Ingeniería y Competitividad
Vol 28 (2) 2026 doi: 10.25100/iyc.v28i2.15751

Vol 28 (2)

ISSN
0123-3033
e- 2027-8284

Original Article

Intellectual capital and university technology transfer: An exploratory analysis

Capital intelectual y transferencia de tecnología universitaria: un análisis exploratorio

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Abstract

Introduction: Intellectual capital (IC) is a key factor in technology transfer (TT) processes in higher education institutions (HEIs), particularly within the framework of the university's third mission.
Objective: To identify recurring approaches and knowledge gaps in the literature on the relationship between the dimensions of intellectual capital and the outcomes of university technology transfer processes, paying special attention to the limitations in understanding and measuring the relational dimension of intellectual capital in these processes.
Methodology: An exploratory literature review was conducted using Web of Science as the primary database, supplemented by a snowball sampling strategy. The process was structured in three phases: (i) planning, which included defining the review protocol and search strategy; (ii) execution, which comprised the selection, full-text reading, and analysis of the studies; and (iii) reporting, during which the findings were synthesized and organized. The final analytical corpus comprised 94 publications.
Results: The findings indicate that the dimensions of intellectual, human, structural, and relational capital have been addressed unevenly in the literature. Human and structural capital have more established measurement approaches, while relational capital has been assessed primarily using aggregate or perception-based indicators.
Conclusions: The reviewed literature shows that the relational dimension of relational capital has greater limitations in terms of its measurement and its connection to technology transfer outcomes.

Keywords: Intellectual capital; technology transfer; third mission; relational capital; social network analysis; universities

Resumen

Introducción: El capital intelectual (CI) es un factor clave en los procesos de transferencia de tecnología (TT) en las instituciones de educación superior (IES), particularmente en el marco de la tercera misión de la universidad.
Objetivo: Identificar enfoques recurrentes y lagunas de conocimiento en la literatura sobre la relación entre las dimensiones del capital intelectual y los resultados de los procesos de transferencia de tecnología universitaria, prestando especial atención a las limitaciones para comprender y medir la dimensión relacional del capital intelectual en estos procesos.
Metodología: Se realizó un análisis exploratorio de la literatura utilizando Web of Science como base de datos principal, complementado con una estrategia de bola de nieve. El proceso se estructuró en tres fases: (i) planificación, que incluyó la definición del protocolo de revisión y la estrategia de búsqueda; (ii) ejecución, que comprendió la selección, la lectura del texto completo y el análisis de los estudios; y (iii) presentación de informes, durante la cual se sintetizaron y organizaron los hallazgos. El corpus analítico final comprendió 94 publicaciones.
Resultados: Los hallazgos indican que las dimensiones del capital intelectual, humano, estructural y relacional se han abordado de manera desigual en la literatura. El capital humano y estructural cuentan con enfoques de medición más consolidados, mientras que el capital relacional se ha evaluado principalmente mediante indicadores agregados o basados en la percepción.
Conclusiones: La literatura revisada muestra que su dimensión relacional presenta mayores limitaciones en cuanto a su medición y vinculación con los resultados de la transferencia de tecnología.

Palabras clave: Capital intelectual; transferencia de tecnología; tercera misión; capital relacional; análisis de redes sociales; universidades

How to cite?

Anaya-Chaparro SJ, Martínez-Ardila HE. Intellectual capital and university technology transfer: An exploratory analysis. Ingeniería y Competitividad, 2026, 28(2)e-30415751

https://doi.org/10.25100/iyc.v28i2.15751

Received: 7/04/26
Reviewed: 28/05/26
Accepted: 28/07/26
Online: 28/08/26

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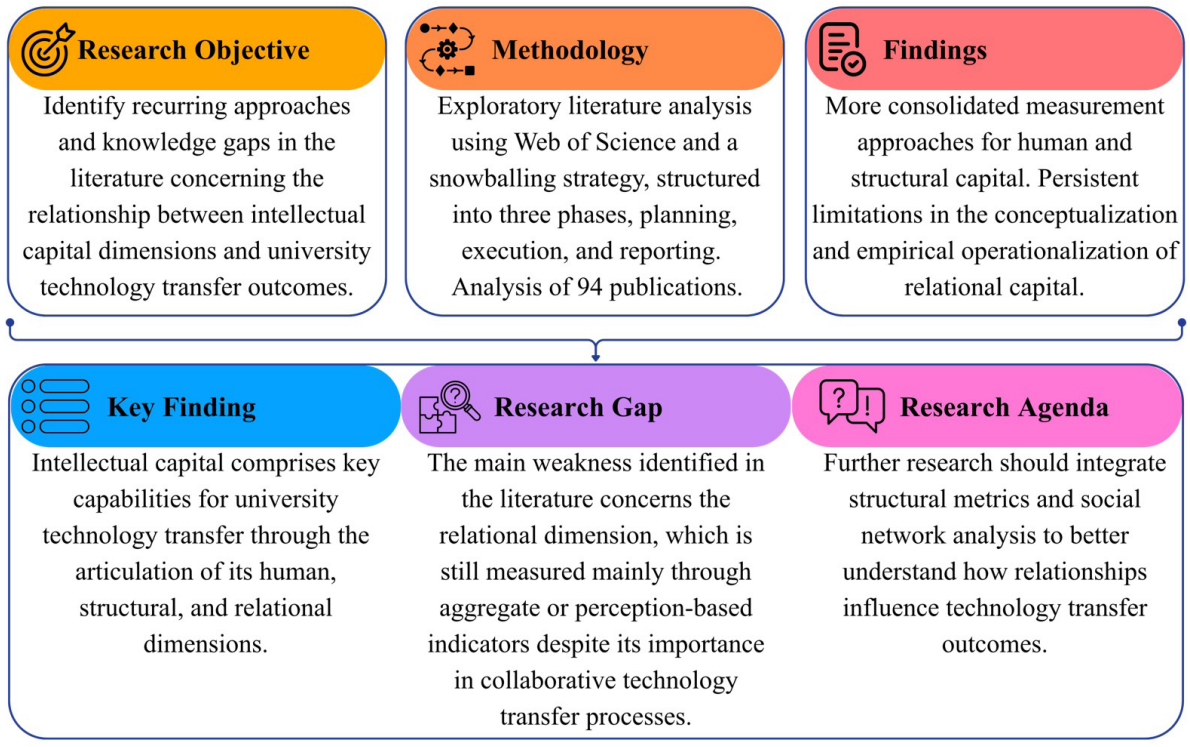
Spanish version

Why was this study conducted?
This study was conducted to address the conceptual and methodological limitations in the literature regarding how the dimensions of intellectual capital influence university technology transfer processes and outcomes. Particular attention was given to relational capital because, despite its importance in the collaborative nature of technology transfer and the university's third mission, its measurement remains less developed than that of human and structural capital.

What were the most significant findings?
The review found that human and structural capital have more consolidated conceptual and measurement approaches, whereas relational capital is still mainly assessed through aggregate, financial, or perception-based indicators. These approaches identify the existence of relationships and collaborative activities but provide limited explanations of how the structure, quality, and dynamics of those relationships influence concrete technology transfer outcomes. Social network analysis was identified as a relevant methodological alternative for addressing some of these limitations.

What do these results contribute?
These results provide an integrated understanding of how human, structural, and relational capital support different stages of university technology transfer. They also clarify the main conceptual and measurement gap concerning relational capital and propose the integration of traditional indicators with structural network metrics. This contribution provides a basis for developing more robust measurement approaches and for supporting higher education institutions and technology transfer offices in managing relationships more strategically and linking them to observable transfer outcomes.

Graphical Abstract



doi: 10.25100/iyc.v28i2.15751

Introduction

Intellectual capital – IC has been widely recognized as a determining factor in organizational performance, particularly in contexts involving innovation and technology transfer –TT within higher education institutions – HEIs. Numerous studies have examined its impact on the development of competitive advantages, highlighting its contribution to organizations' ability to develop new technologies, products, and processes (1–6). In the university context, this role becomes particularly relevant within the framework of the third mission, through which HEIs not only generate knowledge but also seek to transfer it to industry, public organizations, and society (5,7–9).

Technology transfer can be understood as an interaction process through which knowledge, research outcomes, and intellectual property are mobilized from their creators to other actors for the purpose of generating economic and social value (10,11). This process is inherently collaborative and depends on the coordination of multiple actors, which positions intellectual capital as a key resource by providing the capabilities, structures, and relationships required for its development (3,12–16). In particular, HEIs actively involved in technology transfer must strengthen not only their internal knowledge-generation capabilities, but also their ability to interact, negotiate, and collaborate with external actors (17).

Nevertheless, despite the recognition of intellectual capital as an enabler of technology transfer, the literature presents limitations in the way its influence on these processes is understood and measured. Whereas human and structural capital have received greater conceptual and methodological development, relational capital has been assessed mainly through aggregate indicators or general approaches that do not explain its contribution to technology transfer outcomes with sufficient precision. Consequently, a gap remains in the literature regarding the clear linkage between the relational capabilities of HEIs and observable technology transfer outcomes (9,14).

In this context, the objective of this article is to identify the main approaches and knowledge gaps concerning the relationship between the dimensions of intellectual capital and the outcomes of university technology transfer processes. To this end, an exploratory literature analysis was conducted to identify the main conceptual approaches, forms of operationalization, and gaps in the existing literature. Based on this analysis, the article seeks to contribute to a better understanding of the role of intellectual capital in technology transfer and to guide future research in the context of higher education institutions (14,18–25).

Methodology

An exploratory literature analysis was conducted to identify recurring approaches and knowledge gaps concerning intellectual capital and its relationship with technology transfer in higher education institutions, with particular emphasis on relational capital and its operationalization through social network analysis (26).
The analysis was conducted through a systematic review process structured into three phases: (i) planning, (ii) execution, and (iii) reporting of the review findings, as illustrated in Figure 1. The activities conducted during each phase are described below.

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Figure 1. Exploratory literature analysis process

Review Planning

During the planning phase, a review protocol was developed to address the following research question: How has the relationship between the dimensions of intellectual capital, particularly relational capital, and the outcomes of university technology transfer processes been addressed in the literature?

The protocol guided the methodological decisions and the development of the search strategy. Web of Science (WoS) was selected as the main indexing database because it includes publications from internationally recognized collections and publishers and applies widely acknowledged indexing and editorial quality criteria (26,27).

The literature search was designed by identifying the main terms associated with the research topic. Three groups of terms were established. The first consisted of “Intellectual Capital”, as this is the central concept of the study. The second included “technology transfer”, “innovation”, “third mission” and “technology commercialization”, to retrieve studies addressing intellectual capital in connection with technology transfer processes. The third included “universit*” and “higher educ*” to contextualize the results within higher education institutions. The truncation operator “*” was used to include variations of these terms.

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The relevant literature was retrieved using the following search equation:

$$TS = (\text{“}Intellectual\ Capital\text{”}\ AND\ (\text{“}technology\ transfer\text{”}\ OR\ Innovation\ OR\ \text{“}third\ mission\text{”}\ OR\ \text{“}technology\ commercialization\text{”})\ AND\ (universit*\ OR\ \text{“}higher\ educ*\text{”}))$$

Results

The initial search yielded 693 publications. Inclusion and exclusion criteria were subsequently established to identify publications aligned with the research question. The following Web of Science categories were considered: Management or Business or Business Finance or Multidisciplinary Sciences or Educational Research or Engineering Industrial or Engineering Multidisciplinary. The following meso-level citation topics were also included: 6.3 Management or 6.11 Education & Educational Research or 6.238 Bibliometrics, Scientometrics & Research Integrity. In addition, the following micro-level citation topics were considered: 6.3.1691 Intellectual Capital or 6.3.2 Knowledge Management or 6.3.726 Entrepreneurship or 6.3.1467 Academic Entrepreneurship or 6.11.2332 Higher Education or 6.238.166 Bibliometrics or 6.3.368 Technology Acceptance Model.

The main Web of Science search covered publications from 2020 to 2024 and was conducted in early 2025. This period was selected to capture recent developments in the measurement of intellectual capital within a context characterized by the growing relevance of university–environment collaboration.

After applying the categories, citation topics, and publication-period criteria, 207 publications were retained. Their titles and abstracts were subsequently screened to assess their alignment with the research question. Publications were excluded when they referred to intellectual capital or technology transfer but did not examine the relationship between these concepts. Following this screening process, 87 publications were selected for full-text assessment.

Review Execution

During the execution phase, the 87 selected publications were assessed in full. Five publications were excluded because they did not directly address the relationship between intellectual capital and university technology transfer. These publications generally examined the influence of intellectual capital on social or sustainability-related factors or focused on business contexts without addressing its relationship with technology transfer.

Following the full-text assessment, 82 publications from the main Web of Science search were retained. The database search was complemented by backward and forward snowballing. The reference lists of the selected publications and the studies citing them were examined to identify relevant contributions not retrieved through the main search. This strategy enabled the inclusion of seminal and conceptually or empirically relevant publications, including studies published before 2020.

An additional 12 publications were incorporated through the snowballing strategy. Therefore, the final analytical corpus comprised 94 publications, all of which were read and analyzed in full.

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Reporting of the Review Findings

During the reporting phase, the findings obtained from the exploratory literature analysis were synthesized and organized. The analysis focused on identifying the main conceptual approaches, measurement methods, recurring findings, and knowledge gaps concerning the dimensions of intellectual capital and their relationship with university technology transfer outcomes.

Two graphical resources are presented to support the interpretation of the final analytical corpus. The first illustrates the annual distribution of the publications included in the analysis, while the second presents the temporal relationships among the main terms identified in the literature. Figure 2 presents the annual distribution of the 94 publications included in the final analytical corpus. The main Web of Science search covered the 2020–2024 period, while earlier publications were incorporated through the snowballing strategy.

The annual distribution shows a marked increase in publications from 2020 onward, with the highest concentration observed in 2023. This pattern suggests growing academic interest in the relationship between intellectual capital, innovation, and technology transfer in higher education institutions.

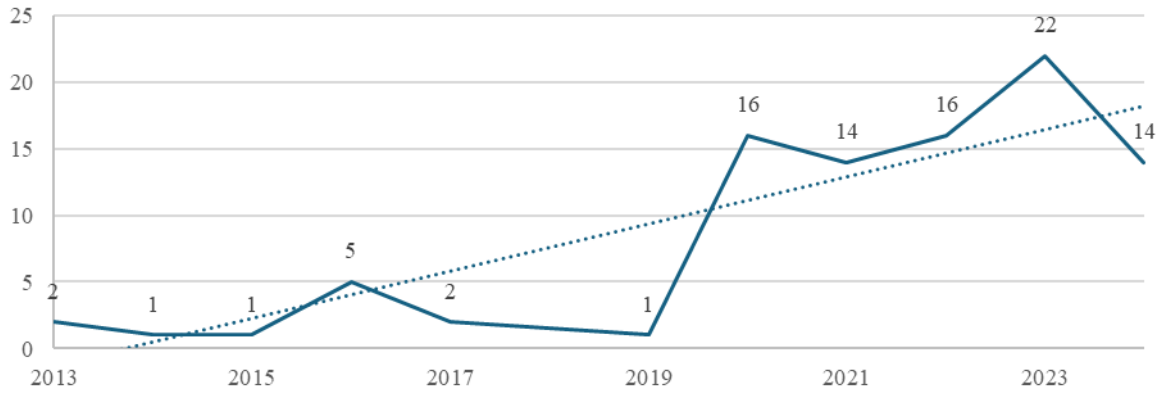

Figure 2. Annual distribution of publications included in the final analytical corpus

The temporal co-occurrence map illustrates the evolution of the main topics addressed in the literature. In the earlier publications, intellectual capital in higher education institutions was associated with terms such as entrepreneurship, industry, management, and relational capital. Subsequently, attention expanded toward concepts such as intellectual capital, impact, innovation, intangible assets, structural capital, and human capital. In the most recent publications, increasing emphasis has been placed on knowledge management, technology transfer, and innovation performance, among other topics.

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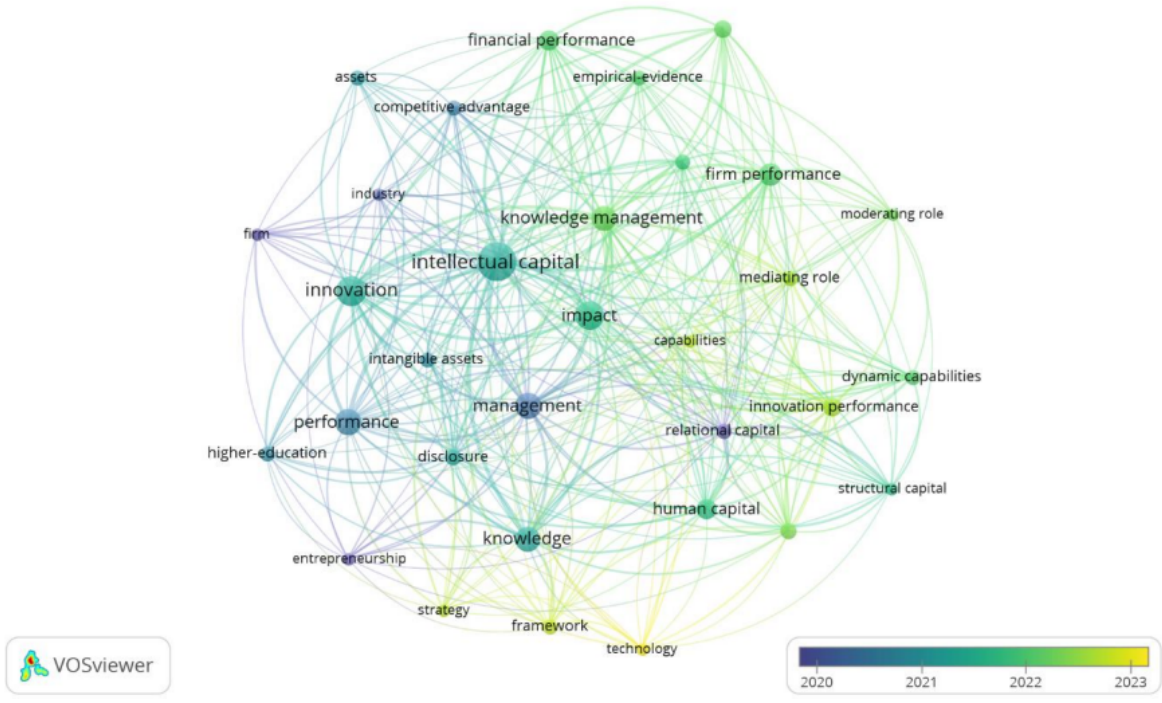

Figure 3. Temporal co-occurrence map

Review Findings

The literature analysis made it possible to identify the main conceptual approaches, forms of operationalization, and relationships between intellectual capital – IC and technology transfer – TT processes in higher education institutions – HEIs, as well as relevant gaps in the measurement of its dimensions. Based on these findings, the results are organized around the recurring themes identified in the literature: intellectual capital as a conceptual framework, its role in knowledge generation, its relationship with the university's third mission, and its connection with technology transfer processes.

Intellectual Capital

The concept of IC has been defined by several authors, although no universally accepted definition has yet been established (12,16,28–32). Likewise, its composition varies according to the author and the context in which it is analyzed. Table 1 presents the main definitions identified in the publications included in this review.

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Table 1. Definitions of intellectual capital

Definition	Author(s)
A value-creation process reflected in the difference between an organization's market value and book value (29,33).	John Kenneth Galbraith (1968)
Intellectual material (knowledge, information, intellectual property, and experience) that can be used to create wealth (32,34,35).	Stewart (1998)
The knowledge and knowing capability of a social collectivity (18,36).	Nahapiet and Ghoshal (1998)
The sum of everything that everyone in a company knows and that provides the company with a competitive advantage (37–39).	Bontis (1998)
The total stock of knowledge, information, technologies, intellectual property rights, experience, learning, and collective competencies capable of creating value for a company (30,37).	Bontis (2005)
A non-monetary asset that ultimately provides a financial advantage (38,40,41).	Edvinsson and Sullivan (1996)
The knowledge, skills, and experience that employees take with them when they leave a company (30,42).	Subramaniam and Youndt (2005)
A multidimensional phenomenon comprising experience-based assets, knowledge, and practical capabilities that enhance a company's value (38,40,43).	Dumay (2016)
The sum of everything that is known and can be used to create value (30,44).	Guthrie (2004)

For the purposes of this review, and based on the definitions presented above, intellectual capital is understood as the combination of assets, intangible resources, and institutional activities that enable an organization to transform material, financial, and human resources into a system capable of creating value (39,41,45). Authors have proposed different dimensions of intellectual capital. However, human, structural, and relational capital are the dimensions most frequently addressed in the literature (4,6,39,41,45–47).

Human capital – HC refers to the tacit and explicit knowledge accumulated by the individuals who make up an organization and contribute to the achievement of its strategic objectives. This dimension includes employees' skills, experience, know-how, education, training, and motivation (41). Structural capital – SC comprises explicit knowledge embedded in procedures, intellectual property, organizational models, information and communication systems, organizational structures, operating procedures, and databases. This dimension also commonly includes the institution's tangible resources (45). Relational capital – RC encompasses the set of economic, political, and institutional relationships between an HEI and its potential partners, including customers, suppliers, competitors, government institutions, and society more broadly at the regional, national, or international level. It also includes intra-institutional relationships and the institution's capacity to establish and maintain such relationships (4,6,41,45–49). In addition,

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relational capital encompasses external perceptions of the organization, including its image, brand, prestige, reliability, reputation, and position within the networks to which it belongs (50).

Relational capital may also be conceptualized as social capital or divided into more specific dimensions. These include customer capital, associated with the intangible assets that support relationships with customers; internal capital, concerning intangible assets that enable intra-institutional relationships; external capital, involving relationships with actors outside the organization, such as customers, suppliers, and other stakeholders; socio-environmental capital, related to the organization's social and environmental responsibilities and impacts; and positional capital, which refers to strategic relationships within networks (8,14,32,51–53).
Structural capital may also be described as organizational capital or divided into dimensions such as technological capital, information technology capital, information capital, innovation capital, and renewal capital (1,6,14,16,31,37,38,40,54–65). Structural capital is one of the most widely examined dimensions in the literature because it includes organizational assets that can be identified relatively easily, including tangible resources and intellectual property assets, on which organizations tend to concentrate their identification and management efforts (8,41,66).
Human capital is the most consistently addressed dimension of intellectual capital in the literature and is commonly operationalized through both qualitative and quantitative variables (1,4–7,9,13,14,16,31,34,37,38,40,47,50,54–60,62–64,67–75). It is also one of the most extensively studied dimensions because it is considered fundamental to every organization and is inherent to the individuals who comprise it. The literature has explored different variables for measuring an organization's intellectual capital capabilities. These variables are summarized in Table 2.

Table 2. Variables associated with intellectual capital

IC dimension	Variables
Human capital	Skills and knowledge (50,56,58) Training and development (72) Experience (3,7) Educational background (34,48) Competencies (6,30) Retention of qualified employees (60) Motivation and commitment (7) Interpersonal relationships (7,58)
Structural capital	Organizational culture and structure (37,67,76) Knowledge management systems (37,58,67) Intellectual property (37,67,77) Policies and procedures (37,67,71) Support infrastructure (40,67)
Relational capital	Quality of relationships (65,78) Social Network (31,65,77) Customer loyalty (56,79) Supplier relationships (31,65) Collaborative partnerships (65,78) Reputation (31,65) Interorganizational communication (31,65) Trust and commitment (31,65)

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The variables proposed for human capital capture this concept comprehensively and can be adapted to the specific context of each organization, thereby enabling the collection of information on individual capabilities and tacit or explicit knowledge (3,6,7,30,34,48,50,56,58,60). Similarly, the structural capital variables identified in the literature represent explicit knowledge and the organization's tangible resources, providing a basis for measuring this dimension (37,40,58,67,76,77).

In contrast, the measurement of relational capital presents greater challenges. In the literature included in this review, this dimension has mainly been assessed subjectively through Likert-type scales or questions based on respondents' perceptions, with limited evidence of objective indicators capable of capturing the concept comprehensively (32,40,54,61,78,80). Furthermore, relational capital has primarily been operationalized in business contexts. Although the variables identified for this dimension may also be relevant in other settings, including higher education institutions, their application requires contextual adaptation (14,16,31,65,77–79).

Intellectual Capital in Knowledge Generation

In the knowledge economy, IC is a crucial driver of innovation and organizational development and plays a strategic role in HEIs (37,45,63). Several authors have examined the relationship between intellectual capital and knowledge generation. Within this relationship, intellectual capital contributes to the development of research competencies associated with HC, technology management capabilities associated with SC and interdepartmental cooperation associated with RC (6).

Given the relevance of intellectual capital to knowledge generation in HEIs, the literature suggests developing more sophisticated assessment methods that account for specific characteristics of academic research and complement quantitative approaches with qualitative methods (7,81). These models should also examine the interaction among the dimensions of intellectual capital to determine their influence on research processes and their contribution to innovation and TT (4,18,33,35,39,41–44,82–84).

Intellectual Capital and the University's Third Mission

The university's third mission can be understood as the set of activities that extend beyond the traditional roles of teaching and research. It involves the generation, use, application, and exploitation of knowledge and other university capabilities outside academic settings, emphasizing the commitment of HEIs to society and their contribution to social, economic, and cultural development (80,85,86). From a broader perspective, the third mission also encompasses extension and social responsibility functions aimed at strengthening the relationships between universities and social, territorial, and community actors. Within this framework, cooperation, collaboration, and the social appropriation of knowledge are relevant components of university–environment interaction, going beyond approaches focused exclusively on knowledge commercialization or university–industry relations (80,85,86). HEIs use different indicators to assess their third-mission performance; however, comprehensive models that incorporate an intellectual capital perspective remain limited (14). The development of models based on intellectual capital is consistent with the nature of universities as organizations devoted to the production and transfer of knowledge (46),

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among other institutional missions. The way intellectual capital is conceptualized and managed also varies according to the internal and external context of each institution. Consequently, the literature highlights the need to redefine intellectual capital in HEIs by considering its strategic role in promoting the entrepreneurial university. Within this context, relational capital acquires particular relevance, as HEIs need not only the capacity to interact with external actors, but also the ability to develop and manage strategic and long-term relationships with the different actors that comprise society (32,50).

Overall, the literature emphasizes the importance of relational capital in strengthening the university's third mission through the connections between HEIs and their environment (73). Nevertheless, despite advances in the measurement and management of intellectual capital, difficulties remain regarding its full integration into university culture and management practices (14,46,50). Table 3 summarizes the main models and approaches used to measure intellectual capital in HEIs. In general, their principal limitations relate to their emphasis on the management of intellectual capital within the first two institutional missions, teaching and research, which makes them insufficient for adequately capturing activities associated with the university's third mission.

Table 3. Approaches to measuring intellectual capital

Approach	Advantages	Limitations
International rankings: Rankings such as the Times Higher Education World University Rankings and the Academic Ranking of World Universities use indicators to classify HEIs globally. (14,46)	They provide a broad overview of institutional performance and enable comparisons among universities worldwide.	They focus mainly on teaching and research and do not comprehensively address the third mission. Therefore, despite offering a broad overview, they may be insufficient for evaluating third-mission activities.
Intellectual Capital Maturity Model (ICMM): An intellectual-capital-based framework for assessing the third mission according to the university's capacity to produce and transfer knowledge. (14,46)	It supports strategic decision-making by focusing on knowledge management.	It emphasizes the assessment of capabilities for developing new technologies but requires further empirical validation across different contexts.
International research projects: Initiatives such as the E3M Project, the Observatory of the European University (OEU), and the Higher Education–Business and Community Interaction (HE-BCI) survey seek to identify and test indicators for evaluating the third mission. (14)	They contribute to the debate on third-mission measurement and propose specific indicators for this area.	They have not reached consensus on a common set of indicators or methodologies for assessing the quality of third-mission activities, which limits the development of clear and comparable datasets.

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Approach	Advantages	Limitations
Italian Evaluation Model (VQR): An Italian evaluation system that has evolved from a product-based approach toward a process-based model incorporating qualitative and quantitative intellectual capital indicators. (46)	It provides a standardized and comparable database covering Italian universities.	It is primarily a research-quality assessment model that uses intellectual capital indicators, but it does not provide a comprehensive measurement of intellectual capital itself.
Value Added Intellectual Coefficient (VAIC™): A model for measuring intellectual capital that has been applied in sectors such as agriculture, construction, manufacturing, and transportation. (6,12)	Its application across different sectors suggests that it is adaptable and robust.	It is based mainly on financial indicators, which limits its applicability depending on the purpose of the assessment.
Integrated Intellectual Capital Measurement Model (IICM): A model designed to capture intellectual capital in contexts of business uncertainty. (12)	It integrates different dimensions of intellectual capital, recognizes the effects of digital transformation, offers flexibility across industries, and combines quantitative and qualitative measures.	It requires further empirical validation to confirm its applicability and effectiveness across different contexts.
Technology Transfer Office Efficiency Model: A self-assessment tool linked to a maturity model that evaluates the efficiency of university technology transfer offices – TTOs through intellectual capital-based indicators. (9)	It enables universities to assess technology transfer efficiency using non-financial indicators.	It proposes relatively basic indicators that could be strengthened to identify more specific capabilities and requires further empirical validation across different contexts.

The approaches presented in Table 3 combine quantitative and qualitative indicators to provide a comprehensive characterization of intellectual capital in HEIs. They differ mainly in their orientation: some prioritize institutional classification, whereas others focus on intellectual capital management. As a result, the indicators used vary according to the model and its context of application, allowing implementation both at the institutional level and within specific organizational units, including TTOs.

The selection of a model therefore depends on the purpose of the assessment and the institution's particular context. Intellectual capital measurement remains a developing field, and further research is required to improve existing models and develop new assessment tools (14,19–22).

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Intellectual Capital and Technology Transfer

The World Intellectual Property Organization – WIPO, defines TT as a collaborative process through which scientific discoveries, knowledge, and intellectual property flow from creators, such as universities and research institutions, to public and private users. Its purpose is to transform inventions and research outcomes into new products and services that benefit society (87,88).

Technology transfer may also be understood as an active interaction process between two or more entities through which technology and related knowledge are transferred to increase or stabilize the recipient's capabilities (89).

Figure 4 provides a graphical representation of the technology transfer process. For analytical purposes, the process is divided into two major stages, shown in fuchsia and purple. The first stage focuses on value creation for innovation, while the second centers on the development of collaboration required to establish and consolidate the partnerships needed to transfer research outcomes. Each stage comprises four phases, resulting in a total of eight phases. Although the process is presented linearly for analytical purposes, feedback loops may occur among the different phases and stages in practice, leading to adjustments and iterations throughout the process. Technology transfer begins with the disclosure of an invention, when the responsible unit, generally the HEI's TTO, identifies a new technology with transfer potential. The process concludes with the follow-up or monitoring of the transfer's development. In the most successful cases, the transferred technology is further developed and commercialized and, once accepted by the market, may be considered an innovation (56,57,88,90).

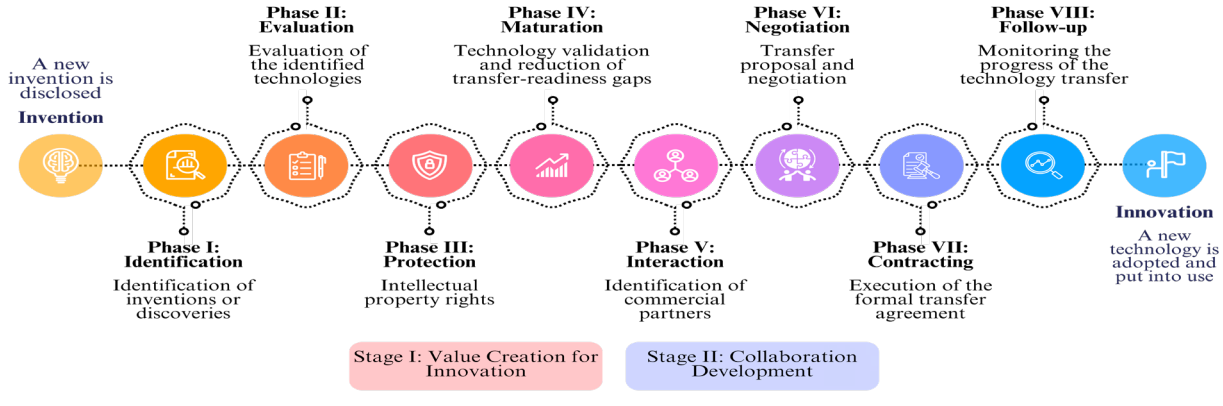

Figure 4. Graphical representation of the technology transfer process

The representation presented in Figure 4 provides a general synthesis of the technology transfer process and is not intended to replace specific technology maturity assessment models. In practice, technology development and transfer may be supported by tools such as technology readiness levels – TRLs, as well as by validation, technology packaging, scaling, and market-readiness activities. However, these tools may vary according to the type of technology, sector, transfer

doi: 10.25100/iyc.v28i2.15751

mechanism, and institutional regulations. Therefore, Figure 4 is used as an analytical framework for distinguishing between activities associated with value creation and those related to collaboration and the formalization of technology transfer. It does not describe or replace the specific tools that may support each phase.

The technology transfer process can be assessed in different ways. It may be evaluated in terms of success, which occurs when one actor's experience influences another actor (91); effectiveness and efficiency, referring respectively to the usefulness and understanding of the technology by its recipients and to the speed and minimization of financial resources involved in the transfer process (92,93); performance, understood as the extent to which recipients acquire additional experience, knowledge, or technologies through the transferred technology (64,94); or knowledge diffusion, which can be assessed in terms of knowledge flows between two or more actors (10,11).

Several authors have identified a positive relationship between intellectual capital and innovation, mediated by technology transfer (1,3,9). Collaboration between HEIs and other actors, enabled by relational capital, contributes to higher performance and greater socioeconomic returns for HEIs (3). Within this relationship, technology transfer offices play an essential role as intermediaries and facilitators between HEIs and other actors. Consequently, TTOs require particularly well-developed relational capital to perform their functions successfully (90).

To promote innovation and technology transfer in HEIs through intellectual capital, the literature proposes the strategies presented in Table 4. Each strategy is organized according to a dimension of intellectual capital and is translated into specific recommendations (1,58,64).

Table 4. Recommendations for promoting innovation and technology transfer in HEIs

Strategy	Recommendations
Strengthen the HEI's human capital (58,64)	Invest in researcher training and development. Encourage interinstitutional mobility. Promote collaboration with external experts.
Develop the HEI's relational capital (1,64)	Establish strong and long-term relationships with other actors through strategic partnerships. Participate in collaborative networks. Promote interaction between academics and business representatives.
Optimize the HEI's structural capital (58,64)	Develop effective knowledge management systems. Create accessible databases. Establish clear institutional policies for intellectual property and technology transfer. Define procedures for technology valuation, negotiation, licensing, and commercialization. Foster an organizational culture that values innovation and collaboration.

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Most of the recommendations presented in Table 4 are general in nature and, in many cases, require financial investment. Although these proposals identify relevant actions for strengthening TT processes, they generally do not specify how those actions should be implemented. Furthermore, few studies have developed specific metrics for measuring an HEI's intellectual capital in relation to its technology transfer processes (9,14). To provide an initial approximation to the measurement of HEI capabilities in terms of intellectual capital for TT, the indicators presented in Table 5 were identified in the literature (9,14).

Table 5. Intellectual capital indicators for technology transfer

IC dimension	Indicator
Human Capital	Number of full-time academics (9)
	Number of associate professors/ number of full-time academics (9)
	Number of employees involved in Creative Commons and social innovation projects (14)
	Number of HEI graduates or employees who have created start-ups or spin-offs (14)
	Number of professors who have coauthored publications with nonacademic organizations (14)
	Number of postgraduate students funded by private companies (14)
	Percentage of staff with advanced degrees (9,14)
Structural Capital	Number of patents, licenses, and trademarks co-owned by the HEI (9,14)
	Number of incubators co-owned by the HEI (9)
	Success rate of R&D project applications (9)
	Number of shared or open-access laboratories and facilities (9)
	Budget allocated to equipment and instruments (9)
	Budget allocated to books, journals, and databases (9)
	Amount of research funding (9)
Relational Capital	Number of university–industry partnerships (9)
	Amount of funding allocated to university–industry collaboration (9)
	Number of international awards received (9,14)
	Number of consortia (9,14)
	Number of international joint R&D projects (9,14)
	Number of new partnerships established for R&D projects (9,14)
	Number of companies cofunding research or academic activities at the HEI (9,14)

The indicators associated with human capital mainly capture capabilities related to knowledge generation and the production of research outcomes. Indicators such as the number of full-time academics, the ratio of associate professors to full-time academics, the number of postgraduate students funded by private companies, and the percentage of staff with advanced degrees primarily reflect conditions that support the first stage of the TT process: value creation for innovation, as shown in Figure 4. However, these indicators are limited in their ability to capture the human capabilities required during the second stage, in which skills related to interaction with external

doi: 10.25100/iyc.v28i2.15751

actors, negotiation, and agreement management become necessary. Some indicators, including the number of employees involved in Creative Commons and social innovation projects, the number of graduates or employees who have created start-ups or spin-offs, and the number of professors who have coauthored publications with non-academic organizations, provide an approximation to these dynamics. Nevertheless, there is generally less availability of metrics capturing the role of human capital in consolidating collaborations and achieving effective TT outcomes, as well as indicators related to the soft skills required during these phases (9,14).

The indicators identified for structural capital capture a broader set of organizational capabilities supporting the TT process at different stages. Indicators such as the budget allocated to equipment and instruments, the budget allocated to books, journals, and databases, and the amount of research funding are associated with financial resources, scientific infrastructure, and access to information. Therefore, they reflect conditions that support knowledge generation and maturation. Indicators such as the number of patents, licenses, and trademarks co-owned by the HEI and the success rate of R&D project applications provide an approximation to the institution's capacity to protect and transform research outcomes into assets with transfer potential. Similarly, the number of co-owned incubators and shared laboratories or facilities reflects organizational conditions that may facilitate interaction with external actors. Overall, structural capital indicators demonstrate a greater capacity to capture the organizational conditions required throughout the TT process. Nevertheless, their specific contribution to the phases of interaction, negotiation, and commercialization remains indirect in some cases (9,14).

Relational capital indicators primarily quantify the HEI's connections with external actors, determine the financial resources devoted to collaboration, or assess aspects of institutional image and reputation. Variables such as the number of university–industry partnerships, international joint R&D projects, consortia, newly established R&D partnerships, and companies cofunding research or academic activities are particularly relevant to the second stage of the TT process, which concerns the development of collaboration, as shown in Figure 4. However, these indicators mainly measure the existence or level of relational activity rather than its effectiveness in terms of TT outcomes (9,14). Although they provide an approximation to the institution's portfolio of partnerships, they remain insufficient for evaluating the success of those relationships in terms of technology adoption, commercialization, or impact (4,48,49). Additionally, several of these indicators originate from approaches developed for general university–environment interaction contexts and have been measured through subjective assessments, including Likert-type scales. This reinforces the need to develop metrics that objectively capture the strategic quality of relationships and their effective contribution to TT processes (19–22,95–97).

doi: 10.25100/iyc.v28i2.15751

Discussion and Conclusions

This review confirms that intellectual capital provides a relevant analytical framework for understanding technology transfer in higher education institutions, as it integrates complementary capabilities that intervene at different stages of the process. Human capital contributes the knowledge, experience, and competencies required to generate research outcomes; structural capital provides the organizational, regulatory, technological, and infrastructural conditions needed to protect, manage, and create value from those outcomes; and relational capital enables institutions to activate, sustain, and leverage the external relationships required for their transfer. From this perspective, university technology transfer does not depend on a single dimension of intellectual capital, but rather on the articulation of capabilities oriented toward both value creation and the development of collaboration.

However, the review also shows that this articulation has been addressed unevenly in the literature. While human and structural capital have more consolidated conceptual foundations and greater possibilities for measurement, relational capital emerges as the least developed dimension in terms of operationalization and in the way it is linked to technology transfer outcomes.

These findings are particularly relevant when examined from the perspective of the university's third mission. This mission requires higher education institutions to move beyond their traditional teaching and research functions and to engage actively with external actors in processes aimed at generating economic, social, and territorial value. In this context, technology transfer constitutes one of the main mechanisms through which universities mobilize knowledge toward their surrounding environment. Nevertheless, this process does not depend exclusively on scientific capabilities or internal resources. It also relies on the institution's ability to establish, maintain, and coordinate relationships with multiple actors, including firms, government entities, social organizations, communities, and other members of the innovation ecosystem. From this perspective, the multi-actor nature of university technology transfer makes relational capital a strategic resource for fulfilling the third mission, as it supports the exchange, cooperation, and coordination processes required to transform academic knowledge into outcomes with economic and social impact. The relevance of the asymmetry identified in the literature therefore lies in the fact that the university's third mission is largely materialized through its relationships, which makes a deeper understanding of those relationships essential.

Despite this importance, the literature analyzed in this review tends to address the influence of relational capital only in general terms. Aggregate, financial, and perception-based indicators predominate, capturing the existence of connections or collaboration efforts but providing limited explanations of how the structure and quality of relationships influence the success of technology transfer.

More specifically, the reviewed studies commonly measure relational capital through aggregate indicators such as the number of university–industry partnerships, joint R&D projects, business cofunding, consortia, and institutional reputation attributes, particularly ranking positions. Although

doi: 10.25100/iyc.v28i2.15751

these indicators are useful for identifying relational activity, they are limited in their ability to capture more complex dimensions, such as the strategic quality of connections, the institution's position within a network, the diversity of its ties, its brokerage capacity, and the sustainability of relationships over time. Consequently, the main gap identified in this review does not lie in the recognition of the importance of relational capital, but in the limited capacity of existing metrics to explain its effective contribution to concrete technology transfer outcomes, including technology adoption, validation, commercialization, licensing, and scaling.

The review also suggests that the value of relational capital cannot be understood as an isolated institutional attribute. Its effectiveness depends on organizational and contextual conditions that mediate the relationship between external ties and transfer outcomes. These conditions include the availability of structural resources, the existence of institutional mechanisms for managing interaction with the external environment, and the role of specialized intermediaries, particularly technology transfer offices. Therefore, rather than conceiving relational capital as an inventory of relationships, it should be understood as an institutional capability to build, coordinate, and sustain collaborative configurations that facilitate knowledge flows, negotiation among actors, and the mobilization of research outcomes toward social and productive uses.

Within this framework, social network analysis – SNA emerges as a relevant methodological alternative for strengthening the measurement of relational capital in the university context. Its main contribution lies in moving beyond the simple counting of relationships and enabling a structural interpretation of collaboration through measures such as centrality, betweenness, density, redundancy, communities, and structural holes. This approach provides a robust basis for understanding how an institution's network of relationships is organized, which actors occupy strategic positions, how resources and information circulate, and how particular configurations may facilitate or constrain trust, coordination, and technology transfer outcomes. From this perspective, network analysis does not replace traditional relational capital indicators but substantially expands their explanatory capacity.

From a practical standpoint, the findings suggest that higher education institutions and their technology transfer offices should move toward more integrated intellectual capital management systems in which the relational dimension is not treated merely as a secondary outcome of research activity, but as a strategic asset requiring specific monitoring, strengthening, and evaluation. This implies not only promoting a greater number of connections with external actors, but also understanding their structure, diversity, stability, and strategic value for technology transfer. Accordingly, complementing traditional indicators with structural network metrics may improve decision-making, support the identification of key actors, reveal excessive dependencies, detect relational gaps, and guide more effective university–environment engagement strategies.

Finally, the research agenda should advance toward studies that directly relate the dimensions of intellectual capital, particularly relational capital, to observable technology transfer outcomes, such as licensing agreements, commercially exploited patents, spin-off creation, socioeconomic impact, and innovation outcomes. Longitudinal and comparative studies are also needed to examine the evolution of collaboration networks over time. Future research should further combine quantitative network metrics with qualitative approaches capable of explaining underlying mechanisms such

doi: 10.25100/iyc.v28i2.15751

as trust, governance, and capability complementarity. Multilayer studies examining different types of ties among actors and the roles played by institutional intermediaries, including technology transfer offices and science and technology parks, would also contribute to a more comprehensive understanding of these processes. In summary, advancing the field requires more than continuing to affirm that intellectual capital is important for technology transfer. It requires the development of analytical frameworks and measurement approaches capable of explaining more precisely how, under what conditions, and through which relational configurations intellectual capital is translated into effective technology transfer outcomes.

Statement of authorship contribution credits

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Ethical implications: none declared; Conflicts of interest: none declared.

References

1. Buenechea M, Sáenz J, Kianto A. Intellectual capital-driven innovation: the influence of servitization degree. R and D Management. 2024 Sep 1;54(4):818-32.

https://doi.org/10.1111/radm.12576

2. Givi M, Saberi MK, Talafidaryani M, Abdolhamid M, Nikandish R, Fattahi A. Assessment of the history and trends of "The Journal of Intellectual Capital": a bibliometrics, altmetrics and text mining analysis. Journal of Intellectual Capital. 2022 May 26;23(4):864-912.

https://doi.org/10.1108/JIC-02-2020-0057

3. Guerrero M, Herrera F, Urbano D. Does policy enhance collaborative-opportunistic behaviours? Looking into the intellectual capital dynamics of subsidized industry-university partnerships. Journal of Intellectual Capital. 2021 Oct 14;22(6):1055-81.

https://doi.org/10.1108/JIC-07-2020-0254

4. Secundo G, De Beer C, Schutte CSL, Passiante G. Mobilising intellectual capital to improve European universities' competitiveness: The technology transfer offices' role. Journal of Intellectual Capital. 2017;18(3):607-24.

https://doi.org/10.1108/JIC-12-2016-0139

5. Ibarra M, Vela J, Hernández F. Interaction between knowledge management, intellectual capital and innovation in higher education institutions. Educ Inf Technol (Dordr). 2023 Jan 13;28(8):9685-708.

https://doi.org/10.1007/s10639-022-11563-x

6. Marulanda N, Vera L. Analysis of core competences and competitive advantages in higher education institutions: An intellectual capital approach. Knowledge Management Research and Practice. 2023;21(5):957-71

https://doi.org/10.1080/14778238.2022.2118636

7. Salinas J, Abreu R, Tamayo J. Intellectual capital and knowledge generation: an empirical study from Colombian public universities. Journal of Intellectual Capital. 2020 Sep 23;21(6):1053-84.

https://doi.org/10.1108/JIC-09-2019-0223

8. Dahiyat SE, Bontis N, Khasawneh SM, Al-Dahiyat M. Intellectual capital stocks and flows: examining the mediating roles of social capital and knowledge transfer. VINE Journal of Information and Knowledge Management Systems. 2023 Jan 2;53(1):11-42.

https://doi.org/10.1108/VJIKMS-06-2020-0110

9. Feng HI, Chen CS, Wang CH, Chiang HC. The role of intellectual capital and university technology transfer offices in university-based technology transfer. Service Industries Journal. 2012 May;32(6):899-917.

https://doi.org/10.1080/02642069.2010.545883

10. Rothaermel FT, Thursby M. Incubator firm failure or graduation?: The role of university linkages. Res Policy. 2005;34(7):1076-90.

https://doi.org/10.1016/j.respol.2005.05.012

11. Sorenson O, Rivkin J, Fleming L. Complexity, networks and knowledge flow. Academy of Management Proceedings. 2004 Aug 1;2004:R1-6.

https://doi.org/10.5465/ambpp.2004.13863811

12. Cosa M, Pedro E, Urban B. How to assess the intellectual capital of firms in uncertain times: a systematic literature review and a proposed model for practical adoption. Journal of Intellectual Capital. 2023;25(7):1-22.

https://doi.org/10.1108/JIC-05-2023-0096

13. Mele G, Sansone G, Secundo G, Paolucci E. Speeding Up Student Entrepreneurship: The Role of University Business Idea Incubators. IEEE Trans Eng Manag. 2024;71:2364-78.

https://doi.org/10.1109/TEM.2022.3175655

14. Secundo G, Pérez S, Martinaitis Ž, Leitner KH. An Intellectual Capital framework to measure universities' third mission activities. Technol Forecast Soc Change. 2017 Oct 1;123:229-39.

https://doi.org/10.1016/j.techfore.2016.12.013

15. Fu N. The role of relational resources in the knowledge management capability and innovation of professional service firms1. Human Relations. 2015 May 6;68(5):731-64.

https://doi.org/10.1177/0018726714543479

16. Ali M, Hussin N, Haddad H, Al-Araj R, Abed I. Intellectual capital and innovation performance: systematic literature review. Risks. MDPI; 2021.

https://doi.org/10.3390/risks9090170

17. Hernández L. Innovación y cambio microinstitucional en el sector salud: evidencia de la telemedicina en México. 2013.

https://www.scielo.org.mx/pdf/etp/n39/n39a3.pdf

18. Nahapiet J, Ghoshal S. Social Capital, Intellectual Capital, and the Organizational Advantage. Academy of Management Review. 1998 Apr;23(2):242-66.

https://doi.org/10.5465/amr.1998.533225

19. Etzkowitz H, Leydesdorff L. The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university-industry-government relations. Res Policy. 2000 Feb;29(2):109-23.

https://doi.org/10.1016/S0048-7333(99)00055-4

20. Bozeman B. Technology transfer and public policy: a review of research and theory. Res Policy. 2000 Apr;29(4-5):627-55.

https://doi.org/10.1016/S0048-7333(99)00093-1

21. Siegel DS, Waldman D, Link A. Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study. Res Policy. 2003 Jan;32(1):27-48.

https://doi.org/10.1016/S0048-7333(01)00196-2

22. Perkmann M, Tartari V, McKelvey M, Autio E, Broström A, D'Este P, et al. Academic engagement and commercialisation: A review of the literature on university-industry relations. Res Policy. 2013 Mar;42(2):423-42.

https://doi.org/10.1016/j.respol.2012.09.007

23. Freeman LC. Centrality in social networks conceptual clarification. Soc Networks. 1978 Jan;1(3):215-39.

https://doi.org/10.1016/0378-8733(78)90021-7

24. Sheble L, Brennan K, Wildemuth B. Social network analysis. In. 2016. p. 250-339.

25. Borgatti SP., Everett MG., Johnson JC. Analyzing social networks. 1st ed. SAGE; 2013. 296 p.

https://sk.sagepub.com/book/mono/analyzing-social-networks-3e/toc#_

26. Denyer D, Tranfield D. Producing a systematic review. In: The Sage handbook of organizational research methods. Thousand Oaks, CA: Sage Publications Ltd; 2009. p. 671-89.

https://acortar.link/JCjpSZ

27. Aghaei Chadegani A, Salehi H, Md Yunus MM, Farhadi H, Fooladi M, Farhadi M, et al. A Comparison between Two Main Academic Literature Collections: Web of Science and Scopus Databases. Asian Soc Sci. 2013 Apr 27;9(5):p18.

https://doi.org/10.5539/ass.v9n5p18

28. Dabi M, Vla□i□ B, Scuotto V, Warkentin M. Two decades of the Journal of Intellectual Capital: a bibliometric overview and an agenda for future research. Journal of Intellectual Capital. 2020;22(3):458-77.

https://doi.org/10.1108/JIC-02-2020-0052

29. Santosa S, Ismail T, Hanifah IA, Muchlish M. Intellectual Capital Measurement Revisited: Bibliometric Analysis of Value-Added Intellectual Coefficient. Quality - Access to Success. 2023 May 1;24(194):333-44.

https://doi.org/10.47750/QAS/24.194.37

30. Baima G, Forliano C, Santoro G, Vrontis D. Intellectual capital and business model: a systematic literature review to explore their linkages. Journal of Intellectual Capital. Emerald Group Holdings Ltd.; 2020. p. 653-79.

https://doi.org/10.1108/JIC-02-2020-0055

31. Ali M, Hussin N, Haddad H, Al-Ramahi NM, Almubaydeen TH, Abed IA. The Impact of Intellectual Capital on Dynamic Innovation Performance: An Overview of Research Methodology. Journal of Risk and Financial Management. MDPI; 2022.

https://doi.org/10.3390/jrfm15100456

32. Secundo G, Ndou V, Vecchio P Del, De Pascale G. Sustainable development, intellectual capital and technology policies: A structured literature review and future research agenda. Technol Forecast Soc Change. 2020 Apr 1;153.

https://doi.org/10.1016/j.techfore.2020.119917

33. Scaringella L. Research centres and universities' intellectual capital: a quantitative empirical study of PhD holders' contributions. R and D Management. 2024 Sep 1;54(4):833-51.

https://doi.org/10.1111/radm.12570

34. Rideg A, Szerb L, Varga AR. The role of intellectual capital on innovation: Evidence from Hungarian SMEs. Tec Empresarial. 2023;17(2):1-19.

https://doi.org/10.18845/te.v17i2.6695

35. Rehman S, Bresciani S, Ashfaq K, Alam G. Intellectual capital, knowledge management and competitive advantage: a resource orchestration perspective. Journal of Knowledge Management. 2022 Jul 26;26(7):1705-31.

https://doi.org/10.1108/JKM-06-2021-0453

36. Rehman S, Ashfaq K, Bresciani S, Giacosa E, Mueller J. Nexus among intellectual capital, interorganizational learning, industrial Internet of things technology and innovation performance: a resource-based perspective. Journal of Intellectual Capital. 2023 Mar 21;24(2):509-34.

https://doi.org/10.1108/JIC-03-2021-0095

37. Rehman S, Elrehail H, Alsaad A, Bhatti A. Intellectual capital and innovative performance: a mediation-moderation perspective. Journal of Intellectual Capital. 2022 Aug 9;23(5):998-1024.

https://doi.org/10.1108/JIC-04-2020-0109

38. Edvinsson L, Malone MS. Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brainpower [Internet]. New York: HarperBusiness; 1997. Available from:

https://api.semanticscholar.org/CorpusID:166850645

39. Lombardi R, Chiucchi MS, Mancini D. Smart technologies, digitalizzazione e capitale intellettuale : Sinergie e opportunità. Primera. Milano: Franco Angeli; 2020.

https://www.torrossa.com/en/resources/an/4925786

40. Bontis N. Intellectual capital: an exploratory study that develops measures and models. Management Decision. 1998 Mar 1;36(2):63-76.

https://doi.org/10.1108/00251749810204142

doi: 10.25100/iyc.v28i2.15751

41. Frondizi R, Fantauzzi C, Colasanti N, Fiorani G. The evaluation of universities' third mission and intellectual capital: Theoretical analysis and application to Italy. Sustainability. 2019 Jun 24;11(12).

https://doi.org/10.3390/su11123455

42. Paoloni P, Modaffari G, Mattei G. Knowledge resources in the university context: an overview of the literature. Journal of Intellectual Capital. 2020 Jun 17;22(4):703-24.

https://doi.org/10.1108/JIC-01-2020-0010

43. Barrena J, Cricelli L, Ferrándiz E, Greco M, Grimaldi M. Joint forces: Towards an integration of intellectual capital theory and the open innovation paradigm. J Bus Res. 2020 May 1;112:261-70.

https://doi.org/10.1016/j.jbusres.2019.10.029

44. Muwardi D, Saide S, Eko R, Iqbal M, Siti Astuti E, Herzavina H. Intangible resources and institution performance: The concern of intellectual capital, employee performance, job satisfaction, and its impact on organization performance. International Journal of Innovation Management. 2020 Jun 1;24(5).

https://doi.org/10.1142/S1363919621500092

45. Secundo G, Lombardi R, Dumay J, Guthrie A.M J. Reflecting on intellectual capital measurement and management in European universities. Meditari Accountancy Research. 2023 Jan 5;31(6):1827-45.

https://doi.org/10.1108/MEDAR-03-2022-1632

46. Walecka A. Strategic Crisis Management using Relational Resources. In: Organizational Change and Relational Resources [Internet]. Taylor and Francis; 2021 [cited 2026 Mar 15]. p. 181-96.

https://doi.org/10.4324/9781003172604-11

47. Lokális társas kapcsolatok - A kapcsolati t□ke bizonyos formáinak alakulása és meghatározottsága gy□rben. Szociologiai Szemle [Internet]. 2014 [cited 2026 Mar 15]. Available from:

https://www.scopus.com/pages/publications/84929255724?origin=scopusAI

48. Dorottya K. Kapcsolati és hálózati t□ke: Vázlat a társadalmi t□ke kett□s természetér□l. Szociologiai Szemle [Internet]. 2013 [cited 2026 Mar 15]. Available from:

https://www.scopus.com/pages/publications/84924234962?origin=scopusAI

49. Xu J, Haris M, Liu F. Intellectual capital efficiency and firms' financial performance based on business life cycle. Journal of Intellectual Capital. 2023 Apr 28;24(3):653-82.

https://doi.org/10.1108/JIC-12-2020-0383

50. Esfandyarpour A, Arasti MR, Farazi MS, Miremadi I. From depth and breadth of knowledge to technological capability: a journey inside a firm's intellectual capital. R and D Management. 2024 Sep 1;54(4):864-81.

https://doi.org/10.1111/radm.12669

51. Najar T, Dhaouadi K, Ben Zammel I. Intellectual capital impact on open innovation: The case of technology-based sectors in Tunisia. Journal of Innovation Economics and Management. 2020;32(2):75-106.

doi: 10.25100/iyc.v28i2.15751

https://doi.org/10.3917/jie.032.0075

52. Pellegrini L, Aloini D, Latronico L. Open innovation and intellectual capital during emergency: evidence from a case study in telemedicine. Knowledge Management Research and Practice. 2023;21(4):765-76

https://doi.org/10.1080/14778238.2022.2039572

53. Harandi AAH, Valmohammadi C, Hosseini SH. Enhancing the Intellectual Capital of Research and Development Centres using Business Intelligence: A System Dynamics Approach. Syst Res Behav Sci. 2024.

https://doi.org/10.1002/sres.3003

54. Ordóñez P. Editorial: Unlocking the potential of intellectual capital, innovation and higher education: some keys for competitiveness in the post-pandemic era. Learning and Intellectual Capital. 2022;19:391-4.

https://doi.org/10.1108/VJIKMS-04-2021-0060

55. Ting IWK, Lu WM, Kweh QL, Ren C. Value-added intellectual capital and productive efficiencies: evidence from Taiwan listed electronics companies. International Journal of Emerging Markets. 2023 Nov 14;18(9):2816-38.

https://doi.org/10.1108/IJOEM-11-2020-1374

56. Valencia A, Patiño ON, Vásquez MH, Vélez O, Zea E. Knowledge Management in Small and Medium Enterprises: Literature Review and Research Agenda. Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration. University of Pardubice; 2024. p. 1656.

https://doi.org/10.46585/sp32011656

57. Akil SR, Soemaryani I, Hilmiana H, Joeliaty J. Determinant Factors of Intellectual Capital for Improving Public Sector Innovation: An Empirical Study from Indonesia. Joeliaty JOELIATY / Journal of Asian Finance. 2021;8:421-0429.

https://scholar.kyobobook.co.kr/article/detail/4010028724150

58. Ge F, Xu J. Does intellectual capital investment enhance firm performance? Evidence from pharmaceutical sector in China. Technol Anal Strateg Manag. 2021;33(9):1006-21.

https://doi.org/10.1080/09537325.2020.1862414

59. Wu HY, Chen JK, Chen IS. Ways to promote valuable innovation: Intellectual capital assessment for higher education system. Qual Quant. 2012 Aug;46(5):1377-91.

https://doi.org/10.1007/s11135-011-9451-z

60. Yin X, Li F, Chen J, Zhai Y. Innovating from university-industry collaboration: the mediating role of intellectual capital. Journal of Intellectual Capital. 2023 Nov 17;24(6):1550-77.

https://doi.org/10.1108/JIC-10-2022-0207

61. Giampaoli D, Bontis N, Sgrò F, Ciambotti M. Integrating knowledge management with intellectual capital to drive strategy: a focus on Italian SMEs. VINE Journal of Information and Knowledge Management Systems. 2024 Jan 2;54(1):22-42.

https://doi.org/10.1108/VJIKMS-04-2021-0059

doi: 10.25100/iyc.v28i2.15751

62. Achim MV, Rus AID, Mirza N. How does intellectual capital spur innovation in economy? A cross-country survey. International Entrepreneurship and Management Journal. 2023 Dec 1.

https://doi.org/10.1007/s11365-023-00931-9

63. Chaudhary S, Dhir A, Farronato N, Nicotra M, Pironti M. Nexus between entrepreneurial orientation and intellectual capital. Journal of Intellectual Capital. 2023 Mar 15;24(1):70-114.

https://doi.org/10.1108/JIC-09-2021-0256

64. Elia G, Lerro A, Schiuma G. Leveraging knowledge management systems for business modelling in technology start-ups: an exploratory study. Knowledge Management Research and Practice. 2022;20(6):913-24.

https://doi.org/10.1080/14778238.2022.2144511

65. Ferreira JJM, Fernandes C, Veiga P. Multilevel approaches to advancing the measurement of intellectual capital research field-What can we learn from the literature? Journal of Intellectual Capital. 2021 Oct 14;22(6):971-99.

https://doi.org/10.1108/JIC-07-2020-0221

66. Hanifah H, Halim N, Zadeh A, Nawaser K. Effect of intellectual capital and entrepreneurial orientation on innovation performance of manufacturing SMEs: mediating role of knowledge sharing. Journal of Intellectual Capital. 2022 Sep 27;23(6):1175-98.

https://doi.org/10.1108/JIC-06-2020-0186

67. Javed HA, Khan NA, Michalk S, Khan NU, Kamran M. High-Performance Work System and Innovation Capabilities: The Mediating Role of Intellectual Capital. Adm Sci. 2023 Jan 1;13(1).

https://doi.org/10.3390/admsci13010023

68. Limones T, Flores J, Reaiche C. Linking HEIs with the production sector: A communication approach between key actors in Ciudad Juárez, Mexico. Industry and Higher Education. 2021 Feb 1;35(1):46-60.

https://doi.org/10.1177/0950422220922059

69. Nigam N, Mbarek S, Boughanmi A. Impact of intellectual capital on the financing of startups with new business models. Journal of Knowledge Management. 2021 Jan 23;25(1):227-50.

https://doi.org/10.1108/JKM-11-2019-0657

70. Paoloni P, Massaro M, Dal Mas F, Bagnoli C. Microfoundations of intellectual capital. Evidence from Italian small accounting firms. Knowledge Management Research and Practice. 2023;21(4):725-37.

https://doi.org/10.1080/14778238.2021.2023676

71. Shafiee MM. Competitive advantage via intellectual capital: a moderated mediation analysis. Journal of Intellectual Capital. 2022 Aug 9;23(5):957-97. doi:10.1108/JIC-05-2020-0152

https://doi.org/10.1108/JIC-05-2020-0152

72. Matricano D, Candelo E, Sorrentino M, Cappiello G. Investigating the link between intellectual capital and open innovation processes: a longitudinal case study. Journal of Intellectual Capital. 2022 Mar 24;23(3):538-57.

https://doi.org/10.1108/JIC-02-2020-0020

73. Norena D, Thalassinos E. Fueling innovation performance through entrepreneurial leadership: Assessing the neglected mediating role of intellectual capital. Journal of Infrastructure, Policy and Development. 2023;7(1).

https://doi.org/10.24294/jipd.v7i1.2020

74. Huang CC, Huang SM. External and internal capabilities and organizational performance: Does intellectual capital matter? Asia Pacific Management Review. 2020 Jun 1;25(2):111-20.

https://doi.org/10.1016/j.apmrv.2019.12.001

75. Molas J, Castro E. Ambiguity and conflict in the development of "Third Mission" indicators. 2006.

https://digital.csic.es/bitstream/10261/10689/3/Ambiguity%20and%20conflict.pdf

76. Jayabalan J, Dorasamy M, Raman M. Initial Survey Validation for the Impact of Intellectual Capital on Frugal Innovation. International Journal of Technology. 2022;13(5):1126-38.

https://doi.org/10.14716/ijtech.v13i5.5861

77. Galbraith JKenneth. The new industrial state. 4th ed. New American Library; 1968. 384 p.

https://www.torrossa.com/en/resources/an/5564474

78. Stewart TA. Intellectual capital the new wealth of organizations. Currency Doubleday; 1998.

https://doi.org/10.1002/pfi.4140370713

79. Subramaniam M, Youndt MA. The Influence of Intellectual Capital on the Types of Innovative Capabilities. Academy of Management Journal. 2005 Jun;48(3):450-63.

https://doi.org/10.5465/amj.2005.17407911

80. Guthrie J, Petty R, Yongvanich K, Ricceri F. Using content analysis as a research method to inquire into intellectual capital reporting. Journal of Intellectual Capital. 2004 Jun 1;5(2):282-93.

https://doi.org/10.1108/14691930410533704

81. Dumay J. A critical reflection on the future of intellectual capital: from reporting to disclosure. Journal of Intellectual Capital. 2016 Jan 11;17(1):168-84.

https://doi.org/10.1108/JIC-08-2015-0072

82. Cohen WM, Levinthal DA. Absorptive Capacity: A New Perspective on Learning and Innovation. Adm Sci Q. 1990 Mar;35(1):128.

https://doi.org/10.2307/2393553

83. Leitner KH. Intellectual capital reporting for universities: conceptual background and application for Austrian universities. Res Eval. 2004 Aug 1;13(2):129-40.

https://doi.org/10.3152/147154404781776464

84. Secundo G, Dumay J, Schiuma G, Passiante G. Managing intellectual capital through a collective intelligence approach. Journal of Intellectual Capital. 2016 Apr 11;17(2):298-319.

https://doi.org/10.1108/JIC-05-2015-0046

85. Bortagaray I. Bridging university and society in Uruguay: perceptions and expectations. Sci Public Policy [Internet]. 2009;36:115-9. Available from:

https://doi.org/10.3152/030234209X413937

86. Compagnucci L, Spigarelli F. The Third Mission of the university: A systematic literature review on potentials and constraints. Technol Forecast Soc Change. 2020 Dec 1;161.

https://doi.org/10.1016/j.techfore.2020.120284

87. WIPO. Incentives in Technology Transfer: A guide to encourage, recognize and reward researchers and professionals. Geneva; 2024.

88. Technology Transfer Licensing Survey | AUTM [Internet]. [cited 2026 Jan 13]. Available from: https://autm.net/surveys-and-tools/surveys/licensing-survey

89. Battistella C, De Toni AF, Pillon R. Inter-organisational technology/knowledge transfer: a framework from critical literature review. Journal of Technology Transfer. 2016 Oct 1;41(5):1195-234.

https://doi.org/10.1007/s10961-015-9418-7

90. Andrews K, Macintosh R, Sitko R. Commercializing University Innovations: A Sense-Making Perspective to Communicate Between Academics and Industry. IEEE Trans Eng Manag. 2024;71:614-25.

https://doi.org/10.1109/TEM.2021.3132798

91. Argote L, Ingram P. Knowledge transfer: A basis for competitive advantage in firms. Organ Behav Hum Decis Process. 2000;82(1):150-69.

https://doi.org/10.1006/obhd.2000.2893

92. Pérez L, Kedia B, Datta D, Rasheed A. Effectiveness and Efficiency of Cross-Border Knowledge Transfer: An Empirical Examination. Journal of Management Studies. 2008 Jun 1;45:714-44.

https://doi.org/10.1111/j.1467-6486.2008.00767.x

93. Szulanski G, Cappetta R, Jensen R. When and How Trustworthiness Matters: Knowledge Transfer and the Moderating Effect of Causal Ambiguity. Organization Science. 2004 Sep 1;15:600-13.

https://doi.org/10.1287/orsc.1040.0096

94. Xie X, Fang L, Zeng S, Huo J. How does knowledge inertia affect firms product innovation? J Bus Res. 2016;69(5):1615-20.

https://doi.org/10.1016/j.jbusres.2015.10.027

95. Rothaermel FT, Agung SD, Jiang L. University entrepreneurship: a taxonomy of the literature. Industrial and Corporate Change. 2007 Jul 11;16(4):691-791.

https://doi.org/10.1093/icc/dtm023

96. Wright M, Clarysse B, Lockett A, Knockaert M. Mid-range universities' linkages with industry: Knowledge types and the role of intermediaries. Res Policy. 2008 Sep;37(8):1205-23.

https://doi.org/10.1016/j.respol.2008.04.021

97. Lockett A, Wright M, Franklin S. Technology Transfer and Universities' Spin-Out Strategies. Small Business Economics. 2003 Mar;20(2):185-200.

https://doi.org/10.1023/A:1022220216972