as the movement of research results from the laboratory to the market. The entities that are dedicated to the mobilization of academic knowledge and discovery for the purpose of effecting broad social impact are generally known as technology transfer offices (TTOs). The effectiveness of these TTOs varies greatly depending on multiple factors, but a TTO's activities may generate benefits both internal and external to its home institution.[5]

In Mexico, the federal government began to support the establishment of TTOs in public research institutions in 2008, through an initiative launched by the National Council of Science and Technology (CONACYT). This program, known as 'AVANCE', was designed to identify opportunities for the creation of businesses based on the results of scientific and technological innovations generated at public research institutions. The AVANCE program also endeavored to facilitate the commercialization of research results by linking industry investors and sponsors with scientific teams and technology managers.[6] Meanwhile, in 2012 the Ministry of the Economy launched a Sectorial Innovation Fund known as 'FINNOVA'. Among other activities, this fund supports innovative research and development, IP registration, capacity building, and the certification of TTOs.[7]

Generally, TTOs across the world operate as the primary interface between their corresponding research institutions and the national authorities responsible for granting IP protection. In Mexico, TTOs based at public research institutions communicate directly with several governmental agencies, which collectively promote IP management, use, and enforcement. These entities include the Mexican Institute of Industrial Property (IMPI), the National Institute of Copyright (INDAUTOR), and CONACYT.

For their part, IMPI and INDAUTOR are actively involved in the management and registration of IP generated at Mexican organizations. IMPI is responsible for activities related to industrial property, including monitoring, enforcement, and imposition of administrative penalties for offenses related to infringement (Articles 1 and 203 Industrial Property Law, LPI). Meanwhile, the mission of INDAUTOR is to safeguard and promote Mexican cultural heritage through the protection of artists', authors', and

5. Barry Bozeman, 'Technology Transfer and Public Policy: A Review of Research and Theory' (2000) 29 Research Policy 627 at 647.

6. 'Secretariat of the Economy – CONACYT Sectoral Innovation Fund' (CONACYT) <http://www.conacyt.gob.mx/index.php/fondos-sectoriales-constituidos2/item/economia-conacyt-2> accessed 8 March 2018.

7. 'Knowledge Transfer Offices Certified by FINNOVA' (CONACYT/Secretaría de Economía, June 2015) <http://www.economia.gob.mx/files/comunidad_negocios/innovacion/oficinas_de_transferencia_de_conocimiento_certificadas_por_finnova.pdf> accessed 8 March 2018.

broadcasters' copyrights in relation to their literary or artistic works in all manifestations, including public performances, publications, recordings, and broadcasts.[8] INDAUTOR also oversees a system of administrative adjudication of copyright infringement cases.

CONACYT has a broader mandate than that of IMPI or INDAUTOR, as the federal public agency responsible for overseeing all national activities related to science and technology in Mexico, including policy development. The institution further operates as a key actor in the Mexican educational sector, given that CONACYT provides funding for a variety of scientific research and technological development projects in Mexico. From the date of CONACYT's inception in 1970 until 1999, the agency was shaped by minor institutional and legal reforms. This stability was interrupted in 2002, when a new Law on Science and Technology was proposed, passed, and promulgated. The reform was conceptually oriented around the notion that the transfer of knowledge and technologies encompasses one of the essential means through which developing countries may transform their economies.

Under the auspices of the 2002 Law on Science and Technology, for the past 15 years CONACYT has been increasingly focused on supporting activities that promote the use of IP protection and the commercialization of technologies developed in the public sector. CONACYT provides financial backing for such initiatives through a variety of funding mechanisms to which technology-based institutions in the public and private sectors alike may apply for resources. Accordingly, under the paradigm created by the 2002 reform, CONACYT has the express mission to act in conjunction with IMPI and INDAUTOR, towards the ends of promoting the protection of IP rights, technology transfer, and the eventual construction of a knowledge-based national economy.[9]

In the post-2002 policy environment, a variety of Mexican public institutions have become increasingly involved in knowledge and technology generation, as well as commercialization activities. These include the various CONACYT Research Centers, as well as the Technological Institutes of Mexico, which are organized under the Ministry of Public Education. Many of these institutions have established local Patenting Centers ('CEPATs' being their acronym in Spanish). These CEPATs are intended to complement the activities already undertaken by TTOs, by providing further support to their home institutions surrounding activities of IP management and technology transfer. The primary differences between TTO and CEPAT functions are detailed in Table 1.

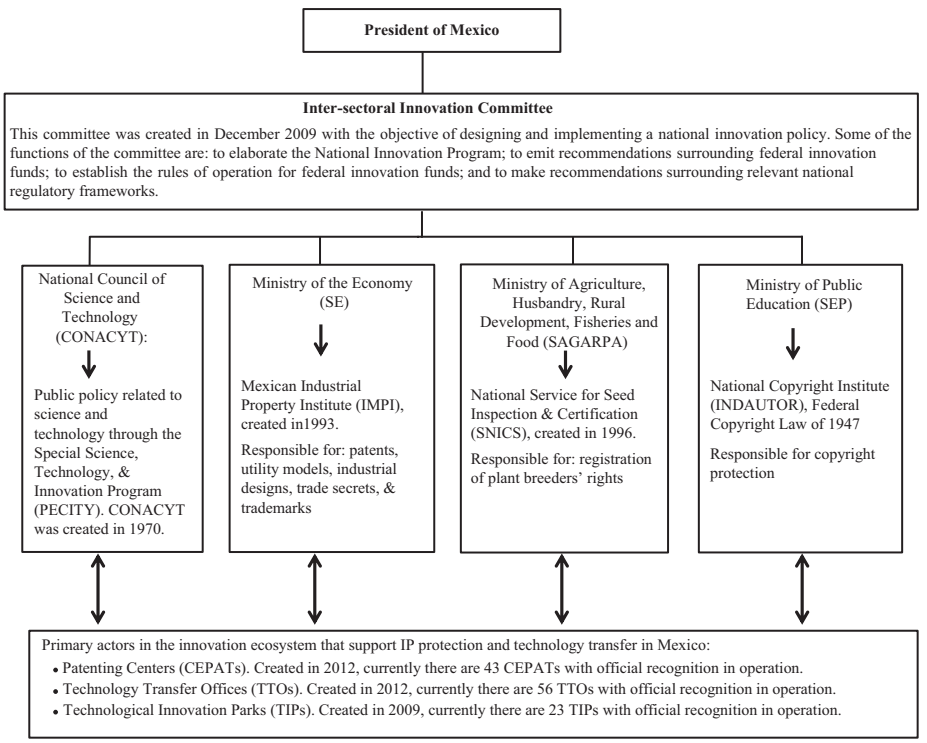
In some instances, CEPATs form part of their home institutions' TTOs, while in others they are independent entities. In either case, to be accredited the CEPAT must be certified by IMPI.[10] The Mexican CEPAT program – as well as corollary institutional technology commercialization initiatives that have been undertaken in recent years – will be discussed in greater detail in section 4 of this article. The institutional structure of Mexican governmental agencies that are involved with innovation, IP protection, and technology transfer are presented in Figure 1. This diagram illustrates the fact that the CEPATs, TTOs, and Technological Innovation Parks are not directly

8. 'Misión y Visión' (Instituto Nacional del Derecho de Autor; INDAUTOR) <http://www.indautor.gob.mx/preguntas.html> accessed 8 March 2018.
9. 'El Conacyt' (CONACYT) <https://www.conacyt.gob.mx/index.php/el-conacyt> accessed 8 March 2018.
10. 'Informe Annual del IMPI' (Instituto Mexicano de la Propiedad Industrial; IMPI) <https://www.gob.mx/impi/documentos/informe-anual-del-impi> accessed 8 March 2018.

Table 1 Differences between TTOs and CEPATs

TTO	CEPAT
Oversight of technology transfer and commercialization activities	Oversight of patent and copyright filings
Evaluation of invention disclosures	Assistance with IP protection strategies
Valuation of intangible assets	Assistance with IP portfolio management
Negotiation of contracts (eg, licenses; material transfer agreements)	Realization of specialized IP analyses (eg, patentability; freedom to operate)
Creation of start-up companies	Capacity building for researchers and TTO administrators
Direct communication with researchers	Utilization of information disclosed in third-party IP filings

Source: Authors' elaboration.



Source: Authors' elaboration.

Figure 1 Institutions and actors involved with innovation, IP protection, and technology transfer in Mexico

linked to governmental agencies. Instead, these entities are housed in public and private academic institutions, in the private sector, or under the auspices of public-private partnerships.

3 INTERNATIONAL CONTEXT OF SPECIALIZED INSTITUTIONAL IP SUPPORT CENTERS

The idea of establishing Patenting Centers in research institutions is not unique to Mexico. In fact, the most prominent international precedent dates from April 2009, when the World Intellectual Property Organization (WIPO) Member States implemented a pilot project to create Technology and Innovation Support Centers (TISCs) within the framework of the WIPO Development Agenda. The fundamental objective of this program centers on responding to Recommendation 8 of the Development Agenda, which urges Member States to facilitate access to specialized databases and online resources for the national IP offices of developing countries, as well as for regional and sub-regional IP organizations.[11]

Since January 2014, the TISC project has been fully incorporated into WIPO's regular activities and is part of the Organization's broader initiative to offer capacity-building services surrounding access to information and knowledge. At the international level, the stated objective of the TISC program is to facilitate the ability of innovators in developing countries to access high-quality information about new inventions as well as technology management services within their local ecosystems, thereby enabling them to maximize the likelihood that these individuals might create, protect, and appropriately manage their intellectual assets.[12]

Depending on the needs and culture of their home institutions, TISCs may offer a variety of services, including: online access to patents as well as scientific and technical documents; training in database searching; realization of searches (eg, prior art, freedom to operate); monitoring of technologies and competitors; provision of basic information on IP laws, IP management and protection strategies; and technology commercialization and marketing. Thus, TISCs serve a variety of functions, ranging from support for local TTO activities, to institutional capacity building, to brokerage with private sector partners. TISCs further act as service providers whose objectives may include enabling local users to effectively benefit from increased access to IP information through direct personal assistance; assisting local users in protecting and managing their IP rights; strengthening the local technological base by creating or reinforcing local know-how; and increasing technology transfer, for example by investigating the possibilities of licensing, joint ventures, etc. In short, TISCs are established for the purpose of acting as local drivers of innovation.[13]

11. 'Project Documents for Implementation of Recommendations 2, 5, 8, 9, and 10' (World Intellectual Property Organization, 30 March 2009) <http://www.wipo.int/meetings/en/doc_details.jsp?doc_id=119552> accessed 8 March 2018.
12. 'About the WIPO Technology and Innovation Support Center (TISC) Program' (World Intellectual Property Organization) <http://www.wipo.int/tisc/en/background.html> accessed 8 March 2018.
13. Yo Takagi and Andrew Czajkowski, 'WIPO Services for Access to Patent Information – Building Patent Information Infrastructure and Capacity in LDCs and Developing Countries' (2012) 34 World Patent Information 30 at 32.

Since its inception, the WIPO TISC initiative has been officially implemented in multiple countries in diverse world regions, spanning Latin America and the Caribbean, North and Sub-Saharan Africa, the Middle East, Eurasia, and different parts of Asia. From 2009 to 2016, 59 countries signed Service Level Agreements to develop national TISC networks, and during this period 517 TISCs were established.[14] Notably, these TISCs do not universally provide the same types of support, though all must offer at least three basic services: (1) access to online patent database systems and technology resources; (2) access to industrial-property-related publications; and (3) assistance in searching and retrieving technology information.[15] As an example, at the TISCs based in Colombia, during 2016, 3909 consultations were conducted surrounding potential IP protection, 305 projects were identified as eligible for protection, and 143 patent applications, four industrial design applications, and 344 trademark applications were drafted and filed.[16]

In countries where WIPO-sanctioned TISC centers have not been established, analogous national-level initiatives are also underway. For instance, beginning in 2003 the Japanese government allocated funding to establish University Intellectual Property Centers through its Ministry of Education, Science and Technology. The overarching mission of these Centers is to strategically implement the creation, management, and utilization of IP under a recently revised legal framework – similar to the 1980 Bayh-Dole Act[17] in the United States – which shifted the focus of IP ownership from individuals to institutions.[18] The University IP Centers also endeavor to provide advice and support for intellectual management within Japanese universities. Like Japan, in recent years Mexico has been experimenting with the creation of IP management and technology transfer support institutions at the national level, outside of the TISC system administered by WIPO.

4 PATENTING CENTERS AS A STRATEGY FOR TECHNOLOGY COMMERCIALIZATION IN MEXICO

To date, no Service Level Agreement exists between WIPO and Mexico that would establish a Mexican TISC network. However, the country has devised an alternative strategy at the national level, manifested as the aforementioned CEPATs, which are associated with and certified by IMPI yet operate independently from this Institution. The CEPAT model is loosely based on a previously established system of Regional

14. 'Technology and Innovation Support Centers (TISCs) Report 2016' (World Intellectual Property Organization) <http://www.wipo.int/edocs/pubdocs/en/wipo_tisc_report_16.pdf> accessed 8 March 2018.
15. 'Technology and Innovation Support Centers (TISC) Implementation Guide' (World Intellectual Property Organization, 2012) <http://www.wipo.int/edocs/pubdocs/en/patents/1038/wipo_pub_1038.pdf> accessed 8 March 2018.
16. Fernando Triana Soto and Rubio Marcela, 'Patent and SMEs in Latin America: Colombia' (2017) 4 les Nouvelles 203 at 204.
17. Officially known as the Patent and Trademark Law Amendments Act, this legislation permits universities, small businesses, or non-profit institutions in the United States to elect to pursue ownership over the inventions that they develop through federal-government-funded research.
18. K Shinohara, 'TLOs and University Intellectual Property Centers' (United States National Science Foundation, Tokyo Regional Office 2004) <https://www.nsf.gov/od/oise/tokyo/reports/trm/rm04-05.html> accessed 8 March 2018.

Team Optimization and Development Centers (CRODEs), which were established in certain technological institutes of the Ministry of Public Education (SEP) beginning in the mid-1970s. A further wrinkle is the fact that in 2012, CEPATs were launched in a set of CONACYT Public Research Centers, thereby extending the initiative beyond the original population of universities.

The origins of the CEPAT program can be traced to the paradigm shift initiated by the 2002 Law on Science and Technology. Although this framework significantly re-oriented national priorities surrounding scientific and technological research, Mexican universities and research centers were slow to embrace technology transfer practices during the first decade of the 2000s. This phenomenon was likely at least in part attributable to the fact that firms participating in the Mexican market had not yet incorporated advanced technology utilization and innovation as key components of their strategies for becoming more competitive.[19] Thus, Mexican universities and public research institutions had few options for technology licensing at the national level. It is possible that CEPATs could in the future collaborate with Mexican TTOs to develop alternative strategies for technology commercialization, such as international licensing or the creation of start-up companies.

In part to address the incipient progress in the commercialization of inventions following the 2002 reform, the National Policy for Fostering Technology Transfer was launched in 2006.[20] This Policy was complemented by a new National Development Plan (2007–2012), in which the executive branch of the federal government voiced the need to create the necessary conditions for Mexico to effectively position a greater number of new technologies in both domestic and international markets. Additionally, during the same time period the Special Program for Science, Technology, and Innovation 2008–2012 (PECITI) was established as the flagship federal executive program designed to ensure that economic development unfolds in a balanced manner in Mexico. Thus, rather than focus on one particular sector, the PECITI initiative supports technological development in a wide variety of areas, including in relation to human capital, scientific and technological infrastructure, social uptake of knowledge, and international cooperation in science, technology, and innovation, among others.[21]

In summation, since 2002 Mexico has enacted multiple reforms to national policies designed to promote the effective protection and management of IP, as well as to encourage active participation in the process of the transfer of intangible assets generated in knowledge-based institutions. CEPATs may be understood as physical manifestations and a direct outgrowth of these policy reforms. In other words, rather than existing as merely aspirational, abstract policies, CEPATs operate as fully functional offices whose purpose is to promote interconnections between knowledge-generating institutions and the production chains of the various sectors that collectively comprise the Mexican economy. CEPATs also focus on channeling 'competitive

19. José Luis Solleiro and Rosario Castañón, 'Competitividad y Sistemas de Innovación: Los Retos para la Inserción de México' (2012) 5 Revista Iberoamericana 165 at 190.
20. G Estrada, *Oficinas de Transferencia de Tecnología* (Asociación Mexicana de Directivos de la Investigación Aplicada y el Desarrollo Tecnológico 2010).
21. 'Programa Especial de Ciencia, Tecnología e Innovación 2014–2018' (CONACYT) <http://www.siicyt.gob.mx/index.php/normatividad/nacional/programa-especial-de-ciencia-tecnologia-e-innovacion-peciti/2014-programa-especial-de-ciencia-tecnologia-e-innovacion/623-peciti-2014-2018/file> accessed 8 March 2018.

intelligence' towards strategic sectors that have been defined under state- (as opposed to federal-) level innovation agendas.[22]

One of the core functions of Mexican CEPATs is to facilitate the protection of new inventions and creations with IP, both nationally and internationally, as well as to support diverse strategies employed by CEPAT host institutions to commercialize IP-protected technologies. As part of these activities, CEPATs act as interlocutors between their home institutions' TTOs and the various governmental agencies responsible for IP protection, including IMPI (for trademarks, slogans and trade names, patent applications, utility models, and industrial designs); INDAUTOR (for copyright registration); and the Ministry of Agriculture, Husbandry, Rural Development, Fisheries and Food (SAGARPA) (for the protection of plant breeders' rights).

The IP management initiatives overseen by Mexican CEPATs also encompass the identification of research projects that are likely to result in protectable inventions. Such work is achieved by conducting in-house prior art searches in order to predict the likelihood that research products would be sufficiently novel and inventive to be protected. CEPATs also conduct 'freedom to operate' analyses, which are designed to generate opinions about whether the commercialization of a particular technology would infringe on the IP rights of third parties. Finally, in addition to these relatively more sophisticated analytical activities, in some instances CEPATs also provide the more essential services of drafting applications for patents, utility models, and industrial designs, conducting phonetic and feasibility searches for the registration of trademarks, slogans, and trade names, and managing IP filings in accordance with the provisions of the Industrial Property Law, Federal Law on Copyright, and the Federal Law on Plant Variety Protections, or according to applicable international or foreign law.[23]

Given that CEPATs are located within knowledge-generating institutions, and that they play a fundamental role in establishing local IP protection strategies, these Centers are also intimately involved with institutional technology transfer in collaboration with institutional TTOs. In general, the principal objectives of the CEPAT network are (1) to promote a national culture of IP utilization and protection, and (2) to support effective technology transfer. An important factor underpinning the realization of these objectives is effective action taken by personnel specialized in IP who work in these Centers. These experts help to increase the number of IP protection applications filed by their host institutions, in addition to facilitating the commercialization of granted IP rights through licensing and other forms of technology transfer. Thus, at least in theory, CEPATs should contribute to strengthening the competitiveness of their home institutions, as well as that of the firms that bring these institutions' innovations to market.

While IP management and technology transfer comprise the central CEPAT functions, these Centers also provide other forms of support to their home institutions. For instance, CEPATs may assist with the drafting and implementation of institutional policies for the sharing of benefits derived from the exploitation of IP rights between inventors and the host institution. In some instances, CEPATs also engage in capacity-building activities, for instance by offering training in IP laws and policies, or around how to appropriately utilize or build upon technological information that has been previously disclosed in third-party IP filings.[24]

22. 'CePat' (Secretariat of Public Education; SEP) <http://www.cepat.tecnm.mx/index.php/cepats> accessed 8 March 2018.
23. Ibid.
24. Ibid.

As discussed above, the establishment of a CEPAT in Mexico occurs in direct collaboration with IMPI, an institution that is required by law to certify these Centers. The overarching motivation behind IMPI's involvement in the CEPAT initiative is to achieve an increase in the number of patent applications filed in the technology areas in which CEPATs specialize. The IMPI certification is also intended to foster the commercialization of IP within the CEPAT's portfolio of inventions. The active involvement of IMPI in the creation of CEPATs also means that this Institute provides initial training through an intensive program for CEPAT staff, in addition to assisting with the definition of localized management procedures.

Beyond this necessary connection to IMPI, and as discussed above, CEPATs are naturally linked to their home institutions' respective TTOs. However, in contrast to these TTOs, CEPATs are able to directly offer specialized services in IP-management-related matters to private firms, outside research institutions, and other external entities that also work in the technology transfer and commercialization space. The Mexican federal government encourages such outwardly focused service provision, and CEPAT-to-CEPAT networking is also viewed favorably.

Although CEPATs are officially independent from Mexican government agencies, IMPI has taken a somewhat interventionist approach to the development of the Patenting Center network. For instance, IMPI recently launched a series of initiatives designed to homogenize the operational model and internal composition of the CEPATs, including through capacity-building programs. The general goal of these initiatives is to increase the number of quality IP registrations as well as the number of technologies that are commercialized based on IP developed in Mexico. Although the IMPI strategy makes sense from a centralized planning perspective, it could have the effect of impeding the customization of the CEPAT model to meet the needs of local institutions. This could result in decreased experimentation with different models of technology commercialization in favor of a uniform national approach.

Aside from these linkages with IMPI, CEPATs are also allied with other public institutions, including CONACYT, the Mexican Network of Technology Transfer Offices (Red OTT), the Ministry of the Economy (SE), INDAUTOR, and SAGARPA. The involvement of these diverse entities in the CEPAT network facilitates continuous training on matters related to IP management and technology transfer. However, as is the case with IMPI, the constant influence of government agencies could mean that CEPATs may be unlikely to develop independent institutional identities. Nevertheless, it is notable that the RED OTT has organized training sessions for CEPAT staff that have been led by external actors. Such capacity-building initiatives have in some instances been developed through collaborations with international organizations such as the Organization of American States (OAS), the Public Intellectual Property Resource for Agriculture (PIPRA), the World Intellectual Property Organization (WIPO), the University of California, Davis (UC Davis), Isis Innovation Ltd of the University of Oxford, and foundations such as the Newton Fund and the Royal Academy of Engineering.

5 INSTITUTIONAL HIERARCHY AND GEOGRAPHICAL DISTRIBUTION OF PATENTING CENTERS IN MEXICO

Contemporarily, the system of Patenting Centers in Mexico contains two essential types of entities. The first of these is embodied by the CRODEs, which were founded in several of the National Technological Institutes of Mexico between 1976 and 1988, well before the enactment of the 2002 Law on Science and Technology. CRODEs are

entities that are designed to foment technological development, by offering access to specialized equipment for R&D in areas related to electronics, mechanical engineering, automation, fiber optics, and engineering in general.[25]

Today, CRODEs exist in four Mexican states, supporting multiple Ministry of Education (SEP) Technological Institutes. Specifically, the Chihuahua CRODE serves 15 Technological Institutes; the Guanajuato CRODE serves ten Technological Institutes; the Veracruz CRODE serves eight Technological Institutes; and the Merida CRODE serves three Technological Institutes. In total, 36 different Mexican Technological Institutes have access to CRODEs. These Centers collectively generate a substantial volume of potentially commercializable inventions that result from the scientific and technological research conducted at the various Institutes.[26]

Additionally, following the 2002 reform, CEPATs have been established in a variety of other types of institutions in Mexico. These CEPATs operate in collaboration with the CRODEs, and take advantage of existing regional technology development infrastructure. To date, CEPATs have been established in the following institutions: (1) the Ministry of National Defense (SEDENA); (2) the National Institute of Genomic Medicine (INMEGEN); (3) the Mexican Petroleum Institute (IMP); (4) La Salle University; (5) the National Polytechnic Institute (IPN); (6) the Mexico State Council of Science and Technology (COMECYT); (7) the National Autonomous University of Mexico (UNAM); and (8) the Polytechnic University of Pachuca (UPP).

Furthermore, in 2012 a related initiative was undertaken to establish a group of CEPATs in nine CONACYT Research Centers. This program was spearheaded by the Mexican Corporation for Research Materials S.A. de V. (COMIMSA), and supported by the National Chamber of Industry (CANACINTRA) in collaboration with CONACYT and IMPI. The institutions in which these new CEPATs are housed are as follows: (1) the Mexican Corporation in Research Materials S.A. de C.V. (COMIMSA); (2) the Northwest Biological Research Center S.C. (CIBNOR); (3) the Food and Development Research Center (CIAD); (4) the Scientific Research Center of Yucatan (CICY); (5) the Center for Research and Innovation in Information Technology and Communication (INFOTEC); (6) the Center for Research and Assistance in Technology and Design of the State of Jalisco, A.C. (CIATEJ); (7) the Center for Research in Advanced Materials, S.C. (CIMAV); (8) the Optics Research Center, A.C. (CIO); and (9) the Scientific Research and Higher Education Center of Ensenada, Baja California (CICESE).

Although they are still relatively young, the impact of the activities spearheaded by the CEPATs established in the CONACYT Research Centers is already measurable. One metric on which to evaluate CEPAT performance is the number of inventions generated at CONACYT Research Centers that have been protected with different kinds of IP. Table 2 presents the total number of inventions by type of IP for four years before and four years after the implementation of the initiative. While the number of applications for IP rights for inventions generated in the CONACYT Research Centers still remains relatively low in comparison to what might be expected at similar institutions in other countries, overall the volume of applications has increased for all Centers.

25. 'Tecnológico Nacional de México' (Secretariat of Public Education; SEP) <http://www.tecnm.mx/informacion/sistema-nacional-de-educacion-superior-tecnologica> accessed 8 March 2018.
26. Ibid.

Table 2 IP Protection activity for industrial property at the CONACYT Research Centers' CEPATs

Inventions	2008	2009	2010	2011	Total*	2013**	2014	2015	Total***
National patent applications	24	27	21	25	97	51	28	46	125
National granted patents	2	7	11	9	29	11	19	18	48
International patent applications	3	4	4	3	14	7	8	1	16
International granted patents	0	0	0	1	1	1	2	3	6
National utility model applications	0	3	0	2	5	6	4	2	12
National utility models granted	0	0	0	2	2	3	4	2	9
Industrial designs applications	1	3	8	1	13	5	4	11	20
Industrial designs granted	0	1	5	1	7	5	0	2	7
Total inventions	30	45	49	44	168	89	69	85	243

Notes: * Total inventions by type of intellectual property four years before the implementation of Patenting Centers. ** Includes data from August to December 2012 and all of 2013. *** Total inventions by type of intellectual property four years after the implementation of Patenting Centers. *Source:* Based on data provided by IMPI and COMIMSA.

Table 3 IP Protection activity for trademarks and copyrights at the Patenting Centers within CONACYT Research Centers in Mexico

Trademarks and Copyrights	2013*	2014	2015	Total
National trademark applications	44	23	41	108
National trademarks granted	32	16	27	75
Commercial notification applications	1	6	11	18
Trademark renewal applications	4	5	1	10
Copyright applications INDAUTOR	87	58	134	279
Copyrights granted INDAUTOR	68	52	124	244

Note: * Includes data from August to December 2012 and all of 2013.
Source: Based on data provided by COMIMSA.

For instance, Table 2 demonstrates that Mexican patent applications and granted patents increased by 28.8 percent and 65.5 percent respectively, four years after the establishment of CEPATs, in comparison to the four years prior to the launching of the initiative. In total, patent applications covering 168 inventions were filed from 2008 to 2011, while the number of filings for 2012 to 2015 was 243, representing an increase of 44.6 percent. These data demonstrate that the availability of local CEPAT services has correlated with an increase in the overall number of patent filings by CONACYT Research Centers. Indeed, IMPI data indicate that during the 2016 calendar year, of the 1310 patent applications received by IMPI, 254 (19.4 percent) were filed with the support of a Patenting Center.[27]

A similar trend was witnessed in relation to filings for IP protection via trademarks and copyrights for the period of 2012–2015, as displayed in Table 3. Notably, copyright protections are important assets for the CONACYT Research Centers, given that software inventions are protected via copyrights rather than patents in Mexico. Table 3

27. 'Celebran IMPI y UP Jornada de Propiedad Industrial e Innovación' (IMPI, 14 March 2017) <https://www.gob.mx/impi/prensa/celebran-impi-y-up-jornada-de-propiedad-industrial-e-innovacion?idiom=es> accessed 8 March 2018.

Table 4 Activities related to IP utilization at the Patenting Centers within CONACYT Research Centers in Mexico

Intellectual Property Related Activity	2013*	2014	2015	Total
Technological searches	277	493	225	995
Consulting with researchers	757	648	684	2089
Training workshops offered	147	82	52	281
Courses or workshops received	24	35	40	99

Note: * Includes data from August to December 2012 and all of 2013.
Source: Based on data provided by COMIMSA.

demonstrates that applications for copyright protection increased by an average of 18 percent from 2013 to 2015, while granted copyrights have increased by 27 percent over the same period. Meanwhile, trademark applications and grants have remained stable over the 2013–2015 period, with an annual average of 36 applications filed and 25 trademarks granted.

Table 4 presents data on various IP management activities conducted by the CEPATs that are based at CONACYT Research Centers. These activities include the prior art searches and patentability analyses. The data suggest that CEPATs have augmented the interest in IP on the part of the academic communities located in their respective home institutions. This phenomenon is demonstrated by the fact that since the establishment of CEPATs in CONACYT Research Centers, an average of 696 consultations took place each year from 2013 to 2015 between CEPAT staff and researchers at the affiliated institution. Meanwhile, an annual average of 331 technological information searches were realized during the 2013–2015 period. CEPATs also continuously conduct workshops and courses related to IP protection and management, which may contribute to changing institutional cultures surrounding technology commercialization.

6 CASE STUDY: THE PATENTING CENTER AT THE NORTHWEST BIOLOGICAL RESEARCH CENTER (CIBNOR): SUPPORT FOR THE INSTITUTION'S FIRST LICENSING AGREEMENT

CIBNOR is a CONACYT Research Center located in La Paz, Baja California Sur. The institution focuses on research related to dryland agriculture, aquaculture, fisheries ecology, and environmental planning. CIBNOR oversees both basic and applied research projects, which together strive to identify solutions for the effective use and management of natural resources, to promote sustainable development at local, regional, national, and international levels, and to generally contribute to the enrichment of knowledge surrounding natural resources utilization.

CIBNOR was one of the first CONACYT Research Centers to establish an in-house CEPAT, which commenced operations in January 2012. Subsequent to its foundation, the CIBNOR Patenting Center quickly began to provide support for effective IP protection and management. Thus, later in 2012 the CIBNOR CEPAT supported the negotiation and execution of the first patent license that the institution had obtained in its 37 years of existence. Prior to the execution of the deal, the CIBNOR CEPAT conducted patentability and freedom to operate analyses in relation to the relevant invention, prepared and filed a national patent application, and assisted with the proof of concept process.

The licensed technology relates to an organic gypsum fertilizer pellet useful for the recuperation and improvement of arid and semi-arid agricultural soils with nutrient deficiencies, for the cultivation of fruits and vegetables. The fertilizer is obtained through the fermentation of an organic mixture of calcium, sulfur, and plants from the Arecaceae family. Fruits and vegetables that are fertilized with the composition present faster growth and mass increase compared to non-fertilized plants. The fertilizer also allows for greater moisture retention in arid soils. The organic pelletized gypsum fertilizer was developed by Dr Lopez Aguilar, a researcher in CIBNOR's Dryland Agriculture program.

To commercialize the new organic fertilizer technology, a license was executed with the Western Mexican Company (COMSA), a firm that had already obtained the requisite permissions from the Mexican federal government to mine calcium sulfate (gypsum) deposits on San Marcos Island, which is located in the Gulf of California. COMSA is currently the largest producer of high-quality gypsum in Mexico, meaning that the firm is a high-profile partner at the national level. The strong reputations of CIBNOR and COMSA, coupled with the products of the licensing agreement, indicate that this commercialization case study could promote future applied research projects. Such work could, for instance, focus on expanding the use of gypsum in diverse applications, including in the construction industry, as well as in the health and agricultural sectors.

The licensing agreement that was executed between CIBNOR and COMSA, which was brokered by the CEPAT, contained terms including a ten-year duration for exclusive commercial exploitation of the relevant patent. The agreement is set to automatically renew for a period of ten additional years, unless COMSA notifies CIBNOR in writing that it does not wish to extend the term of the agreement. As financial consideration for usage rights over the invention, COMSA pays CIBNOR a royalty based on the number of tons of organic pelletized gypsum fertilizer sold in each calendar year. Meanwhile, the agreement stipulates that CIBNOR reserves the right to use the licensed invention for educational and research purposes. The deal also contained diligence terms, requiring that COMSA begin to commercially exploit the technology in a 'reasonable time,' not to exceed two years following the execution of the agreement.

Subsequent to the finalization of the license in 2012, COMSA built a gypsum plant to produce organic fertilizer for agricultural use. The factory currently employs more than fifty workers and has an annual production capacity of 16 000 tons of gypsum. The commercial success that COMSA's fertilizer has achieved has resulted in direct financial benefits for CIBNOR, such that the institution earns significant royalty revenue each year from the agreement. The CIBNOR CEPAT played an instrumental role in successfully bringing this new technology to market, and ultimately the experience has yielded benefits for the licensor institution, the licensee company, and the society at large.

7 CONCLUSIONS: LESSONS LEARNED AND RECOMMENDATIONS FOR THE FUTURE

The Mexican government expressly included the objective of fostering effective IP protection and management as part of its 2013–2018 National Development Plan, a strategy that was designed to strengthen the national economy. Yet in order to foment innovation, the mere creation of broader consciousness surrounding IP frameworks is not in itself sufficient to construct a knowledge-based economy. Instead, specialized programs focused on the strategic utilization of IP to promote innovation, and technology commercialization should be developed and refined. In the Mexican context,

initiatives such as the formation of Patenting Centers can provide insights about how public research institutions may best engage in IP management and technology transfer to promote the creation of innovation ecosystems and economic development.

As this article has demonstrated, the Patenting Center initiative – and in particular the CEPAT network created following the enactment of the 2002 Law on Science and Technology – has already yielded some interesting results. For instance, the support that CEPATs have provided to their home institutions has contributed to an overall increase in the number and quality of applications for IP protection filed nationally. In addition to these quantitative metrics, the success of the Mexican Patenting Centers may be evaluated qualitatively. For example, CEPATs have supported the creation of local cultures of innovation through capacity-building activities directed towards researchers. In some instances, CEPATs have also stewarded the successful transfer of technologies generated at public institutions, as demonstrated in the CIBNOR case study.

Nevertheless, several questions remain about how the CEPAT initiative may continue to promote innovation sustainably, and in a manner driven by local needs. Most prominently, beyond increasing the volume of IP owned by Mexican research institutions, it will be important to ensure that a greater number of inventions are commercialized. This could arguably best occur via technology transfer to national firms or the creation of start-up companies, towards the end of supporting the growth of a technology-based economy. Furthermore, Mexican research institutions will likely face the challenge of how CEPATs may best complement the services already offered by TTOs, and how both types of entities can optimally meet the needs of the scientific and business communities as a whole. Ideally, synergies between these actors would foment the development of institutional policies and practices to support effective IP protection and management, technology transfer, and innovation, in a way that would balance national priorities with local needs.