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Analysis of Colombian research centers for the implementation of scientific tourism supported by knowledge management and ICT

Análisis de centros de investigación colombianos para implementar el turismo científico soportados por la gestión del conocimiento y las TIC

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Abstract: The objective of this article is to present an analysis of the key characteristics of research centers in Colombia, as well as the interest in implementing science tourism (ST), supported by knowledge management (KM) and ICT, as a permanent service at these centers. The research was based on a literature review of ST, KM, and the characteristics of research centers. A survey was conducted among 20 research centers, a statistical analysis was performed, and Kendall's correlation method was applied using SPSS v. 30 software. The results are presented by geographic distribution, city, type of center, number of employees, areas of research specialization, funding sources, technological infrastructure capacity, and equipment. Kendall's Tau-b correlation coefficient (τ) was 0.375. This led to the conclusion that improving technological infrastructure capacity also improves perceptions of and interest in ST, albeit to a moderate extent.

Keywords: scientific tourism, knowledge management, researchers, research centers, Kendall's correlation.

Resumen: El objetivo de este artículo es presentar un análisis sobre las características clave de los centros de investigación en Colombia, el interés en la implementación del turismo científico (TC) soportado por la gestión del conocimiento (GC) y las TIC, como un servicio permanente en dichos centros. La investigación se desarrolló a partir de una revisión literaria sobre TC, GC y las características de los centros de investigación. Se aplicó una encuesta a 20 centros de investigación, se realizó un análisis estadístico, se utilizó el método de correlación de Kendall mediante el software SPSS v. 30. Se presentan los resultados por distribución geográfica, ciudad, tipo de centro, número de colaboradores, áreas de especialización en investigación, fuentes de financiación, capacidad de infraestructura tecnológica y equipamiento. Se obtuvo el índice de correlación Tau-b de Kendall (τ): 0.375.

Esto permitió concluir que, al mejorar la capacidad de infraestructura tecnológica, la percepción e interés por el TC también mejora, aunque de forma moderada.

Palabras clave: turismo científico, gestión del conocimiento, investigadores, centros de investigación, correlación de Kendall.

1. INTRODUCTION

Science tourism is part of the tourism sector; it is an emerging and specialized field based on scientific research, which is a professional practice aimed at generating knowledge in various disciplines. Furthermore, science tourism encourages the active participation of researchers, students, and visitors in the processes of generating, transferring, and disseminating scientific knowledge, while contributing to sustainable development and the strengthening of innovation ecosystems [1]. Similarly, research and technological development centers (RTDC) are strategic venues that help bridge the gap between knowledge generation, scientific dissemination, and regional development [2], [3]. In this regard, Colombia has favorable conditions for promoting technical cooperation thanks to its biodiversity, cultural richness, and scientific capacity, given its geographic location: it is the only country in South America that borders two oceans [4]. However, implementation has focused on nature-based ST in natural areas and in temporary environmental projects, but it has not been applied in the RTDCs, which have not yet incorporated ST as a permanent service, thereby limiting its sustainability and scalability.

KM has proven to be a key factor in strengthening innovation and knowledge transfer in organizations with extensive research activities [5], [6]. However, there remains a gap in the literature regarding the development of models that integrate KM, technology management, ST, and technological tools to facilitate decision-making in research centers [7].

The literature review shows that authors focus on the ST of nature, which highlights the lack of ST models applicable to RTDCs. [2], [3]. At the international level, the ST's approach is interdisciplinary and integrates applied research, sustainability, technological innovation, experiential education, and knowledge transfer. It encourages the active participation of researchers, visitors, communities, and institutions in the processes of observation, interpretation, social appropriation, and knowledge generation, using KM as a strategy to transform scientific capabilities, academic networks, technological infrastructure, and research results into specialized and sustainable tourism services [8], [9], [10].

In the Colombian context, science and technology have been strengthened primarily through biodiversity, nature-based tourism, the social appropriation of science, and collaboration among research centers, universities, communities, and public entities. Some initiatives, such as MinCiencias "Colombia Bio" and the "2022–2026 Sectoral Tourism Plan" [11], demonstrate institutional interest in linking science, the local area, and sustainable development. However, there have been academic advances and initiatives focused on KM in ST [12], There remains a gap in the development of sustainable models that transform the scientific, technological, human, and infrastructure capacities of the RTDCs into ongoing technical cooperation services that generate intellectual, social, economic, and environmental value [13], [11], [14].

The RTDCs are dedicated to conducting research projects, producing scientific results, generating new knowledge, and contributing to the country's development. Researchers play a fundamental role; they are individuals who are passionate about science, have a high level of specialized academic training, and possess the experience, skills, and mastery of research methodologies [15], They conduct research activities and, in the field of knowledge tourism, are the ones who interact directly with tourists and people interested in experiences related to research, knowledge generation, transfer, and dissemination. Tourists participate, either partially or fully, in research activities and in the dissemination of results, with the support of research centers.

This article is part of a doctoral dissertation research project whose objective is to design a continuous training ST model based on KM that can be applied to research centers.

The objective of this study was to analyze the main characteristics of RTDCs based on data published by Minciencias [16] and analyze the relationship bet ween technological infrastructure capacity and interest in implementing ST with KM support as a permanent service, using data from 20 RTDCs in Colombia.

For this study, a descriptive analysis was conducted on the data collected using an online data collection tool, which was administered to 20 RTDCs and university research centers in Colombia. The criteria considered were: demographic characteristics; technological infrastructure capacity and specific equipment; perceptions of ST; and interest in adopting ST as a permanent service. The relationship between technological infrastructure capacity and perceptions of ST at the RTDCs was also analyzed using Kendall's correlation method [17] y [18].

This made it possible to obtain statistical data on key criteria and determine the relationship between interest in implementing cultural tourism and technological infrastructure, which in turn allows for the development of strategies and initiatives to implement cultural tourism and improve the infrastructure's capacity to attract and welcome tourists at the RTDCs. These centers offer opportunities to those interested in cultural tourism, such as doctoral residencies, internships, exchange programs, collaborations, and advanced programs—including master's degrees, doctoral degrees, postdoctoral fellowships, and other research-related services.

2. THEORETICAL CONTEXT

Scientific research focuses on generating new knowledge and is closely linked to the tourism sector and cultural heritage. These two fields are complementary and enable the appropriation of knowledge to transform it into tourism experiences that can be shared. Furthermore, it forms the foundation of the tourism sector, as the activities it carries out contribute to the generation of new data, information, and knowledge.

2.1. Scientific tourism

Currently, ST is characterized as an emerging field; it is a trend known as "new forms of tourism" and is one of the least understood and analyzed areas in academia [19]. It is part of the tourism sector and is regulated by the Ministry of Industry, Commerce, and Tourism (MINCIT). It is a specialized form of tourism for which the World Tourism Organization (UNWTO) has not yet established a definition; the concepts and definitions are provided by ST researchers.

This study has taken into account the definitions provided by various authors, although it should be noted that there is still no consensus on the definition of ST. [19]. ST is considered a reinvention of tourism that seeks out alternative destinations that break away from traditional ways of traveling [20]. According to Rojas Carranza (2018), this is "the type of tourism that directly involves researchers who travel for work or research purposes-such as collaborations, international exchanges, conferences, seminars, or colloquia." [21]. whereas, for [20], [22] They state that "this is an activity in which visitors participate in the generation and dissemination of scientific knowledge in collaboration with research and development centers."

ST's research activities and outreach initiatives can attract research experts, tourists, and other stakeholders. They can also foster collaboration with organizations interested in gaining experience in scientific research processes.

According to [23], three types of scientific tourism have been identified:

- *Scientific eco-volunteering*: In this form, the tourist or volunteer is an active participant.
- *Research tourism or scientific expeditions:* Researchers must travel to the research site or share their knowledge.
- *Cultural tourism with a scientific dimension*: this requires guidance, mediation, facilitation, and scientific interpretation of sites of cultural and heritage interest [23].

Science tourism differs from other forms of scientific mobility because it combines visitors' temporary stays with participation in research, innovation, education, and science outreach activities, thereby linking the tourism experience with the generation and transfer of knowledge [24], [3]. ST is carried out through organized experiences at universities and research centers, where visitors interact with researchers, laboratories, and scientific infrastructure, thereby promoting the social appropriation of knowledge. Academic mobility, for its part, focuses primarily on exchanges, study abroad programs, conferences, and professional training.

For the purposes of this study, a definition has been developed to delineate cultural tourism and distinguish it from academic tourism and event tourism, with a view to its application in research institutions, based on definitions provided by authors such as: [25], [23], [26], [27], [28], [29], [30], [14], To this end, the following model has been developed:

"Scientific tourism is a form of tourism in which scientific researchers participate directly; in which trips are undertaken for work-related or experimental purposes, such as collaborations, international exchanges, conferences, seminars, colloquia, or other scientific events; and in which researchers participate, either fully or partially, in the generation and dissemination of knowledge in coordination with research and development centers."

2.2. Knowledge management

Data alone has no meaning; it must be processed to turn it into information, which is the essential ingredient for generating knowledge in organizations. According to Nonaka (1994), there are two types of knowledge: tacit and explicit:

"*Explicit* or codified knowledge refers to knowledge that can be conveyed through a formal and systematic language. *Tacit knowledge*, on the other hand, is personal in nature, which makes it difficult to formalize and communicate, and is deeply rooted in action, commitment, and participation within a specific context" [31].

According to Ikujiro Nonaka and Hirotaka Takeuchi (1995), knowledge creation in organizations is defined as: "the ability of a company as a whole to create new knowledge, disseminate it throughout the organization, and incorporate it into products, services, and systems" [32]. While for [33] It is "a set of processes and systems that enable an organization's intellectual capital to grow significantly through the efficient management of its problem-solving capabilities."

KM is defined as "a systematic approach to optimizing a company's knowledge economy. It includes elements such as human resources practices, technology, culture, and organizational structures" [34].

Organizations must adopt effective knowledge management practices that facilitate the conversion of data into information and knowledge, the generation of knowledge from information, and that enable them to increase the efficiency and effectiveness of their processes and implement innovations in products and services to become more competitive in the global market [13]. With a good KM, organizations can innovate and optimize their processes, products, or services, thereby gaining strong competitive advantages.

The MK is the mechanism responsible for the operational coordination of the ST at the RTDCs, transforming research results into structured learning experiences, technology transfer, and innovation. Through systematic processes of identifying, collecting, organizing, storing, transferring, applying, and evaluating knowledge, the centers leverage their scientific capabilities, researchers, laboratories, technological infrastructure, and collaborative networks to offer a continuous flow of technology transfer services tailored to visitors, students, researchers, and companies. This process strengthens the social appropriation of knowledge, drives collaborative innovation, and generates intellectual, social, economic, and environmental value, thereby consolidating research as a strategic asset for regional development and institutional competitiveness [35], [32], [36], [37]. Similarly, the integration of digital technologies, artificial intelligence (AI), and knowledge management systems fosters the creation of continuous learning ecosystems that make it possible to institutionalize technical cooperation as an ongoing service within the RTDCs.

2.3. ICT in knowledge management, research and scientific tourism

Information and communication technologies (ICT) form the backbone of organizations, as they enable them to manage data, transform it into information, conduct simulations, and share research findings. They are useful for digitizing cultural findings and heritage, as well as for transferring, disseminating, and preserving knowledge, while also enhancing tourist experiences through virtual tours, the use of mobile technologies, and virtual environments.

ICT facilitates the collection, analysis, processing, and storage of data. Furthermore, disruptive technologies such as artificial intelligence, big data, the Internet of Things, and blockchain have changed the way we conduct research and manage knowledge, facilitate complex analyses, and enable us to simulate and predict phenomena, including those related to an organization's cybersecurity [38]. Virtual and augmented reality tools allow users to enjoy digitally enhanced experiences with real-time tourism content [39], [40]. They are also used to promote tourism, create digital tourist destinations, develop smart routes, and establish virtual labs, while tracking and monitoring research and marketing processes.

Figure 1 illustrates the relationship between ST, KM, research, ICT, and disruptive technologies applicable to RTDCs-such as blockchain, the IoT, augmented and virtual reality, and AI which must be applied and integrated into technological, pedagogical, and ethical frameworks [41]. Similarly, looking ahead, quantum computing is an emerging technology with the potential to revolutionize the way information is processed and stored [42].

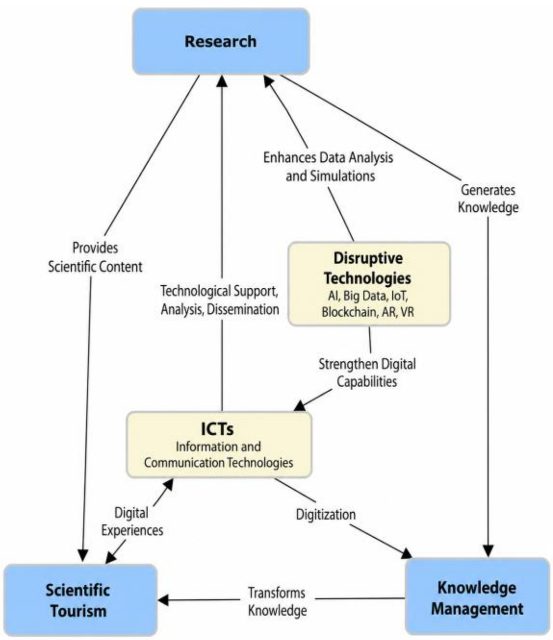

Fig. 1. *Relationship between ST, KW, research, ICT, and disruptive tools.* ***Source:*** *Compiled by the author.*

The technological infrastructure of the RTDCs must be established within the framework of an innovation ecosystem in which ICT, disruptive tools, KM, research, and technology transfer converge. This makes it possible to disseminate science in an interactive and accessible way, promoting sustainable development and the social appropriation of knowledge. Furthermore, organizations can measure their performance using indicators [43].

2.4. Research centers in Colombia

In Colombia, the country's research and scientific and technological development are coordinated, managed, and promoted by the Ministry of Science, Technology, and Innovation (MinCiencias).

RTDCs are "public, private, or mixed-sector organizations dedicated to generating fundamental knowledge for the country through basic and/or applied scientific research projects in specific areas of research" [44], [45]. Recognition of actors is considered "a standard practice intended to support them and make them eligible for public resources from MinCiencias and other government agencies" [46], which is administered by the National System for Science, Technology, and Innovation (SNCTI).

RTDCs are essential for driving productivity, competitiveness, sustainability, and progress in any country. Their goal is to find solutions to various problems affecting society. These research centers specialize in different fields of research, which facilitates the creation of technological advances and innovations that benefit the productive sector. In addition, they contribute to improving social well-being and achieving advances in health. In line with their mission, they focus on generating new knowledge and facilitating the transfer of technology and expertise to organizations for the creation or innovation of products or services. They provide high-level academic and scientific training to new researchers in various fields of science and technology, while promoting a culture of research by supplying the labor market with new qualified professionals.

Under Law 2142 of August 2021, research institutes and centers are authorized to apply to the Ministry of National Education for accreditation of the master's and doctoral programs they offer in collaboration with universities [47].

3. METHODOLOGY

The research methodology is applied in nature, employing a mixed-methods approach with an exploratory-descriptive scope; it is based on Kendall's tau-b correlation coefficient and descriptive statistics. The research was conducted in two phases:

First phase: Secondary sources of information were reviewed in the scientific databases Scopus, ScienceDirect, Scielo, Dialnet, and ResearchGate, as well as in university repositories and through an analysis of RTDCs data published by MinCiencias [46], [48].

Second phase: A data collection instrument was designed specifically for this study, based on the systematic literature review and the identified variables. Its content was validated by a group of

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experts, who assessed the relevance, clarity, and consistency of each item; reliability was verified using statistical procedures appropriate for the ordinal nature of the data. The instrument was structured around dimensions and variables related to ST and KM, operationalized using indicators measured on an ordinal scale with predefined evaluation criteria, thereby ensuring methodological consistency and the possibility of replicating the study in similar contexts.

Likewise, based on a literature review and expert input, a five-level ordinal scale was designed to evenly assess the technological capacity of research centers, regardless of their scientific fields. The evaluation criteria weren't limited to equipment availability; they also considered specialized labs, scientific infrastructure, technological platforms, experimental resources, materials, supplies, and other capabilities required for conducting research and technology transfer activities. This structure allowed for an objective and comparable assessment between institutions with different scientific profiles, taking into account the level of availability, functionality, and support of the technological resources needed for knowledge generation and transfer.

A non-probabilistic sample was used, with convenience being the selection criterion. The RTDCs were chosen based on their availability for research, accessibility, and experience in scientific research activities, KM, and the potential development of ST. This sampling is suitable for exploratory and applied studies, since the goal was to analyze the relationships between the variables 'technological infrastructure capacity' and 'perception and interest in implementing ST'. Also, a descriptive statistical analysis was done, percentages were calculated to see how the centers perceive the ST and assess their infrastructure capacity. Finally, Kendall's tau-b correlation was applied to get the tau coefficient (τ) [17], [18], to the variables: technological infrastructure capacity and the institution's interest in implementing ST.

4. RESULTS

4.1. Analysis of demographic information

The information published by MinCiencias about the RTDCs recognized by SNCTI was analyzed [16] which are classified as shown in Table 1.

Table 1: *Research centers accredited by SNCTI.*

Research Center	Quantity
Science Center	17
Technology Development Center (CDT)	7
Innovation and Productivity Center (CIP)	12
Research Center	50
Highly Innovative Company (EAI)	5
Technology-Based Business Incubator	2
Public Institute	18
Office for the Transfer of Research Results - OTRR	7
Corporate R&D&I Unit	14

Source: *Compiled by the author using data from 2024 [49]*

The demographic information of the RTDCs was analyzed, linking the geographic location by city, types of research centers, number of collaborators, areas of research specialization, and sources of funding. The result of the geographic location by city of the research centers in this study shows that Bogotá is the city with the highest number of research centers, followed by Bucaramanga and Medellín, while Cali, Cartagena, Santa Marta, Tunja, Cúcuta, Leticia, Bello, and Pitalito are the cities with the fewest research centers, as shown in figure 2.

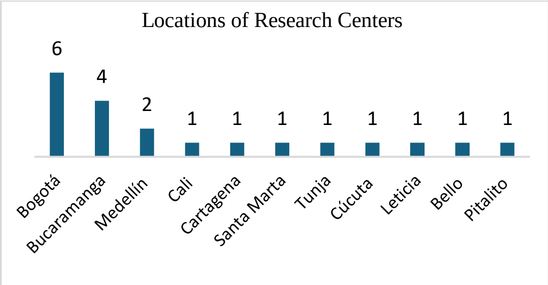

Fig. 2. *Location of Research Centers by City*
Source: *Compiled by the author.*

In the distribution of types of research centers, university research institutes come first, followed by research centers or institutes, while technology development centers and business accelerators have fewer centers, as shown in Figure 3.

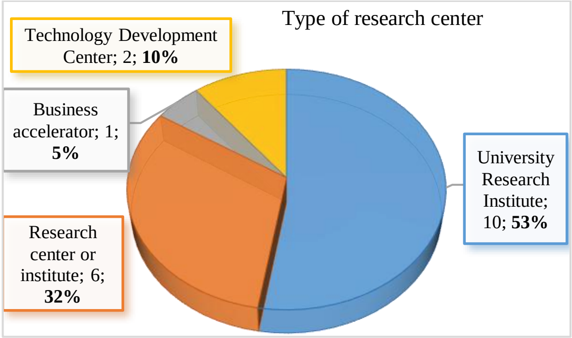

Fig. 3. *Types of research centers.* ***Source:*** *Created by us.*

In the distribution by number of employees, the established ranges are listed, which in turn allows us to identify the size of the research organization. Figure 4 shows the number of employees: from 1 to 10 and between 11 and 50 are the ones with fewer employees, while the ranges of 51 to 200 and more than 500 are the centers with the most employees.

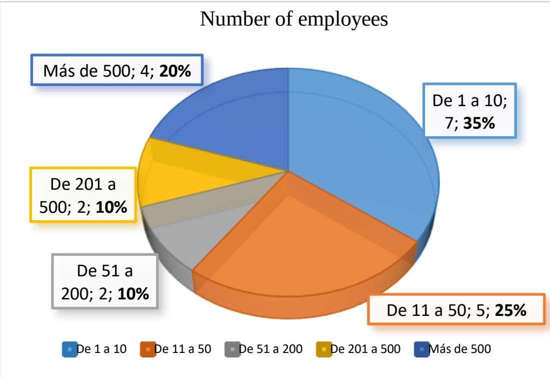

Fig. 4. *Number of employees.*
Source: *Compiled by the author.*

The areas of research specialization are as follows: first, engineering and technology, followed by the humanities, while medical and health sciences, natural sciences, and others are the areas with the fewest research centers. It should be noted that some research centers have multiple areas of research specialization within a single institution. Figure 5 shows the different areas of research specialization.

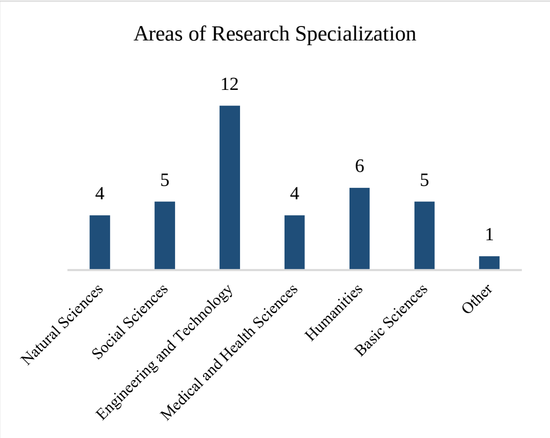

Fig. 5. *Areas of Research Specialization.*
Source: *Compiled by the author.*

The main source of funding for research centers is shown in Figure 6, which indicates that the largest number of centers receive public funding, followed by private funding, and finally, mixed funding, which accounts for the smallest number of research centers.

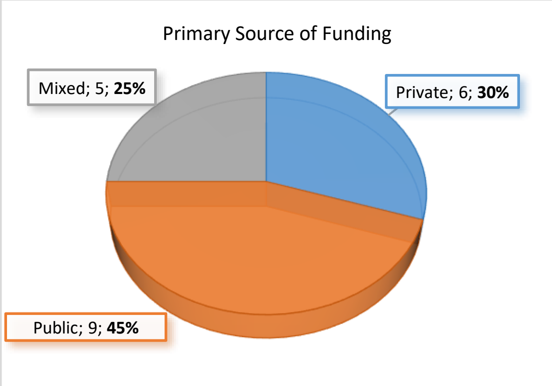

Fig. 6. *Primary Source of Funding.*
Source: *Compiled by the author.*

4.2. Statistical analysis

In the analysis of perceptions of science tourism at the RTDCs, the following aspects were examined:
Technological infrastructure capacity: assesses the technological infrastructure and laboratory equipment available for research and science tourism at the research institution.

Perceptions of science tourism: refers to the research institution's level of interest in establishing science tourism as a permanent service.

An assessment of the capacity of the technological infrastructure and laboratory equipment available for research and ST is highly relevant, as it enables the conduct of research activities and serves as a basis for hosting tourists interested in ST. The results are presented in Table 2, organized into five groups rated on a scale of 1 to 5.

Table 2: *Capacity of the technological infrastructure*

Scale	Category	Number of Centers	Percentage
1	Very inadequate	2	10 %
2	Insufficient	8	40 %
3	Appropriate	5	25 %
4	Well	5	25 %
5	Excellent	0	0 %

Source: *Compiled by the author.*

Fifty percent of the RTDCs included in this study have good and adequate technological infrastructure to implement and provide ST services.

Regarding perceptions of ST, the level of interest in science tourism among research institutions was assessed using an ordinal scale from 1 to 5, as shown in Table 3.

Table 3: *Interest in Science Tourism*

Scale	Category	Number of centers	Percentage
1	Invalid	3	15 %
2	Bass	6	30 %
3	Moderate	6	30 %
4	High	5	25 %
5	Very High	0	0 %

Source: Compiled by the author.

Kendall's tau-b correlation was applied to the following variables: a) the capacity of the technological infrastructure, which measures the equipment available in the institution's laboratories for research and ST; b) the institution's interest in implementing ST, to assess the value of ST with the goal of establishing it as a permanent service. The results of the evaluation of the 20 RTDCs are shown in table 4.

Table 4: *Data for Kendall's correlation.*

Research Center	Technology infrastructure capacity	Interest in promoting science tourism
Center 1	3	2
Center 2	4	4
Center 3	2	1
Center 4	4	4
Center 5	3	3
Center 6	3	4
Center 7	4	3
Center 8	1	3
Center 9	2	3
Center 10	2	1
Center 11	2	2
Center 12	4	2
Center 13	3	2
Center 14	1	2
Center 15	2	2
Center 16	3	3
Center 17	2	4
Center 18	4	4
Center 19	2	1
Center 20	2	3

Source: *Compiled by the author.*

Kendall's correlation was analyzed using SPSS v. 30 software, yielding a Kendall's Tau-b correlation coefficient (τ) of 0.375. This indicates a moderate positive correlation between the two variables. The variables are related, but the relationship is not strong enough. Meanwhile, the p-value is 0.014, which is less than 0.05, thereby rejecting the null hypothesis.

5. DISCUSSION

The analysis of the 20 RTDCs revealed characteristics relevant to the subject of study, which made it possible to obtain specialized, high-quality information, thereby facilitating the correlational analysis. Although this approach limits the generalizability of the results, it provides sufficient empirical evidence for the initial validation of the ST model supported by the integration of KM and ICT, and serves as a basis for future research using probabilistic samples with broader coverage.

The literature review highlights the lack of studies focused on models for the organizational integration of ST and KM [50], By integrating ST, KM, and ICT, it is proposed that tourists actively participate in the processes of knowledge creation, transfer, and appropriation, thereby simultaneously strengthening open science, open innovation, and citizen science.

The results are consistent with international data indicating that the ST relies on the integration of global governance, technological infrastructure, and collaborative networks to generate scientific, educational, and regional value [29], [8], [51]. Similarly, in Colombia, the Bio program of MinCiencias and the 2022–2026 Tourism Sector Plan [11], demonstrate institutional interest in establishing links between science, the region, and sustainable development. In line with these studies, the positive and significant correlation observed between technological infrastructure and interest in launching science tourism activities ($\tau = 0.375$; $p = 0.014$) confirms that technological capabilities support this process; however, its moderate magnitude indicates that this decision is also influenced by organizational and institutional factors, such as strategic leadership, a culture of innovation, knowledge management, cooperation networks, funding sources, the level of scientific specialization, the number of researchers, and the geographic location of the centers. Consequently, technological infrastructure acts as a facilitator, but its impact depends on the institutional capacity to transform scientific knowledge into sustained technology transfer experiences through innovation and knowledge transfer processes.

According to the results, 50% of the RTDCs have adequate infrastructure to implement ST. However, this does not depend exclusively on the available infrastructure, but rather on the interplay between scientific capabilities, governance, research experience, specialization in the subject area, the size of the institution, and financial sustainability. These characteristics determine the varying levels of institutional readiness to incorporate ST as a permanent service within the RTDCs. Similarly, it is necessary to invest in technological infrastructure and human capital development, which in turn will expand scientific output and the capacity to host visitors interested in knowledge transfer, thereby generating intellectual, economic, and social capital. Furthermore, promoting ST can help disseminate research results and facilitate knowledge transfer both within and outside research centers, which benefits the community [52]. At the same time, this can contribute to regional development by boosting the tourism sector, since scientific tourists, during their stay at the research center, can also engage in other tourist activities, such as staying at hotels, enjoying local cuisine, and using public transportation.

This study is relevant for improving public policy, as well as for the academic, scientific, and business sectors, as drivers of sustainable development.

6. CONCLUSIONS

The correlation analysis performed using Kendall's tau-b coefficient yielded a coefficient of $\tau = 0.375$, with a p-value of $p = 0.014$, indicating a positive correlation of moderate strength that is statistically significant at a 95% confidence level ($p < 0.05$). Consequently, the null hypothesis of no association is rejected, and it is accepted that there is a significant relationship between the analyzed variables, ruling out the possibility that the result is due to chance. Furthermore, the results show a trend indicating that, as the capacity of the technological infrastructure improves, so do the perception of and interest in ST, albeit to a moderate extent. Furthermore, the coefficient suggests a moderate positive relationship; this is a direct relationship, though not a decisive one. However, there may be other additional factors that influence the perception of ST. The correlation is moderate enough to suggest that the infrastructure has some impact, but it is not the only variable to consider in the analysis of perception.

This correlation is consistent with the characteristics observed in the CDITs evaluated, particularly those with a stronger scientific infrastructure, interdisciplinary teams, cooperation networks, and diversified funding models-conditions that foster both the generation and transfer of knowledge toward technology transfer activities.

Challenges were identified in improving the capacity of the necessary technological infrastructure, with the aim of raising awareness and interest in implementing ST as a permanent service at the RTDCs, thereby promoting research and strengthening these centers; however, significant difficulties remain in implementing ST in a sustainable manner and meeting the expectations of tourists and external researchers.

This study contributes by proposing science tourism as a permanent service at research centers, supported by knowledge management and technological infrastructure. Furthermore, it provides empirical evidence using Kendall's Tau-b correlation coefficient, which demonstrates a positive and significant association between technological infrastructure and institutional interest in implementing science tourism activities, thereby supporting its incorporation as a strategy to strengthen knowledge transfer and generate scientific, social, and economic value.

Future work

As a future line of work, we propose expanding the validation of the model to a larger number of research centers and different institutional contexts, incorporating longitudinal studies that will allow us to evaluate its impact on knowledge management, innovation, and technology transfer. In addition, we recommend integrating emerging technologies and artificial intelligence to optimize decision-making and establish technology transfer as a permanent service at research centers.

Limitation of Research

The first limitation of this study is the use of a non-probability sample of 20 RTDCs, which limits the generalizability of the results to other contexts. Although Kendall's tau-b coefficient proved adequate for analyzing the association between ordinal variables, this method only allows for identifying the strength and direction of correlations without establishing causal relationships; furthermore, the coefficient indicates that there are other factors that may influence the study. Consequently, the results should be interpreted within the context of the sample analyzed, and it is recommended that future research utilize larger probabilistic samples and methodological designs that strengthen the external validity of the findings.

The second limitation was the scarcity of recent studies on science tourism that focus on its implementation as a permanent service at research centers. This lack of empirical evidence and well-established conceptual models limited the ability to draw broader comparisons with previous research, highlighting the need to strengthen this line of research through applied and longitudinal studies that contribute to its theoretical and practical consolidation.

Contributions by authors: MS: Conceptualization, Formal analysis, Methodology, Validation, Drafting-original draft, Research, Resources, Visualization. **FC**: Research, Formal analysis, Methodology, Project management, Resources, Validation, Writing, review, and editing. **VM**: Research, Methodology, Formal Analysis, Validation, Writing, Review, and Editing.

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