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Information Systems: an analysis of market solutions and the support for NIT governance

Sistemas Informatizados: uma análise de soluções de mercado e o suporte à governança dos NITs

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Abstract

Technological Innovation Centers (NITs) are mandatory structures within Brazilian Science and Technology Institutions (ICTs), responsible for managing institutional innovation policy and bridging the gap between academia and the productive sector. Despite their importance in technology transfer and intellectual property management, the national landscape is heterogeneous, varying widely in maturity and performance. In this context, digitalization emerges as an essential driver to enhance governance, transparency, and strategic decision-making. The current ecosystem of systems is diversified, divided between robust commercial solutions and flexible in-house platforms. However, the implementation of these tools faces significant barriers, such as high costs, data fragmentation, a shortage of qualified personnel, and cultural resistance. This disparity is heightened by the size of the centers: larger NITs tend to adopt robust systems and formalized governance, while smaller ones contend with severe technical and financial limitations to consolidate their digital transformation.

Keywords: Computerized Systems; NITs Governance.

Resumo

Os Núcleos de Inovação Tecnológica (NITs) são estruturas obrigatórias nas ICTs brasileiras, responsáveis por gerir a política de inovação e conectar a academia ao setor produtivo. Apesar de sua importância na transferência de tecnologia e gestão da propriedade intelectual, o cenário nacional é heterogêneo, variando em maturidade e desempenho. Nesse contexto, a informatização surge como um vetor essencial para aprimorar a governança, a transparência e a tomada de decisões estratégicas. O ecossistema atual de sistemas é diversificado, dividindo-se entre soluções comerciais robustas e plataformas internas flexíveis. Contudo, a implementação dessas ferramentas enfrenta barreiras significativas, como altos custos, fragmentação de dados, escassez de pessoal qualificado e resistência cultural. Essa disparidade é acentuada pelo porte dos núcleos: NITs maiores tendem a adotar sistemas robustos e governança formalizada; enquanto os menores lidam com severas limitações técnicas e financeiras para consolidar sua transformação digital

Palavras-chave: Sistemas Informatizados; Governança dos NITs.

Technological Areas: Innovation Management, Information and Communication Technology, Software, Technology Forecasting.

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1 Introduction

Technology Innovation Centers (NITs) have emerged as fundamental structures within Brazilian Scientific, Technological, and Innovation Institutions (ICTs), with the purpose of managing institutional innovation policies. Their creation and strengthening were driven by the need to professionalize intellectual property management and technology transfer activities, serving as a crucial link between the scientific and technological output of universities and research institutes and the demands of the productive sector. NITs act as intermediaries, facilitating the complex university-industry interaction, often through incubators and technology parks, while centralizing legal and commercial discussions so that researchers can focus on their primary research and teaching activities (Ribeiro, Andrade, & Lima, 2019).

The Innovation Law (Law No. 10,973/2004) and, subsequently, the New Legal Framework for Science, Technology, and Innovation (ST&I), consolidated through Law No. 13,243/2016 and Constitutional Amendment No. 85/2015, established the mandatory existence of a Technology Innovation Center, either independently or in association with other ICTs, for every public ICT, with the purpose of supporting the management of its innovation policy (Brazil, 2016).

Article 16 of Law No. 10,973/2004, updated by Law No. 13,243/2016, details a set of minimum responsibilities for NITs that extend far beyond the role of a patent office. Their primary responsibilities include safeguarding institutional innovation policies, evaluating research outcomes, providing opinions on intellectual property protection and disclosure, monitoring intellectual property processes, assessing third-party inventions, conducting technological prospecting and competitive intelligence activities, developing technology transfer strategies, promoting relationships with companies, and negotiating and managing agreements (Brazil, 2016).

The strategic importance of NITs within the national innovation system has increasingly been recognized. Initiatives such as international missions organized by the National Forum of Innovation and Technology Transfer Managers (Fortec) and the National Association of Entities Promoting Innovative Enterprises (Anprotec) seek to strengthen Brazil's presence in the global innovation landscape by fostering exchanges, strategic partnerships, and the sharing of best practices with internationally recognized institutions. These initiatives, which involve representatives from NITs, universities, federal institutes, and other innovation system stakeholders, aim not only to promote learning but also to establish connections that stimulate innovation and technology transfer in Brazil (Anprotec, 2025).

Nevertheless, NITs in Brazil exhibit considerable heterogeneity. Studies conducted by Fortec indicate that, although there is a critical mass of well-established NITs with qualified personnel and significant achievements in licensing activities and the creation of academic spin-offs, there remains substantial variation in maturity, organizational structure, and performance among these centers. This diversity is reflected in multiple indicators, including the length of time NITs have been in operation, the number of intellectual property protection filings, the volume of executed licensing agreements, the implementation of innovation policies, and the size of their workforce (Fortec, 2022).

This heterogeneity highlights the need to investigate the factors influencing NIT performance and effectiveness, among which the adoption of information systems and the implementation of robust governance practices stand out.

The complexity of the legal responsibilities assigned to NITs, combined with the need to interact with a diverse range of stakeholders, requires the support of information systems. The management of intangible assets, R&D&I projects, contracts, and external relationships benefits substantially from the automation and organizational capabilities provided by digital tools. Governance also plays a critical role, requiring practices such as transparency, internal control, efficiency, integrity, and compliance. Informatization can serve as a key driver of improved governance by facilitating data collection, performance monitoring, and process traceability.

Given the strategic role of NITs, the complexity of their functions, and the need for robust governance mechanisms, this article aims to analyze the information systems currently used by Technology Innovation Centers (NITs) in Brazil that have achieved notable prominence. The study seeks to investigate how the functionalities of these systems align with the minimum responsibilities assigned to NITs, as well as to identify their potentialities, limitations, and challenges in enhancing transparency, traceability, and decision-making processes.

2 Methodology

The methodology of this study was based on a qualitative and descriptive approach, employing the review and analysis of relevant literature and publicly available information. To ensure a comprehensive analysis, data sources were divided into four main categories: Brazilian Legislation, which included the analysis of the Innovation Law and the New Legal Framework for Science, Technology, and Innovation (ST&I), with a focus on the responsibilities assigned to NITs; Institutional Reports, such as the annual reports of the Fortec Innovation Survey and governance frameworks developed by the Brazilian

Federal Court of Accounts (TCU); Academic Literature, encompassing scientific articles, dissertations, and theses related to the management of NITs; and Publicly Available Information, which enabled the identification of software systems mentioned on institutional websites and technology dissemination portals. The objective was to analyze and interpret data and information based on descriptive evidence rather than statistical methods (Gil, 2008).

The mapping of the systems used by NITs began with publicly available information from the National Institute of Industrial Property (INPI). The search strategy included software titles and employed the following terms: Intellectual Property Management (5 results), NIT Management (3 results), NIT (5 results), INPI (9 results), and intellectual property (17 results). A temporal restriction was applied, limiting data collection to the previous ten years.

The same search terms were subsequently used in internet searches through Google. This stage aimed to identify systems available online that had not been registered with INPI.

Following data collection, an analysis was conducted to identify duplicate systems based on the software title and ownership, as well as to exclude systems whose primary purpose was not the management of Technology Innovation Centers. After this stage, the analysis was expanded through specific procedures, including identifying the current landscape of informatization within NITs and mapping the types of systems employed; exploring governance concepts; and categorizing governance indicators.

A comparative analysis of software systems designed for NITs was carried out through the mapping and categorization of the types of solutions identified during the research. Based on the collected information, the systems were organized and evaluated according to the following criteria: internal, commercial, open-source/adapted, or portal-based solution; main functionalities; cost model; and the advantages and disadvantages associated with each approach.

This methodology made it possible to contrast the characteristics of internally developed solutions, which offer high levels of customization and alignment with institutional processes, with commercial platforms, which generally provide greater robustness and technical support but may involve higher costs and limited specificity regarding the particular needs of Technology Innovation Centers.

3 Results and Discussion

The management of intellectual property (IP) portfolios, technology transfer (TT) agreements, technological prospecting activities, stakeholder relationships, and spin-off monitoring are functions that benefit substantially from the use of information systems. The absence of adequate systems may lead to inefficiencies, delays, missed deadlines, and difficulties in generating performance indicators, thereby contributing to the heterogeneity observed among NITs (Machado, Fabris, & Nicoleit, 2023).

Information systems not only optimize the management of deadlines, fees, and patent-related procedures, but also enable the generation of performance indicators, such as the number of patents filed per year, which are essential for governance and strategic decision-making. Furthermore, the availability of dedicated tools within the NIT environment allows for the centralization of processes, documents, and historical records, which is crucial for efficient management, reliable record-keeping, and the production of management reports. These elements are fundamental for transparency and activity monitoring, providing benefits that extend to any NIT, regardless of its size or level of maturity (Mori, Russano, & Barbosa, 2017).

The mapping of informatization systems used by Brazilian Technology Innovation Centers (NITs) reveals a highly diverse landscape. The management of intellectual property portfolios, contracts, and stakeholder relationships benefits significantly from the use of information systems; however, their adoption varies considerably among institutions. As described in Box 1, searches conducted in the INPI database and through Google identified 39 systems. Of these, 33 explicitly included NIT management functionality in their descriptions or on their respective websites.

In contrast, many ICTs have chosen to develop their own systems or adapt open-source software in order to obtain more affordable solutions that are better aligned with their specific needs. Examples of this approach include Gestec-NIT, developed by Fiocruz; the Integrated System of Unicamp; and SGPI PRO developed by Univasf. As shown in Graph 1, among the 33 NIT management systems identified, those whose ownership is linked to government institutions were segmented and analyzed separately.

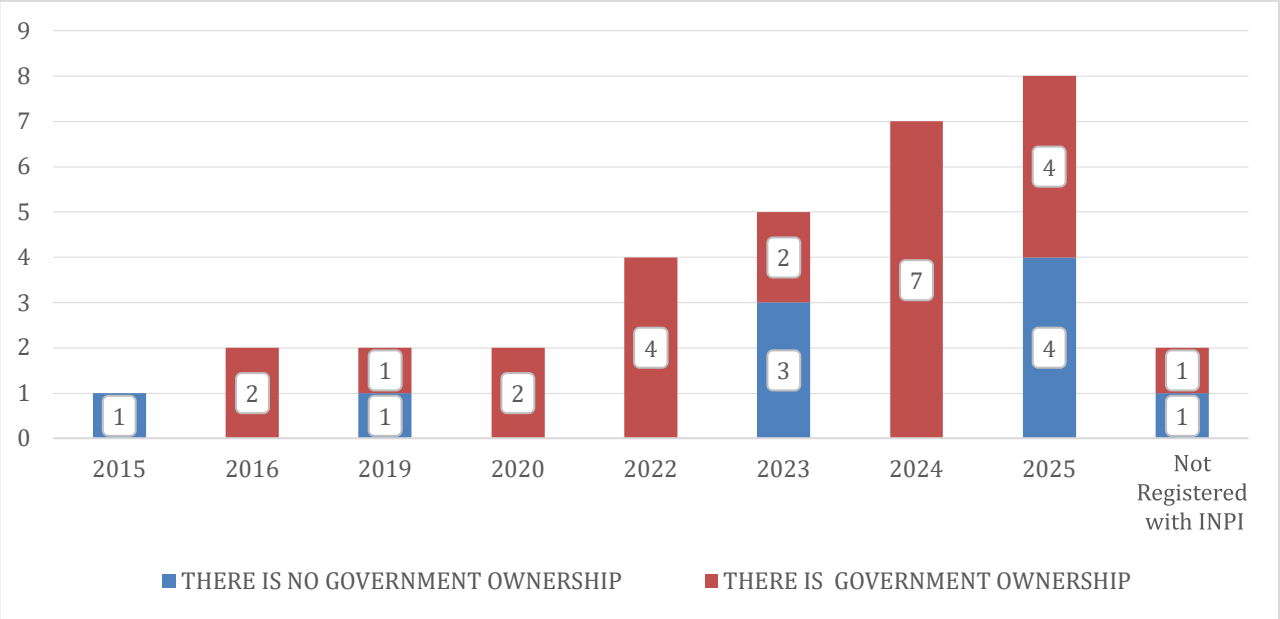
Nakamura, De Lima Fedato, and Gasparini (2024) argue that the analysis of intellectual property management experiences reveals the need to reassess interactions with society and the role of academic actors in the transition away from the traditional university model. In this context, universities have restructured their management practices by implementing innovation policies and processes focused on commercialization and technology transfer, while emphasizing the importance of internal and external capacity building and stakeholder engagement. This positioning of universities becomes evident when examining the data presented in Graph 2.

Box 1 – Systems identified through INPI and Google searches

INPI Registration Year	Does Not Involve NIT Management	Involves NIT Management	Total
2015	0	1	1
2016	0	2	2
2019	0	2	2
2020	1	2	3
2022	2	4	6
2023	0	5	5
2024	1	7	8
2025	2	8	10
Not Registered with INPI	0	2	2

Source: Prepared by the authors of this article based on searches conducted in the INPI database and Google (2025)

Graph 1 – Systems owned by government entities



Source: Prepared by the authors (2025)

As part of a deeper analysis of the identified solutions, Graph 3 presents an examination of the programming languages registered for the systems identified through INPI and Google searches. A predominance of technologies associated with web development can be observed, particularly CSS, JavaScript, Ajax, and PHP. It is also noteworthy that, although MySQL and PostgreSQL are Database Management Systems (DBMSs), both were registered with INPI as programming languages associated with the analyzed solutions (Pires; Nascimento; Salgado, 2006).

Research in the field of intellectual property management is still in a consolidation phase due to the relative novelty of the subject. Nevertheless, it is essential to recognize that the management of intangible assets, the development of protection strategies, and the establishment of a qualified team are critical elements for achieving superior performance (Alves et al., 2020).

Governance within Technology Innovation Centers (NITs) is a multifaceted concept that is essential for the effective management of innovation within Science,

Technology, and Innovation Institutions (ICTs). The absence of a comprehensive and accurate evaluation model can directly affect the implementation of innovation policies and the ability to demonstrate the effectiveness of NIT activities (Santos et al., 2020). Its application can be analyzed through different complementary frameworks, with particular emphasis on:

a) Public Governance: Applicable to NITs within public ICTs, encompassing principles such as responsiveness, integrity, reliability, internal control, and transparency.

b) IT Governance: Particularly relevant due to the increasing informatization of NIT activities, employing maturity models and frameworks such as COBIT 5 and ISO 38500.

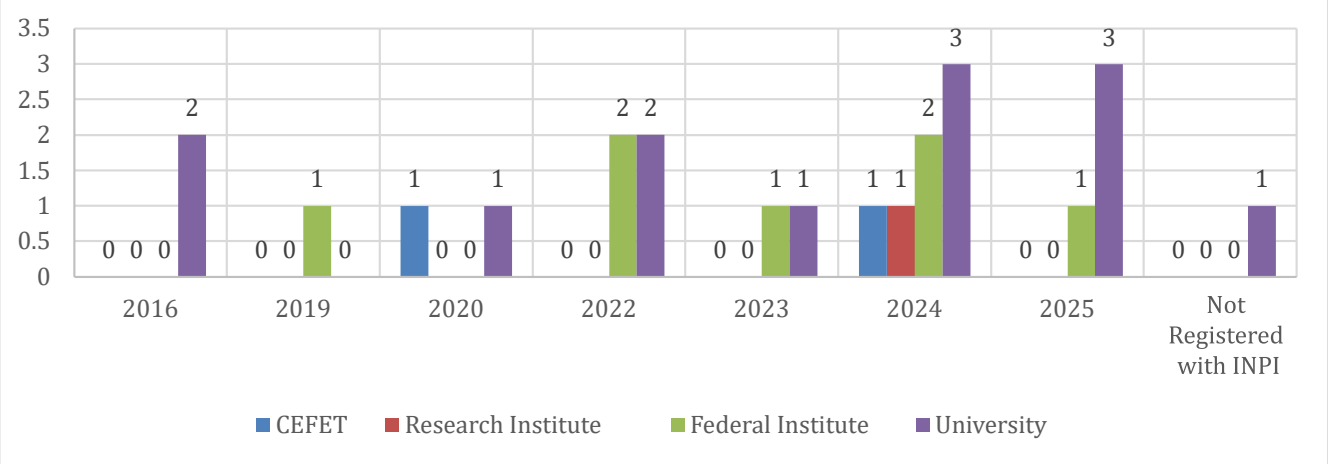
c) Adaptive Governance: Emphasizes collaboration, self-organization, and flexibility within complex ecosystems such as innovation environments.

d) Innovation Policy Governance: Focuses on institutional arrangements and policy instruments that shape innovation processes.

e) IFAC/CIPFA Framework: A practical framework composed of seven principles, namely integrity, openness, sustainable outcomes, optimization of interventions, capacity building, risk and performance management, and transparency. This framework has already been applied in studies involving Brazilian NITs.

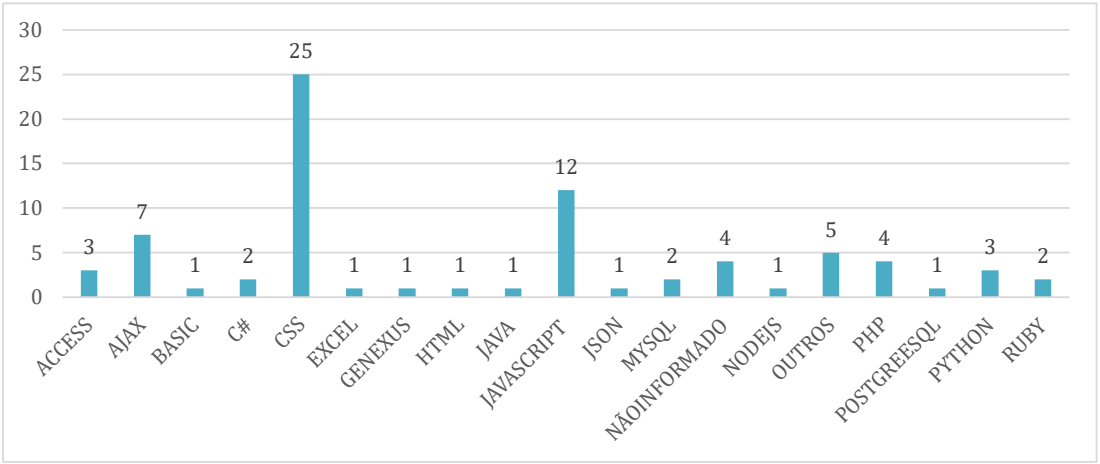
Machado, Fabris, and Nicoleit (2023, p. 1) analyzed 15 studies related to governance models applied to Brazilian Technology Innovation Centers (NITs) and concluded that "[...] there is no standard governance system for Technology Innovation Centers." Therefore, each NIT tends to place greater emphasis on specific governance processes. Figure 1 illustrates the common elements identified among the principal governance processes applied to NITs.

Graph 2 – INPI-Registered management systems by type of government institution



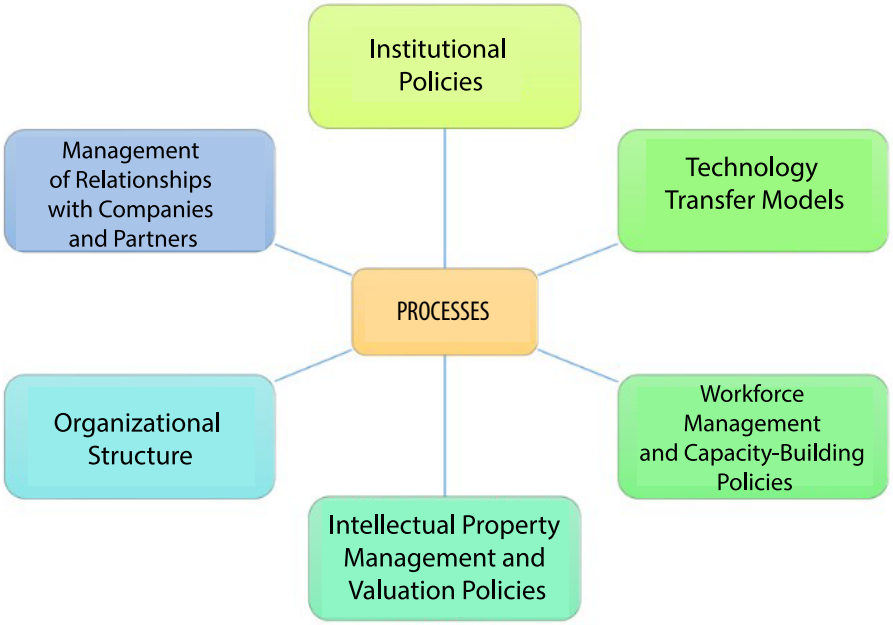
Source: Prepared by the authors (2025)

Graph 3 – Types of programming languages registered in NIT management systems



Source: Prepared by the authors (2025)

Figure 1 – Examples of governance processes applied to NITs



Source: Machado, Fabris e Nicoleit (2023)

To assess governance effectiveness, specific indicators are required, which can be classified as quantitative or qualitative. Quantitative indicators measure the inputs, outputs, and outcomes of NIT activities. In contrast, qualitative indicators seek to capture good governance practices in a broader and more subjective manner. Box 2 presents selected examples of governance indicators.

Measuring governance, however, presents several challenges. Box 3, for example, highlights a series of key indicators that support this assessment. The lack of standardized indicators, the cost and complexity associated with the systematic collection of data, institutional resistance to transparency, and the difficulty of measuring qualitative aspects are among the main barriers

Box 2 – Governance indicators for NITs

Quantitative Indicators	Qualitative Indicators
Structure/Resources: Number of staff members, qualifications, budget, and sources of revenue. Processes/Activities: Number of invention disclosures, IP applications (filed/granted), agreements (technology transfer and R&D&I), spin-offs created, and events organized. Results/Impact: Licensing revenue (total or average), licensing rate, percentage of agreements generating revenue, active spin-offs, and equity participation. Efficiency**:** Average time (IP filing, contract execution), average cost (IP filing), and conversion rate (invention disclosure → IP application filing).	Transparency: Publication of reports, clarity and accessibility of information, and communication channels. Internal Control: Audits, formal performance evaluations, clarity of roles and responsibilities, and accountability mechanisms. Compliance and Ethics: Adherence to the Legal Framework for Science, Technology, and Innovation, code of ethics, and whistleblowing/reporting channels. Perceived Efficiency and Effectiveness: User satisfaction, perceived agility, and clarity of procedures. Participation and Responsiveness: Feedback channels, quality of NIT-researcher relationships, and responsiveness capacity. Strategic Management and Risk Management: Formal strategic planning, alignment with the Institutional Development Plan (PDI), and risk management processes. Integrity and Organizational Culture: Perceived ethical commitment and a culture of innovation and collaboration. Institutional Capacity: Adequacy of training programs and perceived competencies of the NIT team. Policy Implementation**:** Degree of implementation and perceived quality of innovation policies.

Source: Prepared by the authors (2025)

encountered. Overcoming these challenges is essential for NITs not only to demonstrate their value but also to improve their practices and strengthen innovation management in a strategic and responsible manner.

As shown in Box 3, there is a robust set of quantitative indicators that measure institutional capacity, performance, and effectiveness, including the number of staff members, team qualifications, the number of licensing agreements executed, and the revenue generated. These indicators are essential because they provide an objective view of NIT outcomes and impacts, enabling performance comparisons across different institutions. The inclusion of efficiency indicators, such as the licensing rate, is particularly relevant for assessing the NIT's ability to transform protected intellectual property into transferred technology, moving beyond the simple counting of patent filings.

On the other hand, Box 4 highlights the critical importance of qualitative indicators, which capture good governance practices that are often overlooked in NIT evaluations. Measuring transparency through the publication of reports, for example, is fundamental to ensuring visibility of the center's activities and outcomes, while the existence of a formal strategic plan helps guide actions toward long-term objectives. The inclusion of indicators such as user satisfaction levels and the implementation of risk management processes demonstrates a concern with responsiveness, perceived effectiveness, and institutional resilience, dimensions that quantitative data alone cannot adequately capture.

Within this context, several solutions specifically developed to support Technology Innovation Centers (NITs) were identified and are presented in Box 4.

Despite their benefits, the implementation of information systems faces considerable limitations and challenges. One of the primary issues is system fragmentation, as the use of isolated tools hinders an integrated view of operations and the consolidated collection of data. Another critical concern is that many systems tend to prioritize operational tasks at the expense of governance indicator monitoring, thereby limiting their strategic contribution. Furthermore, the quality of the data entered is a determining factor for system reliability. The implementation of robust systems also requires financial resources and qualified personnel, which may constitute significant barriers. Finally, cultural and organizational resistance to change processes and transparency may impede the effective adoption of new tools.

Box 3 – Key governance indicators for NITs

Indicator	Type	Governance Dimension	Reference Source/ Framework	Relevance to NITs
Number of Staff Members	Quanti	Institutional Capacity	Fortec	Measures the workforce structure available to perform NIT functions.
Team Qualifications (% PhDs, Master's Degree Holders, Profnit Graduates)	Quanti	Institutional Capacity	Fortec	Indicates the level of technical and managerial expertise of the team.
Number of IP Applications Filed/Granted	Quanti	Performance/ Effectiveness (Output)	Fortec	Measures the intellectual property protection activity generated by the ICT.
Number of Licensing/ Assignment Agreements Executed	Quanti	Performance/ Effectiveness (Output)	Fortec	Measures technology transfer activity through contractual agreements.
Licensing Revenue	Quanti	Performance/ Effectiveness (Outcome)	Fortec	Measures the direct financial return generated by technology transfer activities.
Licensing Rate (% of Licensed IP Assets)	Quanti	Performance/ Effectiveness (Outcome)	Fortec	Indicates the efficiency of converting protected intellectual property into transferred technologies.
Number of Spin-offs Created/Operating	Quanti	Performance/ Effectiveness (Outcome)	Fortec	Measures the impact on technology-based entrepreneurship

Indicator	Type	Governance Dimension	Reference Source/ Framework	Relevance to NITs
Publication of Activity Reports and Performance Indicators	Quali	Transparency, Internal Control	IFAC/CIPFA (Practice G), Public Governance	Ensures visibility of the NIT's activities and results.
Conduct of Internal/ External Audits	Quali	Internal Control, Internal Control	IFAC/CIPFA (Practice G)	Assesses the compliance and efficiency of processes and control mechanisms.
Existence of a Formal Strategic Plan	Quali	Strategic Management	IFAC/CIPFA (Practice C, D), FORTEC	Guides NIT activities toward achieving long-term objectives aligned with those of the ICT
User Satisfaction Level (Researchers/ Companies)	Quali	Responsiveness, Perceived Effectiveness	IFAC/CIPFA (Practice B), Study	Measures the quality of services from the perspective of key stakeholders.
Clarity and Accessibility of Institutional Information	Quali	Transparency, Openness	IFAC/CIPFA (Practice B, G)	Facilitates engagement with and access to NIT services.
Implementation of Risk Management Processes	Quali	Risk Management, Internal Control	IFAC/CIPFA (Practice F) , Public Governance	Enhances resilience and the ability to anticipate potential challenges.
Compliance with the ST&I Legal Framework	Quali	Legal Compliance	IFAC/CIPFA (Practice A)	Ensures that the NIT operates in compliance with essential legal and regulatory requirements.

Source: Prepared by the authors (2025)

The heterogeneity of NITs in Brazil is a factor that directly influences both the capacity to adopt information systems and the implementation of governance practices. Studies conducted by Fortec indicate that larger and more mature NITs generally possess more robust internal systems and more formalized governance structures, whereas smaller or more recently established NITs tend to rely on simpler tools and exhibit less structured governance practices. This disparity is largely attributable to shortages of qualified personnel and limited financial and human resources, which constrain investments in technology and governance structures, thereby perpetuating heterogeneity and the challenges faced by the sector.

4 Final Considerations

The analysis of informatization and governance within Brazilian Technology Innovation Centers (NITs), based on the collected sample, reveals a complex and notably heterogeneous landscape. Although NITs play a crucial role in innovation management and technology transfer, the manner in which their activities are managed varies considerably across institutions. Informatization ranges from highly customized internal systems in large ICTs to the use of generic tools or spreadsheets in smaller institutions, highlighting a gap in the availability of specialized and affordable commercial solutions. Governance, in turn, is widely recognized as essential but remains underdeveloped in many practices, particularly regarding qualitative dimensions, with many NITs placing greater emphasis on intellectual property protection than on the effectiveness of technology transfer activities.

The relationship between technology and management is clear and interdependent. Well-designed information systems can strengthen governance by providing greater traceability, process standardization, and robust support for decision-making. However, this potential is constrained by challenges such as system fragmentation, the need for financial and technical resources for implementation, and cultural resistance to change and transparency. The heterogeneity of NITs, as highlighted by Fortec studies, further amplifies these difficulties, with more established centers demonstrating greater maturity both in system adoption and in the formalization of governance practices.

The principal challenges identified are associated with the need for integrated and affordable software platforms, the standardization of processes, and the definition of qualitative governance indicators. Additional challenges

include deficits in multidisciplinary staff training and limitations in financial and human resources, which restrict investments in technology and governance structures. For NITs to overcome these barriers and demonstrate their strategic value, it is essential that innovation stakeholders and managers pursue solutions that not only optimize operational activities but also provide a solid foundation for transparent and effective governance.

Box 4 – Solutions for the Management of Technology Innovation Centers

Year	Title	Article Objective	Research Findings and Contributions
Brito e Santos (2022)	Technological Mapping of Intellectual Property Management Software and SWOT Analysis for the Development of a New Technology.	To obtain a diagnosis of the computer programs available for innovation management by NIT managers.	The study identified 12 registered computer programs related to intellectual property management, most of which originated from academic institutions. However, the functionalities offered by these programs do not adequately meet the actual needs of NITs.
Pereira e Santos (2023)	Proposal for the Development of an Application Based on the Demand Readiness Levels Method to Support the Selection of Patent Applications in Technology Innovation Centers (NITs).	To develop a mobile application based on the Demand Readiness Levels (DRL) methodology to assist NITs in selecting new patent applications.	The Intellectual Property Assistant Meter (MAPI) application was developed as a tool to increase the efficiency of NITs in the selection of patent applications by assessing the maturity level of each demand.
Teles et al. (2023)	Development of an Intellectual Property Management System for Science and Technology Institutions.	To present the SIGPPI system, designed to manage IP information within an ICT, thereby facilitating the analysis and search for technologies.	The SIGPPI system was developed using the Python Django framework and the MariaDB database management system. It is capable of automatically extracting, cleaning, and organizing semi-structured data from the INPI Official Gazette. The system's primary contribution lies in its integration with INPI and its ability to filter and organize data related to office actions and fee payments, thereby reducing human error and the time required for manual management
Araujo e Vilela (2023)	Digital Tools to Support Intellectual Property Management for Startups	To analyze existing digital tools for intellectual property management worldwide, identifying the main intellectual property and IP management aspects addressed by each solution.	The main aspects of IP management addressed by the tools are intellectual property asset portfolio management and the assessment of new knowledge for decision-making, both of which are present in most of the tools analyzed.
Correia e Santos (2024)	Development of a Web-Based System for the Management of Technology Innovation Centers (GNIT)	To propose a web-based management system for Technology Innovation Centers, called GNIT, with the objective of supporting staff members and automating a significant portion of routine activities, particularly those related to intellectual property governance.	The GNIT system emerged as a proposal to address this gap by offering software designed to automate and optimize routine activities performed by NITs. The technological prospecting identified similar products, but all of them were commercial in nature. GNIT was developed on demand, initially for the NIT of the Federal Institute of Alagoas (IFAL), with the aim of operating within a local institutional context.

Year	Title	Article Objective	Research Findings and Contributions
Lisboa, Melo e Rocha (2025)	Technological Prospecting of Software to Support the Activities of Innovation Agents in Technology Innovation Centers (NITs)	To prospect software solutions that support Innovation Agents in activities related to technological prospecting, intellectual property registration, and technology transfer processes.	The technological prospecting identified 48 software programs focused on intellectual property, 52.08% of which were owned by universities and federal institutes; however, none were easily available for use. The high turnover of innovation agents and the geographical distance between NITs and campuses were identified as bottlenecks for management.
França e Da costa (2025)	Development of a Web-Based Mechanism for Intellectual Property Management at Unitins	To develop an intellectual property management software focused on computer programs at the State University of Tocantins (Unitins). The objective is to meet the institution's needs in managing intellectual assets, thereby strengthening the regional innovation ecosystem.	The web platform simplifies the process of registering computer programs and managing intellectual property, contributing to informatization and the democratization of access to these tools.

Source: Prepared by the authors (2025)

5 Future Perspectives

The complexity of the topics addressed in this study points to numerous and valuable opportunities for future research. Conducting multiple and in-depth case studies would be particularly valuable for analyzing how different NITs, with varying levels of informatization and governance maturity, have implemented their systems and management practices. Such studies could identify critical success factors and achieved outcomes, providing practical insights for other Technology Innovation Centers.

Furthermore, the development of large-scale quantitative studies using data from sources such as the Fortec Innovation Survey could test hypotheses regarding the relationship between specific levels of informatization and both performance and governance indicators.

Other promising avenues for investigation include analyzing the impact of adopting agile methodologies and project management approaches based on frameworks such as PMBOK on the efficiency and governance of NITs, particularly in the management of Research, Development, and Innovation (R&D&I) projects.

Finally, a particularly relevant topic for future studies is the analysis of the specific role of Customer Relationship Management (CRM) systems in improving NIT interactions with researchers and companies, as well as their impact on the effectiveness of technology transfer processes.

These research perspectives may contribute significantly to the theoretical and practical advancement of innovation management and governance in Brazil.

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