InternexT

INTERNATIONAL BUSINESS AND MANAGEMENT REVIEW

v.21, n. 1, e842, 2026| e-ISSN: 1980-4865 | http://internext.espm.br

TECHNOLOGY TRANSFER CONTRACTS: A BIBLIOMETRIC ANALYSIS FROM THE THEORY OF THE CONSOLIDATED META-ANALYTICAL APPROACH

Marcia Gabriela Bilbao La Vieja[1]* & Rejane Sartori[1,2]

[1]Universidade Estadual de Maringá – Maringá (PR), Brasil.

[2]Universidade Cesumar – Maringá (PR), Brasil.

ARTICLE DETAILS

Received:
Nov 9, 2024

Accepted:
Sep 8, 2025

Available online:
Dec 11, 2025

Double Blind Review System

Editors
Priscila Rezende da Costa
Mário Ogasavara
Alex Fabianne de Paulo
Diogo Barbosa Leite
José Jassuipe da Silva Morais

ABSTRACT

Objectives: The aim of this study was to map and analyze the scientific production involving technology transfer contracts, in order to identify how the scientific community addresses the subject. **Method:** This is a bibliographical study of an exploratory-descriptive nature, grounded in the meta-analytic approach theory. The data were obtained from research conducted in the Web of Science and Scopus databases. **Main Results:** The study identified the publication of 163 articles between 2012 and 2023. Additionally, 411 researchers and 24 countries published on technology transfer contracts across 108 different journals. The analyses revealed licensing as the most widely used contractual form for technology transfer. Three major groups of studies were identified, focusing respectively on: the influence of external factors on contracts; the analysis of contractual clauses; and the analysis of technology transfer instruments. **Relevance/Originality:** This study contributes to the enhancement of the literature on technology transfer contracts. The approaches, elements, and bibliographic references provide a foundation for future interdisciplinary works addressing technology transfer contracts. **Theoretical/Methodological Contributions:** This article contributes to the academic understanding of studies on technology transfer contracts by providing a structured overview of the current research landscape on the subject. It highlights the lack of approaches from various perspectives regarding technology transfer contracts, as well as the need for ongoing research. **Social/Managerial Contributions:** There is a pressing demand for new research in this field, enabling the continuation of academic investigations concerning technology transfer contracts, their influences, clauses, and forms.

Keywords: Technology Transfer. Innovation. Contracts. Bibliometrics.

CONTRATOS DE TRANSFERÊNCIA DE TECNOLOGIA: UMA ANÁLISE BIBLIOMÉTRICA COM BASE NA TEORIA DO ENFOQUE METANALÍTICO CONSOLIDADO

DETALHES DO ARTIGO

Recebido:
9 Nov, 2024

Aceito:
8 Set, 2025

Disponível online:
11 Dez, 2025

Sistema de revisão
"Double Blind Review"

Editores
Priscila Rezende da Costa
Mário Ogasavara
Alex Fabianne de Paulo
Diogo Barbosa Leite
José Jassuipe da Silva Morais

RESUMO

Objetivos: Mapear e analisar a produção científica envolvendo contratos de transferência de tecnologia, de modo a identificar como a comunidade científica apresenta o tema. **Método:** Este é um estudo bibliográfico, de cunho exploratório-descritivo, lastreado na teoria do enfoque metanalítico. Os dados foram obtidos da pesquisa efetuada nas bases de dados Web of Science e Scopus. **Principais Resultados:** A pesquisa identificou a publicação de 163 artigos no período compreendido entre 2012 e 2023. Ademais, 411 pesquisadores e 24 países publicaram sobre contratos de transferência de tecnologia em 108 periódicos distintos. As análises demonstraram o licenciamento como forma contratual mais utilizada para a transferência de tecnologia. Constatou-se a existência de três grandes grupos de estudo, com foco: na influência de fatores externos ao contrato; na análise de cláusulas dos contratos; e na análise dos instrumentos de transferência de tecnologia. **Relevância / Originalidade:** Este estudo contribui para o aprimoramento da literatura sobre contratos de transferência de tecnologia. As abordagens, os elementos e as referências bibliográficas servem de subsídio para futuros trabalhos interdisciplinares que permeiem os contratos de transferência de tecnologia. **Contribuições Teóricas / Metodológicas:** Este artigo contribui para a compreensão acadêmica dos estudos sobre contratos de transferência de tecnologia, fornecendo uma estrutura do cenário atual de pesquisa em torno do tema. Aponta para a carência de abordagens em diversas perspectivas de contratos de transferência de tecnologia, além da necessidade da continuidade das pesquisas. **Contribuições sociais / para a gestão:** É premente a demanda por novas pesquisas na área, permitindo a continuidade das investigações acadêmicas a respeito dos contratos de transferência de tecnologia, influências, cláusulas e espécies.

Palavras-chave: Transferência de Tecnologia. Inovação. Contratos. Bibliometria.

*Autora correspondente: bilbao@uel.br

https://doi.org/10.18568/internext.v21i1.842

INTRODUCTION

Innovation has been recognized as fundamental to promoting the technological and economic development of a nation, and technology transfer, consequently, assumes growing importance, given that it is predominantly in the market where technological innovation materializes (Czelusniak et al., 2018). It is within this context that incremental and disruptive inventions transform the economy (Christensen, 2012; Schumpeter, 1988).

Although technological innovation is observed to materialize in the market, it is acknowledged that innovative firms rely on multiple competencies, with interaction with external agents, particularly universities, being decisive for the development of innovative performance (Ferreira et al., 2017). Collaboration among governmental, industrial, and academic development agents constitutes a key factor for economic growth, technological progress, and sustainable development (Berbegal-Mirabent et al., 2015; Wit-de Vries et al., 2019).

From this perspective, technology transfer from academia to the productive sector emerges as an alternative and complementary path toward achieving a higher technological level for firms and toward the technological advancement of nations (Muscio, 2010). It is through the transfer of knowledge and technology that university–industry relations can become materialized, evolving from merely informal interactions to more formal, frequent, and planned arrangements, through technology transfer agreements involving the exchange of property rights (Graef et al., 2022).

For technology transfer to occur with interested partners, it is necessary to establish legally binding instruments that recognize responsibilities, duties, and rights—namely, technology transfer contracts (Lopes, 2019). The execution of such contracts, with clear clauses defining the rights and obligations of the parties involved, within the limits of the relevant legislation, ensures legal security for both parties and fosters new alliances between universities and companies, thereby generating economic returns for society (Suzart, 2015).

Given this context, the identification and analysis of scientific knowledge concerning technology transfer contracts per se are of particular relevance, as understanding formalized technology transfer, along with its challenges and benefits, enables the improvement of legal instruments. This understanding allows for the identification of common elements, expressed through a shared cognitive foundation, which can facilitate the relationship between the market and academia so that both parties benefit. Furthermore, identifying existing knowledge on technology transfer contracts contributes to a broader understanding of the subject and may serve as a reference point for the advancement of knowledge, helping to fill theoretical gaps regarding the legal instrumentation of technology transfer. The topic holds fundamental importance, as there is no consolidated body of literature specifically addressing technology transfer contracts.

Therefore, considering the relevance of the topic of technology transfer contracts, as well as the importance of legal instruments to ensure that technological innovations reach society, and the interest in contracts capable of adequately structuring technology transfer relations, the present study seeks to answer the following question: How is the scientific production on technology transfer contracts characterized? To this end, this study aims to map and analyze the scientific output concerning technology transfer contracts, in order to identify how the academic community approaches the topic.

This article is structured into five sections. Following this introduction, the next section presents general considerations on technology transfer contracts. The third section describes the methodological procedures employed, while the fourth section presents and discusses the results obtained. Finally, the fifth section provides the concluding remarks, followed by the references.

1. TECHNOLOGY TRANSFER: CONCEPTS AND INSTRUMENTS

Technology transfer is regarded as a field of study or discipline, rather than merely an interesting topic for analysis. Research in this area has been published at least since 1977, with the release of the first volume of an international journal specifically devoted to technology transfer, the *Journal of Technology Transfer*, in addition to other relevant journals that have emerged over time (Noh & Lee, 2019). According to Lee and Win (2004), by the late 1990s, research

began to focus on collaborative interactions with universities, suggesting a shift in emphasis from governmental organizations to universities as central agents in technology transfer studies.

Universities and hybrid organizations that integrate academia, industry, and government have been intensively examined as agents of technology transfer. With the advent of the knowledge-based society in the 21st century, a completely new model of technology transfer emerged, one that encompasses broader and more complex transfer interactions, replacing the traditional, linear model focused on the movement of a well-defined technology from one economic unit to another. The scope of technology transfer research has thus expanded beyond simple transfer cases to include nonlinear mechanisms and dynamics (Amaral, 2015; Bozeman, 2000; Etzkowitz, 2008; Santos, 2002). The study of these dynamics has evolved over the years, and the understanding of technology transfer itself has been the subject of diverse scholarly inquiry.

Given the complexity that surrounds technology transfer, its definition remains unconsolidated across different analytical perspectives (Cysne, 2006; Pagani et al., 2016). The intended mapping, therefore, aims to identify and organize the existing body of knowledge on the subject. The literature on technology transfer encompasses a wide range of studies addressing distinct and often divergent aspects of the phenomenon (Graef et al., 2022).

According to Mogavero and Shane (1982), technology transfer refers to the use of knowledge, even when such use does not meet the expectations initially envisioned. From another perspective, Van Horne and Dutot (2017) conceive technology transfer as a form of knowledge transfer, and knowledge, in this sense, also encompasses know-how. In line with this understanding, Landry et al. (2013) define knowledge transfer as a process through which both tacit and legally protected knowledge are moved from one party to another, to develop or improve products or services that generate economic and social value for customers. Theoretical distinctions thus arise depending on the nature of the object being transferred within the process of technology transfer.

More broadly, Rogers (1972) and Shih and Chang (2009) conceptualize technology transfer as a systematic process through which entities exchange technological knowledge. Consequently, the components of technology transfer can largely be categorized into two types (Battistella et al., 2016). In the first type, the agent of transfer is an entity engaged in a technology transfer process, which includes intermediaries, beneficiaries, and donors. The second type regards technological knowledge as a transferable asset that encompasses both tacit and explicit forms of knowledge—concepts widely recognized within the field of knowledge management (Noh & Lee, 2019).

From a perspective that emphasizes the actors involved in the technology transfer process, Van Horne and Dutot (2017), along with Noh and Lee (2019), define technology transfer as a set of sequential interactions among agents aimed at achieving knowledge-based innovation. For these authors, the triple helix model proposed by Etzkowitz and Leydesdorff (2000) highlights the roles of government, industry, and academia in the technology transfer process. However, in recent years, they have expanded this dynamic to include intermediary organizations (Van Horne & Dutot, 2017), such as technology transfer offices abroad and technological innovation hubs (NITs) in Brazil, as well as society itself, conceptualized as a fourth helix. From this standpoint, the definition of technology transfer is intrinsically linked to the agents that compose and structure the process of transferring technology.

Several authors present a wide range of existing mechanisms for technology transfer; however, considering that the primary objective of this study is to map the scientific production concerning contractual means of transferring technology, it is necessary to highlight the main contractual mechanisms used for this purpose, in order to identify potential gaps in the literature. To delimit this scope, the study focuses on Brazilian legislation governing the most commonly used contracts for technology transfer in Brazil, as referenced in Law No. 9,279/1996, the Industrial Property Law.

Czelusniak (2015) identified seven types of contracts mentioned in Brazilian legislation: patent assignment agreements, patent licensing agreements, know-how licensing agreements, research and development partnership agreements, agreements for the provision of technical assistance and technical services, franchise agreements, and mixed agreements.

A patent assignment agreement transfers industrial property, that is, ownership of a patent filed with the National Institute of Industrial Property (INPI). The assignee thereby assumes all rights and obligations inherent to the previous holder of such rights, and the change must be recorded in the patent application, granted patent, or relevant INPI registry. The legal provisions concerning patent assignment are outlined in Articles 58 to 60 of Law No. 9,279 (Brazil, 1996).

A patent licensing agreement, on the other hand, is understood as an authorization granted by the patent holder or applicant allowing a third party to use and exploit the patented object, either free of charge or for consideration, for a specified period, without transferring ownership of the protected right. Barbosa (2010) interprets this authorization as having both a negative and a positive dimension. The negative aspect lies in the obligation of the patent holder to refrain from exercising their right of exclusion against the licensee, thereby allowing the licensee to use the patent without risk of infringement litigation. The positive aspect, in turn, consists of the patent holder granting the licensee the right to use and exploit the invention with all the powers and means necessary for such purpose.

A know-how licensing agreement is a contract through which only knowledge or information is transferred from one party to another. Such knowledge may be technical, scientific, commercial, administrative, financial, or of another nature (Viegas, 2007).

The research, development, and innovation partnership agreement is a legal instrument designed to formalize collaboration between scientific, technological, and innovation institutions (ICTs) and public or private entities. Its purpose is to carry out joint scientific and technological research and to develop technology, products, services, or processes, without the transfer of public financial resources to the private partner, and in alignment with the ICT's institutional functions (Azin et al., 2023). Under the terms of Law No. 10,973/2004, the partnership agreement constitutes a formal instrument of cooperation between ICTs and companies.

Contracts for technical assistance and technical services involve the provision of personal services such as repairs, supervision, measurement, auditing, or other forms of technological or technical application that do not result in the creation of a (nonmaterial) product, such as an engineering project (Barbosa, 2006). The distinction between technical assistance and technical services lies in the duration and continuity of the engagement: in technical assistance contracts, the agreement typically extends over a longer period, during which the contracted party remains available to perform services as needed. In technical service contracts, by contrast, the activity is not continuous; services are rendered as a single act to address a specific issue (Czelusniak, 2015).

The franchise agreement, or franchising, enables the expansion of numerous companies that would not, on their own, possess the infrastructure, resources, or technology required to remain competitive in dynamic markets. In this model, a company associates with another entrepreneur already operating in the sector. Likewise, it allows entrepreneurs to establish their own businesses while transferring a portion of their profits to the franchisor (Toledo & Proença, 2005).

A mixed contract combines multiple types of technology transfer arrangements within a single contractual instrument (Czelusniak, 2015). In this sense, it is possible to execute a contract that simultaneously includes a patent assignment and a know-how supply agreement or a contract that merges technical assistance services with a patent licensing arrangement.

Executing technology transfer contracts with clear clauses defining the rights and obligations of the parties involved—within the limits of applicable legislation—ensures legal security for both parties and fosters new alliances between universities and companies, thereby generating economic benefits for society (Suzart, 2015). Identifying the types of contracts established under Brazilian law allows for the delimitation of the scope of scientific production mapping related to technology transfer agreements. Consequently, the identification and analysis of scientific knowledge concerning such contracts are of significant relevance, as they may contribute to the improvement of legal instruments, thereby facilitating the relationship between the market and academia.

2. METHOD

This is a bibliographic and exploratory study with a quantitative approach, conducted through bibliometric analysis. As stated by Mariano and Rocha (2017), data derived from bibliometric studies make it possible to assess the state of science through quantitative measures provided by published secondary information.

The chosen method was the consolidated meta-analytic approach (Temac), proposed by Mariano and Rocha (2017), which consists of three stages:

- research preparation;
- data presentation and interrelation;
- detailing, integrative modeling, and validation through evidence.

In the first stage, research preparation, the researcher defines the keywords, the databases to be consulted, the search fields, the time span of the research, and the areas of knowledge relevant to the study. In the second stage, data presentation and interrelation, the researcher selects the most appropriate options for presenting and analyzing the results according to the objectives of the study. Finally, in the third and final stage, detailing, integrative modeling, and validation through evidence, the results obtained in the previous stages are examined in greater depth to better understand the subject under investigation. At this stage, the researcher selects the authors to be included in the review, identifies the main approaches and the most commonly used lines of research, and validates the proposed model through evidence by comparing results obtained from different sources. Bibliometric indicators are employed to identify relationships among authors, references, and countries in the literature, such as co-citation, coupling, and co-authorship, as well as keyword co-occurrence and frequency, which help establish the main research lines through the recurrence of key terms. Finally, the researcher compiles a personal catalog of the works, aiming to identify similarities highlighted in the previous bibliometric analyses and to create an inventory, typically in a spreadsheet, presenting the results obtained (Mariano & Rocha, 2017).

Thus, in the first stage of the method, research preparation, the keywords *technology transfer* and *contract* were defined, as well as the databases Web of Science and Scopus, given their status as solid and internationally recognized scientific repositories. Although the number of databases and the volume of available content have grown exponentially, Cobo et al. (2012) state that, when it comes to scientific research, the most important databases are among those selected for this study. The Google Scholar platform, also mentioned by the authors as the only multilingual and more comprehensive source, was excluded due to the difficulty of selecting and measuring information, given the vast amount of material available. Consequently, the study faces limitations related to the underrepresentation of Latin American research not indexed in the selected databases.

Considering the different search options available in each of the selected databases, the search fields *Article title*, *Abstract*, and *Keywords* were used in both Scopus and Web of Science. As for the temporal scope, publications from 2012 to 2023 were included. Areas of knowledge closely related to law, economics, and administration were chosen because the article's objective was to analyze the legal instruments aimed at technology transfer, which aligns with the selected fields of knowledge.

The searches were conducted in June 2024 and returned a total of 318 articles. Table 1 presents the numerical results obtained from each database, according to the search strings applied and the fields of knowledge in which the research was carried out.

Table 1. Search results by database, search strings, and areas of knowledge.

Database	Search strings	Area of knowledge	Results
Scopus	*Technology transfer and contract*	*Business, management and accounting, social sciences, economics, econometrics and finance, decision sciences, and arts and humanities*	161
Web of Science	*Technology transfer and contract*	*Business economics, materials science, science and technology, other topics, government law, and public administration*	157
Total			318

Source: Prepared by the authors (2024).

Once the article search stage was completed, the filtering of documents began, focusing on duplicates and titles unrelated to the intended research topic. To this end, the 318 retrieved articles were exported to Microsoft Excel and alphabetically sorted, which allowed for the identification and exclusion of 65 duplicate entries, leaving a total of 253 articles. Subsequently, the titles of these 253 articles were reviewed to assess their relevance to the study. As a result, 90 articles were excluded because their titles were unrelated to the research objective, that is, they did not specifically address the term *technology transfer contracts* or any initiative related to technology transfer, leaving an inventory of 163 publications.

The following section presents the results corresponding to the second and third stages of the Temac method, namely data presentation and interrelation and detailing, integrative modeling, and validation through evidence. It is noteworthy that, for the execution of the second stage, particularly for measuring the frequency of keywords, the software TagCrowd was employed. This free text analysis tool identifies term occurrences and generates word clouds. Accordingly, the keywords defined by the authors of the 163 articles included in this study's inventory were entered into the software for analysis.

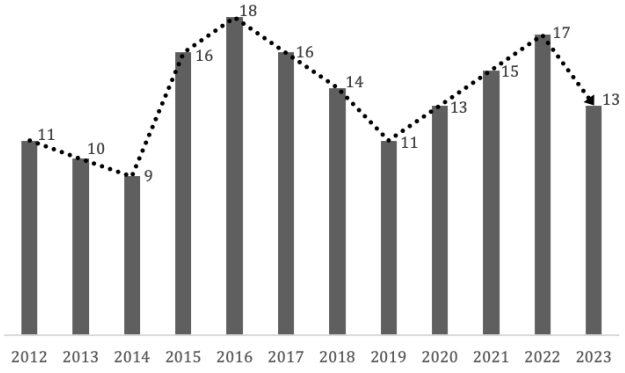
3. PRESENTATION AND ANALYSIS OF RESULTS

For the purpose of achieving data presentation and interrelation, analytical mechanisms commonly employed in meta-analytic research were utilized, such as the evolution of publications over time, identification of the most prolific authors, countries, and journals on the topic, the most cited publications, and keyword frequency (Mariano & Rocha, 2017).

Regarding the evolution of studies included in this research inventory (163 articles), it is observed that, between 2012 and 2023, there is no consistent growth trend in the number of annual publications, as illustrated in Figure 1. Figure 1, which depicts the progression of publications, shows the absence of a linear growth pattern, since the number of studies fluctuates across the years. The lowest number of publications occurred in 2014, while the years 2015, 2016, 2017, and 2022 registered the highest outputs, with an annual average of 15 publications.

Despite the lack of linear growth, there is a discernible tendency toward expansion and continuity of research, as the final triennium of the analyzed period features a higher number of publications compared to the initial triennium. Specifically, 30 articles were published between 2012 and 2014, and 45 between 2021 and 2023—corresponding to 18% and 27% of the total number of publications, respectively—representing an approximate 10% increase from the first to the last triennium.

From the 163 articles included in this study's inventory, a total of 411 researchers were identified. Quantitative consolidation of each author's scientific output made it possible to determine the most prolific contributors, as shown in Table 2. Table 2 indicates that a single author, Jasmina Berbeal-Mirabem, contributed five articles, while Sougata Poddar and Swapnendu Banerjee published four each. Alessandro Muscio, Bradley J. Rickard, Davide Quaglione, Johan Swinnen, Pablo D'Este, and Valentina Tartari each authored three. Additionally, 25 authors published two articles each, while the remainder contributed only one.



Source: Prepared by the authors (2024).
Figure 1. Evolution of publications.

Table 2. Publications by author.

Author	Quantity
Jasmina Berbegal-Mirabent	5
Sougata Poddar	4
Swapnendu Banerjee	4
Alessandro Muscio	3
Bradley J. Rickard	3
Davide Quaglione	3
Johan Swinnen	3
Pablo D' Este	3
Valentina Tartari	3

Source: Prepared by the authors (2024).

The publication inventory reveals that journals from 24 countries have published articles on the topic of technology transfer contracts. Figure 2 illustrates the distribution of publications by country. The United States stands out as the country with the highest number of publications on the subject, with 59 articles, representing 33% of the total inventory. This concentration of publications in the United States may reflect its position as a global leader in innovation and technology transfer; however, it does not necessarily indicate consolidation of the field, given the research gaps identified in this study. The Netherlands follows with 34 articles (19% of publications), and the United Kingdom with 31 articles (17%). Brazil ranks fifth, with seven publications, corresponding to 4% of the total inventory. Additionally, eight countries contributed one publication each, while seven produced two.

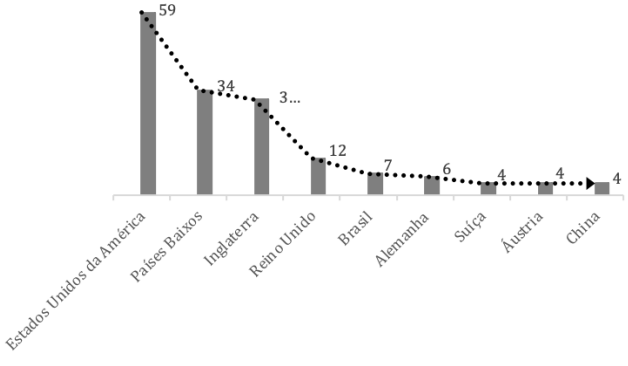
Regarding the analysis of publications by journal, the article inventory from this research identifies 108 journals. The highest number of publications appears in *Research Policy* and *Journal of Technology Transfer*, with 12 and 11 articles respectively, accounting for 22% of all publications (Figure 3).

As shown in Figure 3, there is a predominance of publications in *Research Policy*, an academic journal founded in 1971 by British economist Christopher Freeman. Published by Elsevier, it is considered the leading journal in the field of innovation studies (Liu et al., 2015; Thongpapanl, 2012). Following it is the *Journal of Technology Transfer*, the official journal of the Technology Transfer Society, an international forum for the exchange of ideas that enhances and advances understanding of technology transfer practices. A ranking of major journals in technology and innovation management identifies this journal as one of the top 10 publications in innovation research (Thongpapanl, 2012).

To assess the scientific recognition of the articles included in this study's inventory, the number of citations listed in the Web of Science database was primarily considered. Table 3 presents the 16 most cited articles—approximately 10% of the 163 selected—along with their respective authors, journals, year of publication, and citation counts. Together, these 16 papers account for 2,629 citations, representing 68% of all citations within this research's inventory. The 32 most cited articles total 3,139 citations, or 82% of the overall citation count (3,850). According to the Temac methodology, "citations attribute importance to documents insofar as they are cited by other authors, and the 80/20 Law can be adapted to identify the 20% of documents that account for 80% of citations" (Mariano & Rocha, 2017, p. 437).

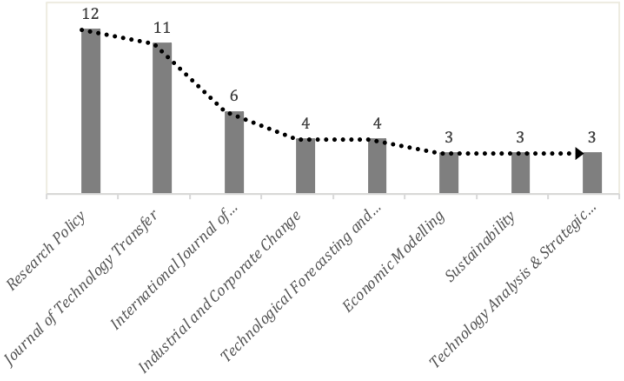
Table 3 shows that the article titled "Academic Engagement and Commercialisation: A Review of the Literature on University–Industry Relations," authored by Markus Perkmann et al. and published in *Research Policy* in 2013, has accumulated 1,403 citations, making it the most cited article, accounting for 36% of the total citations.

The 163 publications analyzed, originating from 22 countries and involving 411 authors, demonstrate a lack of proximity among authors, which reflects low levels of collaboration and may suggest a certain theoretical isolation across much of the research on tech-



Source: Prepared by the authors (2024).

Figure 2. Publications by country. (from left to right: United States of America, the Netherlands, England, United Kingdom, Brazil, Germany, Switzerland, Austria, and China).



Source: Prepared by the authors (2024).

Figure 3. Journals that publish the most on technology transfer.

Table 3. Publications with the highest number of citations.

N.	Title	Authors	Journal	Year	Citations
1	"Academic engagement and commercialisation: A review of the literature on university-industry relations"	Perkmann, M.; Tartari, V.; McKelvey, M.; Autio, E.; Broström, A.; D'Este, P.; Fini, R.; Geuna, A.; Grimaldi, R.; Hughes, A.; Krabel, S.; Kitson, M.; Llerena, P.; Lissoni, F.; Salter, A.; Sobrero, M.	*Research Policy*	2013	1.403
2	"Best channels of academia-industry interaction for long-term benefit"	De Fuentes, C.; Dutrenit, G.	*Research Policy*	2012	157
3	"Academic engagement: A review of the literature 2011-2019"	Perkmann, M.; Salandra, R.; Tartari, V.; McKelvey, M.; Hughes, A.	*Research Policy*	2021	132
4	"The influence of organizational culture and climate on entrepreneurial intentions among research scientists"	Huyghe, A.; Knockaert, M.	*Journal of Technology Transfer*	2015	107
5	"Does government funding complement or substitute private research funding to universities?"	Muscio, A.; Quaglione, D.; Vallanti, G.	*Research Policy*	2013	104
6	"Toward successful commercialization of university technology: Performance drivers of university technology transfer in Taiwan"	Hsu, D. W. L.; Shen, Y. C.; Yuan, B. J. C.; Chou, C. J.	*Technological Forecasting and Social Change*	2015	102
7	"University-industry partnerships for the provision of R&D services"	Berbegal-Mirabent, J.; García, J. L. S.; Ribeiro-Soriano, D. E.	*Journal of Business Research*	2015	85
8	"Formal and informal knowledge and technology transfer from academia to industry: Complementarity effects and innovation performance"	Grimpe, C.; Hussinger, K.	*Industry and Innovation*	2013	82
9	"Contractual flexibility, rent seeking, and renegotiation design: An empirical analysis of information technology outsourcing contracts"	Susarla, A.	*Management Science*	2012	76
10	"Commercializing university research in transition economies: Technology transfer offices or direct industrial funding?"	Belitski, M.; Aginskaja, A.; Marozau, R.	*Research Policy*	2019	72
11	"The effects of university rules on spinoff creation: The case of academia in Italy"	Muscio, A.; Quaglione, D.; Ramaciotti, L.	*Research Policy*	2016	71
12	"Crossing the Rubicon: exploring the factors that shape academics' perceptions of the barriers to working with industry"	Tartari, V.; Salter, A.; D'Este, P.	*Cambridge Journal of Economics*	2012	71
13	"Markets versus spillovers in outflows of university research"	Mowery, D.C.; Ziedonis, A. A.	*Research Policy*	2015	58
14	"University research and knowledge transfer: A dynamic view of ambidexterity in british universities"	Sengupta, A.; Ray, A.	*Research Policy*	2017	55
15	"Are researchers deliberately bypassing the technology transfer office? An analysis of TTO awareness"	Huyghe, A.; Knockaert, M.; Piva, E.; Wright, M.	*Small Business Economics*	2016	54
16	"Academic spin-offs, corporate spin-outs and company internal start-ups as technology transfer approach"	Festel, G.	*Journal of Technology Transfer*	2013	41

Source: Prepared by the authors (2024).

nology transfer contracts. As noted by Ferreira et al. (2014), the absence of proximity among researchers within co-authorship networks may indicate dispersion and a lack of consolidation within the scientific field. The co-authorship map (Figure 4) identified only five groups of researchers who have published together more than once on the topic under study.

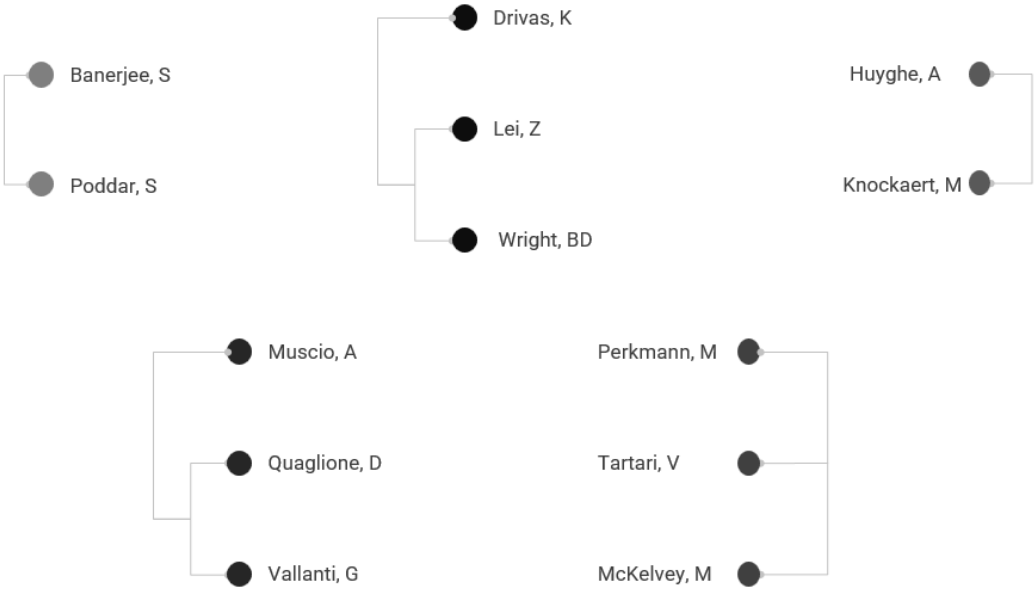
Co-authorship analyses detect "invisible colleges, identifying relationships among authors" (Mariano & Rocha, 2017, p. 438), thereby revealing the collaboration patterns and research networks these scholars establish. The findings of this study thus indicate the absence of central figures who act as knowledge hubs within the field of technology transfer contracts.

The analysis of article keywords also provides valuable insights into the thematic evolution of the field, revealing specific characteristics of each study and allowing for the grouping and classification of research works (Mariano et al., 2011). The diagram generated from the most frequent keywords found in the 163 articles included in this research inventory is presented in Figure 5. The size of each term varies according to its frequency of occurrence in the publications, making it possible to identify the main topics of study.

In addition to the search terms *technology transfer* and *contract*, Figure 5 highlights the most recurrent keywords, *licensing*, *innovation*, *knowledge*, and *university*, which indicates that licensing is the most common contractual form of technology transfer, while innovation and knowledge constitute its primary objects, and the university serves as a central actor in the technology transfer process. These clusters of keywords thus help elucidate the concepts and subjects that revolve around the central theme explored in the publications analyzed.

Subsequently, the process of personal cataloging of the works was carried out in order to identify similarities within the bibliometric analyses and to generate an inventory in a spreadsheet containing the results obtained, as indicated in the third and final stage of the Temac method. Consequently, only articles with open access to their full content were considered, which resulted in the exclusion of 21 papers. An additional 92 articles were also excluded following content analysis, either through the reading of abstracts or full texts, because they did not fully adhere to the research topic. Although these articles addressed technology transfer, they did not discuss any aspects of contractual instruments related to technology transfer. Thus, 50 articles were selected.

Despite identifying 50 articles with full relevance to the topic, the 20 most cited were chosen to represent, through sampling, the main directions of research in this field. Accordingly, Table 4 presents the final inventory of this study, listing 20 of the 50 articles selected for full reading.



Source: Prepared by the authors (2024).
Figure 4. Co-authorship map.

Source: Prepared by the authors (2024).
Figure 5. Word cloud.

An analysis of the similarities among the articles comprising this final inventory, as systematized in Table 4, revealed the existence of common factors, allowing for the grouping of the articles into three major categories with similar approaches:

- the influence of external factors on contracts;
- the analysis of contractual clauses;
- the analysis of technology transfer instruments.

The grouped view of the themes present in these 20 articles demonstrates that studies on technology transfer contracts exhibit distinct theoretical approaches, as well as a clear trend toward examining how to construct instruments that effectively contribute to achieving innovation. Among these articles, four discuss the influence of the number of research initiatives, administrative structures, human resources, university location, and other factors on the success of technology transfer initiatives. Another nine articles focus their analyses on the various possibilities of contractual clauses within legal instruments for technology transfer.

Studies have been conducted to identify the impacts, advantages, and disadvantages of specific contractual clauses, with particular attention given to exclusivity and nonexclusivity clauses, as well as clauses determining payment modalities, either through fixed fees or royalties. The predominance of studies focusing on exclusivity and payment clauses in technology transfer contracts highlights the economic concerns underlying such arrangements, alongside the broader societal benefits derived from innovation.

The remaining seven articles concentrate on the different types of technology transfer, identifying a variety of contractual instruments. Beyond licensing, recognized as the most common mechanism for technology transfer, these studies investigate the most effective instruments for facilitating technology transfer and, consequently, for fostering innovation.

Finally, the selection of 20 out of the 50 articles for presentation in the final inventory considered the most cited works. It was observed that there is a similarity among the study groups when comparing the 20 articles included in the final inventory with the 50 selected for analysis. Moreover, the same three thematic clusters identified earlier persist:

- the influence of external factors on contracts;
- the analysis of contractual clauses;
- the analysis of technology transfer instruments.

FINAL CONSIDERATIONS

This study aimed to map and analyze the scientific production on technology transfer contracts in order to identify how the scientific community has approached the topic, using the Temac method. The search was

Table 4. Final research inventory.

N.	Title	Author	Year	Country	Citations	Objective
1	"Toward successful commercialization of university technology: Performance drivers of university technology transfer in Taiwan"	Hsu, D. W. L.; Shen, Y. C.; Yuan, B. J. C.; Chou, C. J.	2015	United States	102	It analyzes the mechanisms of university technology transfer and, based on Taiwanese universities, presents the factors that affect technology transfer.
2	"University-industry partnerships for the provision of R&D services"	Berbegal-Mirabent, J.; García, J. L. S.; Ribeiro-Soriano, D. E.	2015	United States	85	It indicates, based on data from Spanish universities, that the success of transfer contracts is influenced by the university, the technology transfer offices, and the university's location.
3	"Formal and informal knowledge and technology transfer from academia to industry: Complementarity effects and innovation performance"	Grimpe, C.; Hussinger, K.	2013	England	82	It identifies formal and informal channels of technology transfer and confirms their complementarity based on data analysis from 2000 German companies.
4	"Tacit knowledge and the structure of license contracts: evidence from the biomedical industry"	Hegde, D.	2014	United States	60	This study compares the characteristics of a sample of 505 licensing agreements between inventors and developers of biomedical inventions with theoretical prescriptions regarding contractual terms in cases where tacit knowledge between the parties is necessary to commercialize the inventions.
5	"International and domestic technology transfers and productivity growth: firm level evidence"	Belderbos, R.; Van Roy, V.; Duvivier, F.	2013	England	25	It examines the impact of national and international technology transfers on firm productivity performance in a sample of 448 innovative Belgian firms from 2003 to 2006.
6	"Optimal licensing of uncertain patents in the shadow of litigation"	Amir, R.; Encaoua, D.; Lefouili, Y.	2014	United States	22	This study investigates the choice of licensing method in cases of patent uncertainty, focusing on royalties per unit.
7	"Contract theory: Impact on biopharmaceutical alliance structure and performance"	Taneri, N.; De Meyer, A.	2017	United States	20	It analyzes a dataset of over 2000 biopharmaceutical alliances and concludes that a theoretical concern with contracts is fundamental.
8	"'To sell or not to sell': Licensing versus selling by an outside innovator"	Banerjee, S.; Poddar, S.	2019	Netherlands	16	It analyzes the licensing and sale of property rights, in addition to showing the advantages of each modality.

Continue...

Table 4. Continuation.

N.	Title	Author	Year	Country	Citations	Objective
9	"Applications of fuzzy logic for determining the driving forces in collaborative research contracts"	Berbegal-Mirabent, J.; Llopis-Albert, C.	2016	United States	16	It examines factors such as human capital, experience, attractiveness, and the profile of technology centers that affect the performance of science-industry research and development partnerships, and concludes that different causal pathways explain profitable research and development contracts.
10	"University technology transfer and manufacturing innovation: The case of Italy"	Cardamone, P.; Pupo, V.; Ricotta, F.	2015	United States	13	It demonstrates that technology transfer activities play a significant role in the likelihood of innovation in Italian industrial companies located in the same province as the university.
11	"Tariff induced licensing contracts, consumers' surplus and welfare"	Kabiraj, A.; Kabiraj, T.	2017	Netherlands	13	This demonstrates that a tariff on foreign products can influence the licensing strategy of a foreign company, and that such a strategy can be chosen in a way that induces tariff licensing and maximizes both consumer surplus and domestic welfare.
12	"University-industry relations and research group production: is there a bidirectional relationship?"	Aguiar-Diaz, I.; Diaz-Diaz, N. L.; Ballesteros-Rodriguez, J. L.; De Saa-Perez, P.	2016	England	12	It presents the influence of scientific production on the number of technology transfer agreements.
13	"Evaluating determinant priority of license fee in biotech industry"	*Evaluating determinant priority of license fee in biotech industry*	2018	Switzerland	12	This indicates that the development phase, the rate of attrition, the negotiability of intellectual property, and the licensee's licensing experience, followed by the quality of the technology, are determinants of the licensing rate in the biotechnology industry.
14	"The drivers of efficient knowledge transfer performance: evidence from British universities"	Rossi, F.	2018	England	12	It explores institutional and environmental factors that influence the effectiveness of UK universities in technology transfer.
15	"The relationship between research funding and academic consulting: An empirical investigation in the Spanish contexto"	D'Este, P.; Rentocchini, F.; Grimaldi, R.; Manjarres-Henriquez, L.	2013	United States	11	It investigates the relationship between sources of funding for research activities and scientists' involvement in academic consultancy.

Continue...

Table 4. Continuation.

N.	Title	Author	Year	Country	Citations	Objective
16	"Scientific disclosure and commercialization mode selection for university technology transfer"	Chang, X. H.; Chen, Q.; Fong, P. S. W.	2016	England	10	It analyzes the broader process of technology transfer from faculty to industry and develops partnership models involving professors, universities, and companies.
17	"Experiential learning, bargaining power, and exclusivity in technology licensing"	Khoury, T. A.; Pleggenkuhle-Miles, E. G.; Walter, J.	2019	United States	9	It presents new insights that explain when licensors are likely to enter into nonexclusive agreements based on their previous licensing agreements, and when bargaining power moderates the relationships between previous agreements.
18	"License to learn: an investigation into thin and thick licensing contracts"	Leone, M. I.; Reichstein, T.; Boccardelli, P.; Magnusson, M.	2016	United States	9	It exposes contracts that include a clause specifying that licensors are obliged to assist licensees in the assimilation and integration of technology, and, based on a sample of 133 licensees and an equal number of nonlicensees, presents empirical evidence that such contracts increase the likelihood of licensees introducing inventions.
19	"Exclusive licensing of university technology: The effects of university prestige, technology transfer offices, and academy-industry collaboration"	Shen, H. J.; Coreynen, W.; Huang, C.	2022	Netherlands	9	This study examines exclusive and nonexclusive licensing, and also points out the relationship between university prestige and the likelihood of two parties choosing exclusive licensing.
20	"Vertical licensing, input pricing, and entry"	Bakaouka, E.; Million, C.	2018	Netherlands	7	It demonstrates that vertical licensing, despite increasing competition and costs for the licensor, brings several benefits to the licensor.

Source: Prepared by the authors (2024).

conducted in the Web of Science and Scopus databases, covering the period between 2012 and 2023. The bibliometric survey identified a total of 318 articles.

In cataloging these articles, duplicates and those whose titles were unrelated to the research theme were excluded, resulting in an inventory of 163 articles. From the analysis of these 163 articles, published between 2012 and 2023, it was observed that there was no linear growth in research output, as the number of publications fluctuated throughout the years. Furthermore, 411 researchers and 24 countries were identified as contributors to publications addressing technology transfer contracts. The journal analysis revealed 108 different periodicals publishing on the topic, with *Research Policy* and the *Journal of Technology Transfer* standing out with 12 and 11 publications, respectively.

Of the 163 articles, after reviewing their abstracts, 50 were selected, and 20 were chosen to compose the final research inventory. The analysis revealed licensing as the most commonly used contractual mechanism

for technology transfer, though several others exist. Additionally, innovation and knowledge were identified as the main objects of technology transfer, with a plurality of definitions emerging depending on the object of the transfer relationship. The university was identified as a fundamental actor in the technology transfer process.

When the selected articles were grouped, three main clusters with similar approaches were identified:

- influence of external factors on technology transfer instruments, establishing relationships between the number of research initiatives, administrative structures, human resources, and even the geographical location of universities in determining the success of technology transfer;
- analysis of different contractual clauses within technology transfer instruments, with particular attention to the impacts of exclusivity and nonexclusivity clauses, as well as those governing payment methods, whether fixed fees or royalties;
- analysis of the types of technology transfer instruments, highlighting the predominance of licensing as the most common form of technology transfer.

It was also found that there is a lack of approaches from various perspectives concerning technology transfer contracts, in addition to the need for continued research. This underscores the necessity of new studies in the field to sustain academic investigations into technology transfer contracts, their influencing factors, clauses, and types.

In this way, the importance of the present research was realized, with the objectives of mapping the scientific production regarding technology transfer contracts and, consequently, identifying the theoretical gaps on the subject, which is so relevant for guiding the relationships between academia and companies and, equally, for the development of countries.

The approaches, elements, and references presented in this study may serve as a foundation for future interdisciplinary research that explores technology transfer contracts, without intending to exhaust the references available in this extensive field of study.

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How to cite this article:

La Vieja, M. G. B., & Sartori, R. (2025). Contratos de transferência de tecnologia: uma análise bibliométrica com base na teoria do enfoque metanalítico consolidado. *Internext*, 21(1), e842. https://doi.org/10.18568/internext.v21i1.842