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Kingdom of the Netherlands

The Brazilian Landscape of Science, Technology and Innovation in Artificial Intelligence

Center for Strategic Studies and Management
Science, Technology and Innovation

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A social organization supervised by the Ministry of Science, Technology, and Innovation (MCTI)

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Foreword

The Netherlands Innovation Network, part of the Ministry of Economic Affairs of the Netherlands, actively works on the bilateral relationship on science, technology and innovation between the Netherlands and Brazil. As a part of this mandate, it actively seeks to work with key Brazilian stakeholders to investigate the scientific, technological, and innovative developments in key technology areas in Brazil. One of those areas is Artificial Intelligence and as head of the Netherlands Innovation Network in Brazil I am happy that we have chosen to develop a partnership with the Center for Strategic Studies and Management (CGEE) to do a landscape mapping of the current policy, R&D and innovation developments in Brazil in Artificial Intelligence. The resulting report will undoubtedly contribute to the further development of the science, technology and innovation relationship between the Netherlands, Europe and Brazil.

Robert Thijssen

Counselor for Innovation, Technology and Science

for the Netherlands in Brazil

Disclaimer

This work was commissioned by the Netherlands Innovation Network in Brazil and conducted by the Center for Strategic Studies and Management (CGEE), a social organization supervised by Brazil's Ministry of Science, Technology, and Innovation (MCTI). The analysis, findings, and conclusions presented herein are based on independent research and do not necessarily reflect the views of the commissioning entity or of the MCTI.

The Brazilian Landscape of Science, Technology, and Innovation in Artificial Intelligence

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1. Introduction

Scientific progress is founded on transparency, inclusivity, and connectivity. By democratizing access to knowledge and fostering international collaboration, science transcends traditional barriers to information exchange. In this context, a strategic assessment of Brazil's scientific and technological capabilities reveals significant opportunities to establish international partnerships, allowing the country to leverage its strengths in a globally interconnected research landscape.

This report aims to assess the possibilities for international research cooperation with Brazil in the strategic area of artificial intelligence. This assessment evaluates opportunities through three key dimensions: policy and regulation, public and private investments, and research, development, and innovation (which includes regional RD&I centers overview, patent analysis, graduate research, and scientific paper analysis).

Brazil possesses a dynamic AI scientific community, particularly in life sciences, environmental sciences (including energy), finance, and mining. However, limited research infrastructure and constrained funding can impede innovation. Internationally, Brazil can benefit from partnerships with nations that excel in research infrastructure, open science practices, and public-private collaborations. Global innovation leaders emphasize transparency, collaboration, and knowledge dissemination – practices that can complement Brazil's emerging capabilities.

Modern innovation ecosystems rely on the interplay between scientific research, academic institutions, and corporate innovations. Research conducted within universities and research centers generates foundational knowledge that drives technological advancements while businesses translate these discoveries into market-ready applications. This relationship is not linear but reciprocal, with feedback loops continuously refining the innovation cycle. Academic institutions serve as catalysts in this process, training skilled professionals and facilitating knowledge transfer between research and industry.

Brazil's AI landscape can be viewed through three strategic lenses (Figure 1): its position as Latin America's emerging AI development hub, the comprehensive assessment of its capabilities across policy, investment, and R&D dimensions, and the growing potential for regional leadership in AI innovation. This multifaceted approach provides a framework for understanding Brazil's current strengths and identifying promising opportunities for international collaboration that can accelerate its AI development trajectory.

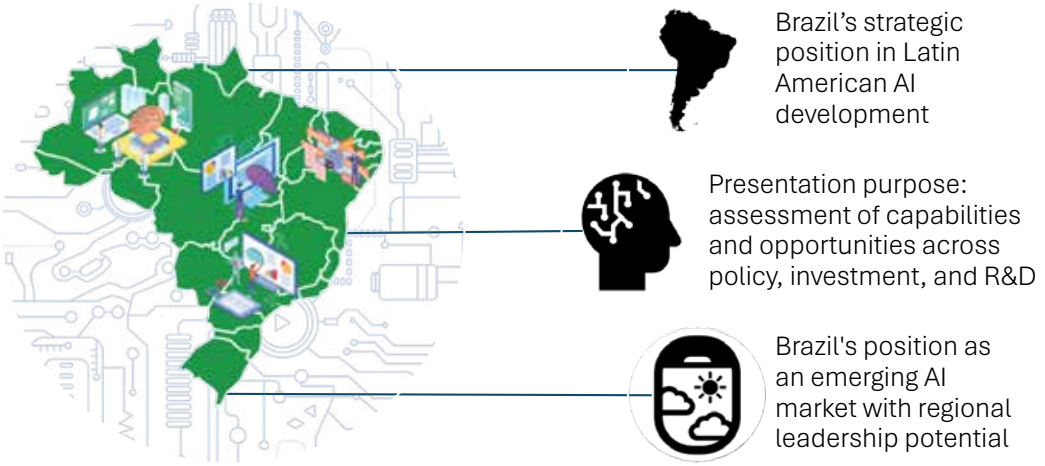

Figure 1. Brazil's AI Landscape: Report Context and Objectives

This study employs a comprehensive methodological approach to assess Brazil's AI landscape across multiple dimensions. We analyze policy documents and regulatory frameworks to understand the governance environment, compile investment data from both public and private sources to quantify financial commitments, and examine academic production through postgraduate research, scientific publications indexed in Web of Science, and patent filings registered with INPI and documented in the Derwent database. This multi-dimensional assessment provides a robust foundation for evaluating Brazil's capabilities, identifying strategic strengths, and pinpointing opportunities for productive international collaboration. By integrating insights from policy, investment, and research dimensions, we can construct a more nuanced understanding of Brazil's position in the global AI ecosystem and its potential for growth through targeted partnerships.

2. AI Policy and Regulation in Brazil

2.1. The Evolution of Brazil's AI Legislation

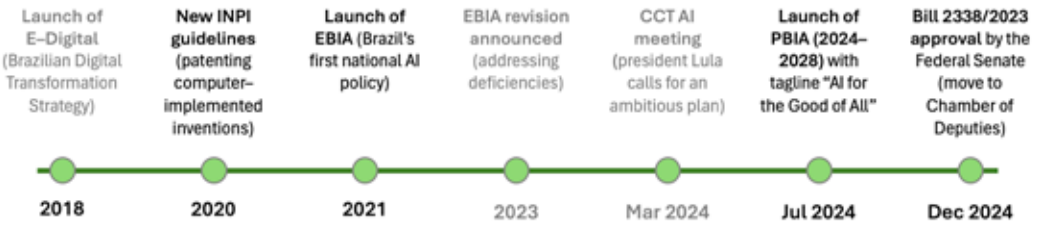

Figure 2. The Evolution of Brazil's AI Legislation in the Past Five Years

Brazil has made significant progress in formulating public policies and building a regulatory framework for artificial intelligence, seeking to balance incentives for technological innovation with the protection of fundamental rights and the promotion of social welfare. The timeline in Figure 2 shows that Brazil's AI policy development has accelerated in the past five years, with several key milestones.

The first significant step was the launch of the Brazilian Strategy for Digital Transformation (E-Digital) in 2018, which pointed to the importance of addressing AI as a priority for the country. This was followed in 2020 by the new INPI guidelines for patenting computer-implemented inventions, which established more explicit parameters for AI-related intellectual property protection (see subsection 2.2).

In 2021, the Brazilian Artificial Intelligence Strategy (EBIA) was published as the first public policy dedicated exclusively to developing artificial intelligence in Brazil. EBIA aimed to boost the development and use of artificial intelligence to promote scientific progress and solve tangible problems in Brazil. The strategy was built through a participatory process, with public consultation with society. It was drawn up by the Ministry of Science, Technology and Innovation (MCTI) in partnership with other government bodies.

By 2023, recognizing EBIA's limitations, the MCTI announced a strategy revision. However, this revision was subsequently paused when, in March 2024, during a meeting of the National Science and Technology Council (CCT), President Lula called for the establishment of a more comprehensive Brazilian AI Plan (PBIA).

In July 2024, the PBIA – dubbed "AI for the Good of All" – was officially presented during the 5th National Conference of Science, Technology and Innovation opening, covering the strategic period from 2024 to 2028. In December 2024, Bill 2338/2023, also known as the AI Legal Framework, was approved in the Federal Senate and moved to the Chamber of Deputies for deliberation in January 2025.

2.2. Brazil's Approach to AI Patentability

Regarding the patentability of AI in Brazil, the legal framework is defined by the Brazilian Industrial Property Law (Law No. 9,279/1996), which explicitly excludes software per se from patent protection. However, AI-related inventions can be patented under specific conditions. The Brazilian Patent and Trademark Office (INPI) has established guidelines indicating that AI techniques like machine learning and deep learning may qualify for patent protection when they are applied to solve specific technical problems.

This means that while abstract algorithms or purely computational models cannot be patented, AI applications that produce a concrete technical effect or contribute meaningfully to a technical field may be eligible for protection. Recent INPI decisions have emphasized the requirement for this technical effect, indicating that AI implementations must be both innovative and non-obvious to meet the threshold for inventiveness.

Examples of patentable AI applications include methods for filtering seismic data to reduce noise, systems for controlling vehicle or robot movement, data compression methods using AI, AI for signal processing of electrocardiographic data, AI for optimizing memory access and hardware usage, and AI cryptography methods. Conversely, abstract AI algorithms and mathematical methods, AI software code itself (which is protected by copyright instead), AI for business methods, accounting, or finance, AI presentations of information without technical effect, and AI for therapeutic or diagnostic methods applied directly to humans or animals are not patentable in Brazil.

The INPI is currently developing specific rules for the eligibility and patentability of AI-related inventions, with publication expected in 2025.

2.3. The Brazilian Artificial Intelligence Strategy (EBIA)

EBIA was the first comprehensive AI policy in Brazil but was met with strong criticisms. As a strategy, it included 74 strategic actions along three vertical and six horizontal axes, with the premise of stimulating research, innovation, and development, promoting the conscious and ethical use of AI, and solving concrete problems in Brazil. The vision was to transform Brazil's economic and social structures through ethical AI development.

However, EBIA faced substantial criticism from experts in technology, digital law, and public policy since its announcement in 2021. Key concerns included its overly broad conceptual approach, failure to align with Brazil's technological and economic strengths, inadequate public consultation, absence of concrete governance and implementation frameworks, and insufficient integration of ethical safeguards.

Critics described the EBIA as a strategy in name only – marked by abstraction, weak execution plans, and a disconnect from national priorities. The absence of clear governance mechanisms, sectoral priorities, and actionable steps rendered the plan more aspirational than operational. As a result, in 2023, MCTI announced a revision of EBIA (supported by the CGEE).

2.4. AI for the Good of All: The Brazilian AI Plan (PBIA)

In 2024, following President Lula's challenge issued on March 8 during a meeting of the National Science and Technology Council (CCT), work began on developing a more ambitious AI strategic plan. During this CCT meeting, which Lula personally presided over, he called for the creation of a comprehensive AI Plan that would be tailored to the Brazilian context and benefit all Brazilian citizens. In response, the MCTI, providing executive support to the CCT, led the development of the Brazilian Artificial Intelligence Plan (PBIA) proposal, working with various ministries and the Civil Office of the Cabinet of the President. This comprehensive plan – dubbed AI for the Good of All – was officially presented during the opening of the 5th National Conference of Science, Technology and Innovation in July 2024, covering the strategic period from 2024 to 2028.

The Brazilian AI Plan (PBIA) – or "AI for the Good of All" – improved upon EBIA in several ways. Developed while EBIA was under revision, PBIA features a more concrete and actionable focus, streamlined from 9 to 5 structural axes, and provides a stronger governance framework with better alignment with national technological strengths.

The PBIA aims to promote the development, availability and use of AI in Brazil, geared towards solving major national challenges. The Plan includes 54 structuring actions for the development of AI, as well as 27 actions with an immediate impact. Unlike EBIA, there are only 5 structuring axes: (i) AI infrastructure and development; (ii) diffusion, training and capacity building in AI; (iii) AI for improving public services; (iv) AI for business innovation; and (v) support for the AI regulatory and governance process. The plan was developed through a participatory process, with workshops and meetings involving civil society and various key players in decision-making. It is an inter-ministerial policy that mobilizes ministries such as the Ministry of Management and Innovation in Public Services (MGI), the Ministry of Development, Industry, Trade and Services (MDIC), the Ministry of Health, the Ministry of Education, among others.

PBIA's vision is to equip Brazil with advanced technological infrastructure, train and qualify AI professionals on a large scale, promote Brazil's global presence in AI, and develop advanced language models with national data to strengthen AI sovereignty.

Although EBIA and PBIA are the only national policies focused exclusively on artificial intelligence, the topic is covered in other government documents and plans, reflecting this technology's interdisciplinary and cross-cutting relevance. The Brazilian Strategy for Digital Transformation (2018-2026), for example, highlights the need to stimulate research, development and innovation (RD&I) in artificial intelligence as an essential pillar for the country's digital transformation. In addition, the New Industry Brazil (NIB) program defines generative artificial intelligence as an investment priority in its mission No. 4 – Industry Digital Transformation to Increase Productivity. The Digital Government Strategy (2020-2022) prioritized implementing AI resources to improve federal public services, focusing on efficiency and quality of service to the population. The Federal Development Strategy for Brazil (2020-2031) underlines the strategic role of artificial intelligence, along with other digital technologies, as an engine to boost economic growth, improve public services and promote innovation. As a result, artificial intelligence is being consolidated as a theme in various government initiatives.

2.5. The AI Legal Framework

Bill No. 2338/2023, which was approved by the Senate in December 2024 and moved to the Chamber of Deputies, seeks to establish a regulatory framework for artificial intelligence in Brazil. This AI Legal Framework is built on several fundamental principles, including a human-centered approach, respect for human rights, equality and non-discrimination, personal data protection, transparency and explainability, and security and reliability.

The bill defines the roles of "agents of AI" (developers and system operators), setting obligations such as risk assessments and accountability for damages caused by their applications. Its objectives include protecting fundamental rights, fostering responsible innovation and competitiveness, ensuring the implementation of secure and reliable systems, and supporting scientific, technological, and economic development.

The AI Legal Framework includes governance features such as clear accountability for damages and standardized documentation requirements. It also aligns with frameworks like the General Data Protection Law (LGPD) and the Internet Civil Code. It's important to note that, in addition to Bill 2338/2023, other bills addressing AI regulation and governance in Brazil are under discussion, such as Bill 21/2020 and Bill 759/2023. However, Bill 2338/2023 is the most advanced regarding discussion and approval.

2.6. State-Level AI Initiatives

While there are no formalized state-level AI plans yet, AI initiatives are emerging across the Brazilian federation. Notably, Piauí became the first state with a dedicated AI Secretariat (SIA), establishing the Secretariat of Artificial Intelligence and Digital Economy. São Paulo has launched a pilot project using AI to update teaching materials through the State Department of Education (Seduc-SP), and Minas Gerais has developed the Automatiza.MG strategic project, which uses AI to automate civil servant processes.

These state-level initiatives reinforce the potential of AI as a strategic tool for regional development. As national policies mature, states are expected to develop tailored AI strategies to address regional technological and economic differences, growing state-level recognition of AI as a strategic tool, and aligning with federal initiatives while addressing local needs.

2.7. Concluding Remarks on AI Policy and Regulation in Brazil

Brazil is making significant progress in artificial intelligence through national strategies, regulatory frameworks, and expanding state-level initiatives. With policies like EBIA and PBIA guiding AI development and Bill 2338/2023 shaping its governance, the country is balancing innovation with ethical implementation. As AI becomes central to digital transformation, Brazil is positioning itself to advance technological capabilities, economic growth, and social development while safeguarding fundamental rights. These policy and regulatory frameworks are being translated into concrete public and private investments in AI nationwide.

3. Public and Private Investments in AI in Brazil

In terms of investment, the main public financial instrument to support AI projects in Brazil is the National Fund for Scientific and Technological Development (FNDCT), which finances high-impact innovative projects and is operated by agencies such as FINEP and CNPq (both of which also contribute their own funding to AI financing activities). Public calls and funding programs have been used to select and support initiatives from companies, startups, and research centers operating in the field.

Brazil has made a substantial investment commitment to artificial intelligence development since 2021, with approximately R$24 billion allocated between 2021 and 2028 (Figure 3). This comprehensive financial approach balances long-term infrastructure development with market-responsive innovation initiatives.

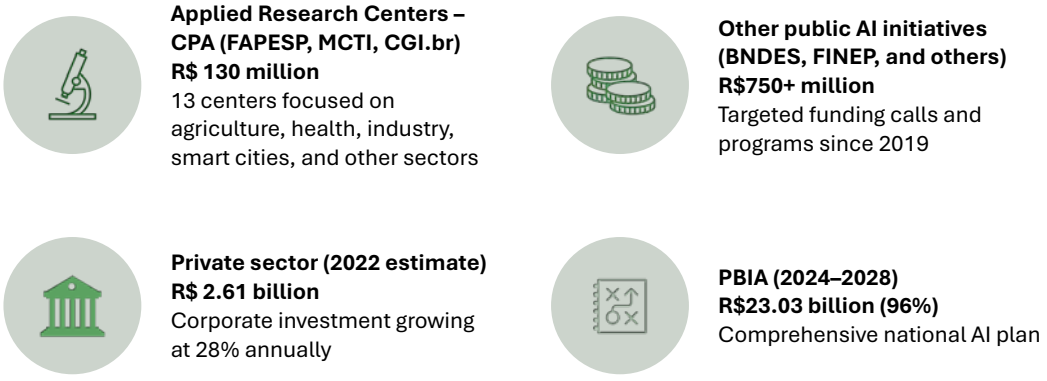

Figure 3. Overview of Brazil's R$24 billion Commitment (2021–2028) to AI

3.1. EBIA's key outcome: the Applied Research Centers in AI (CPAs)

Although EBIA was not an operational or budgetary program that directly provided resources, credit, or financing, it was a strategy to guide and coordinate existing policies and instruments within Brazil's innovation and science and technology ecosystem. In this context, one concrete outcome of EBIA was the creation of eight Applied Research Centers (CPAs) in Artificial Intelligence, focusing on areas such as Agriculture, Health, Industry, and Smart Cities. The total investment amounted to R$ 160 million in research centers, distributed over 10 years.

Therefore, CPAs represent a significant component of Brazil's AI strategy, connecting academic research to industry needs and public policy priorities. These centers feature 10-year funding commitment from FAPESP, MCTI, and CGI.br, providing long-term research stability through partnerships between academia, industry, and government. They focus on both fundamental research and practical applications while developing AI solutions tailored to Brazilian strategic priorities and training specialized AI researchers and professionals.

The CPAs concentrate on strategic sectors including agriculture (AI solutions for precision farming, crop monitoring, and agricultural productivity), health (AI applications for diagnostics, treatment planning, and healthcare management), industry (smart manufacturing, predictive maintenance, and industrial automation), smart cities (urban mobility, utilities management, and public services optimization), and other multidisciplinary areas such as cybersecurity, AI fundamentals, renewable energy, and education.

3.2. PBIA's investment commitments

3.2.1. PBIA's funding approach

The Brazilian AI Plan (PBIA) has a total investment of R$ 23.03 billion from various funding sources. Of the total R$ 23 billion allocated in the PBIA, approximately R$ 13 billion (or 55%) will be offered as credit through FINEP and BNDES. Another R$ 5.75 billion (25%) will come from non-reimbursable funds provided by the FNDCT. In comparison, around R$ 3 billion (13%) is expected to originate from the federal public budget through the Annual Budget Law (LOA), to be voted on by the National Congress. Private sector participation is also expected, with direct investments estimated at 4% of the total and the raising of credit through FINEP and BNDES. The remaining 3% is expected to be financed from other sources. This funding approach is notable for its limited reliance on traditional public budget allocations, instead leveraging protected funding streams and credit instruments to ensure the sustainability of the AI development ecosystem.

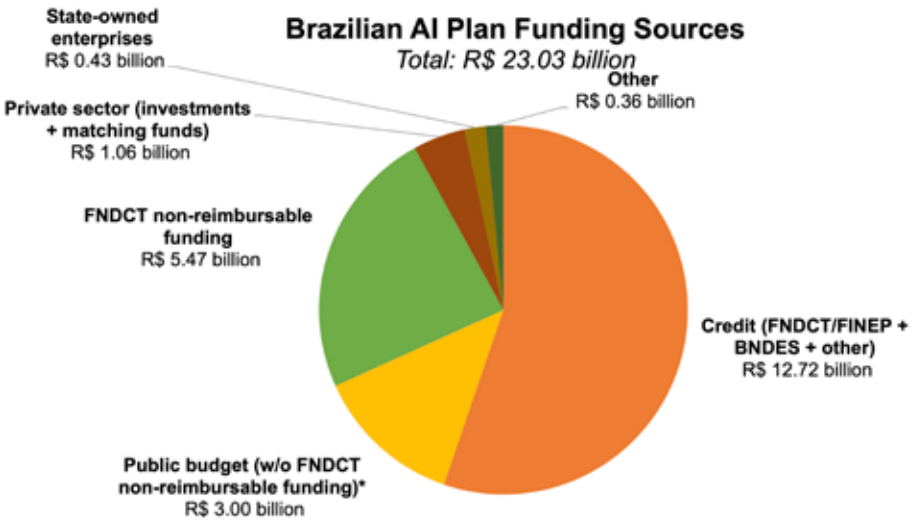

Figure 4. PBIA's Funding Approach

While PBIA incorporates demand stimulation for AI, it primarily relies on traditional supply-side funding instruments administered through the National Fund for Scientific and Technological Development (FNDCT), such as:

- Investments in innovation infrastructure;
- Support for research networks, technology services, and extension programs;
- Scholarships for researchers and specialist training;
- Programs such as the National Institutes of Science and Technology (INCTs);
- Special credit lines for R&D with reduced interest rates.

Most of PBIA's funding is managed by FINEP, which oversees the National Fund for Scientific and Technological Development (FNDCT), distributing resources through two main channels:

- Reimbursable funds (loans) – Special financing for companies
- Non-reimbursable funds – Support for non-profit scientific and technological institutions focused on infrastructure projects and capacity building

In addition, FINEP also provides economic subsidies for companies seeking to innovate in high-risk technologies with significant market impact.

3.2.2.PBIA priorities: budget allocation across strategic axes

The PBIA budget allocates R$ 23.03 billion across five strategic axes and immediate impact actions, with the largest portions dedicated to business innovation and AI infrastructure and development (Figure 5).

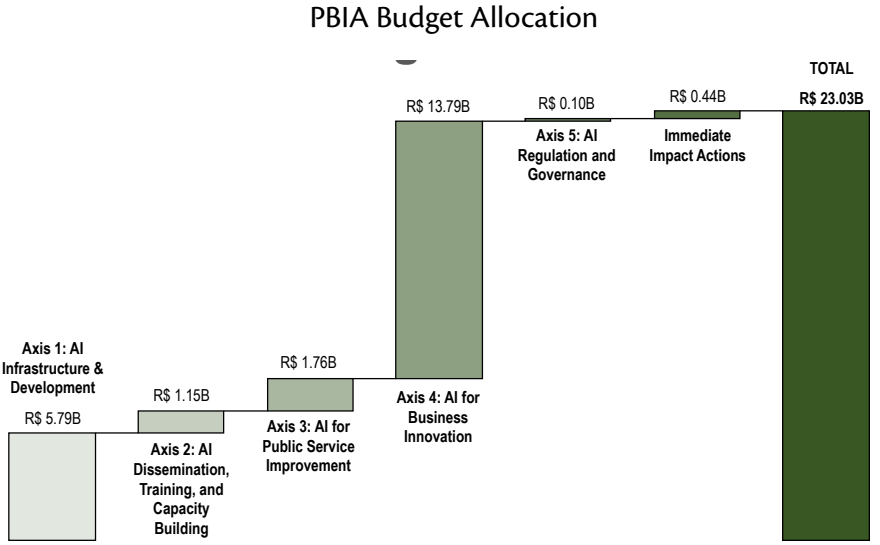

Figure 5. PBIA Budget Allocation Across Strategic Axes

Business innovation represents 60% of total Investments of PBIA (R$ 13.79 billion), followed by AI infrastructure at 25% (R$ 5.79 billion), public sector at 8% (R$ 1.76 billion), training and capacity building at 5% (R$ 1.15 billion), immediate impact actions at 2% (R$ 0.44 billion), and regulation and governance at 0.4% (R$ 0.10 billion).

Considering PBIA's vision, which aims to transform the lives of Brazilians through sustainable and inclusive innovations based on artificial intelligence; equip Brazil with advanced technological infrastructure featuring high processing capacity powered by renewable energy; develop advanced Portuguese-language

models using national data that reflect the country's cultural, social, and linguistic diversity, strengthening AI sovereignty; train, upskill, and reskill people in AI on a large scale to empower workers and meet the high demand for qualified professionals; and position Brazil as a global leader in AI through national technological development and strategic international collaboration, it becomes clear that the axes, along with their respective programs and actions, were designed to align with and fulfill all aspects outlined in this vision.

For structuring advanced technological infrastructure with high processing capacity, key initiatives include acquiring a supercomputer and expanding processing capacity in Brazil's high-performance computing centers, which will position Brazil favorably in the global AI landscape and enhance its ability to conduct research involving artificial intelligence. To ensure sustainability, the Pro-Infra Sustainable AI initiative has been proposed to support dozens of projects in this field. Regarding the second point of the vision, which calls for the development of advanced Portuguese-language models leveraging Brazil's rich and extensive national data to strengthen AI sovereignty, PBIA includes the initiative AI Based on National Data and AI Software Stack Development, which aims to support various stages of this value chain. To establish a structured and accessible national dataset for AI applications, Axis 3 features the National Data Infrastructure Program, which focuses on data cataloging, structuring, integration, and reuse and on the implementation of a Government Sovereign Cloud.

For the training, capacity building, and large-scale reskilling of AI professionals and researchers, PBIA presents initiatives that range from the establishment of AI undergraduate programs to the granting of scholarships for scientific initiation, master's, doctoral, and postdoctoral studies, both in Brazil and abroad (only for doctoral studies). Additionally, the plan includes industry-supported programs aimed at training and reskilling approximately 200,000 Brazilian workers. Among these are traditional MCTI programs, such as Human Resources in Strategic Areas (RHAE) and ICT Residency, both of which include AI-related projects.

To promote Brazil's global leadership in AI through national technological development and strategic international collaboration, the Plan includes various initiatives across its five axes. International partnerships are planned to develop supercomputer nodes, accelerator chips, and collaborations for sharing AI R&D infrastructure. Additionally, cooperation agreements with Latin American and African countries are foreseen to foster R&D activities. Finally, the Plan proposes the establishment of researcher networks to ensure Brazil's qualified participation in the international debate on ethical and responsible AI.

3.2.2.1. Axis 1: AI Infrastructure and Development

Axis 1 consists of four programs totaling approximately R$ 5 billion in investment over the four-year duration of the AI Plan:

a) The National AI Infrastructure Program aims to establish AI infrastructure for the country's research and science institutions. Among the key initiatives, the purchase of a supercomputer stands out, with an investment of R$ 1.9 billion, funded through non-reimbursable resources from FNDCT. Additionally, this program includes the modernization of the National High-Performance Computing Centers (CENAPADs) and the interconnection of supercomputing centers with high-speed networks, estimated at R$ 180 million, also financed with non-reimbursable FNDCT resources. Furthermore, this program promotes international partnerships for the development of supercomputer nodes and accelerator chips and the sharing of AI R&D infrastructure. These two initiatives are expected to receive approximately R$ 180 million in non-reimbursable FNDCT funds and private sector investments.

b) This axis also includes the Sustainability and Renewable Energy Program for AI, which estimates R$ 500 million in investments using non-reimbursable FNDCT resources.

c) The AI Data and Software Ecosystem Development Program foresees approximately R$ 1.4 billion in funding for actions aimed at developing an AI software stack and creating a Portuguese-language LLM based on national data. This program will rely on non-reimbursable FNDCT resources and participation from private companies interested in developing these technologies.

d) Finally, the AI Research and Development Program focuses on fostering AI R&D activities, establishing AI-focused National Institutes of Science and Technology (INCTs) and the National Institute of Informatics with an AI focus, and supporting AI R&D projects in collaboration with South American and African countries. This program is expected to receive R$ 873 million, funded through non-reimbursable FNDCT resources and research funding agencies such as CNPq and CAPES.

3.2.2.2. Axis 2: AI Dissemination, Training, and Capacity Building

Under Axis 2, there are three programs:

a) AI Dissemination and Awareness Program allocates R$ 100 million in non-reimbursable FNDCT resources for initiatives aimed at popularizing AI, including organizing an AI Olympiad.

b) AI Training Program, which foresees an investment of R$ 550 million, with actions focused on opening AI undergraduate programs across the country, providing scholarships for undergraduate, master's, doctoral, and postdoctoral students in AI in Brazil, as well as granting scholarships for Brazilian PhD researchers abroad. This program will be funded through budgetary resources and research agencies such as CNPq and CAPES.

c) AI Professional Training, Qualification, and Reskilling Program, which focuses on professional AI training, involving R$ 500 million in funding from non-reimbursable FNDCT resources, private sector investments, and funding from the ICT Law.

3.2.2.3. Axis 3: AI for Improving Public Services

a) Axis 3 has the National Data Infrastructure as its main program in terms of allocated resources. This program foresees an investment of R$ 1.4 billion, emphasizing the creation of the Government Sovereign Cloud, as well as initiatives for data cataloging, governance, integration, and strategic use.

b) This axis also includes the structuring of the Federal Government AI Center as a second program, a program whose most significant action is the deployment of the Government AI Platform and the experimentation of AI projects within the government, in addition to the training of public servants in artificial intelligence, with an estimated investment of R$ 59 million over the period.

c) Finally, there is the AI Solutions for Public Services Program, with an investment of R$ 260 million, aimed at providing AI solutions for the government in areas such as cybersecurity, enhancement of public procurement, personnel management, federal assets management, and extreme climate forecasting to mitigate societal and economic damage. This axis is characterized by actions primarily funded through budgetary resources, apart from the AI solutions for government and AI for extreme climate forecasting initiatives, financed with non-reimbursable FNDCT resources.

3.2.2.4. Axis 4: AI for Business Innovation

Axis 4 has projected investments of approximately R$ 13 billion, divided into two programs.

a) AI Value Chain Development Program, whose primary initiative is the development of national AI data centers. It also includes support for the AI value chain, assistance for startups and micro and small AI enterprises, human resource training in strategic AI areas and talent retention in the AI sector.

b) AI Program for Challenges in Brazilian Industry, which foresees investments of R$ 9.4 billion, including the creation of a National AI Center for Industry, the development of AI solutions to support Brazil's industrial policy (New Industry Brazil – NIB), and incentives for the adoption of AI in micro and small industrial enterprises to boost productivity.

c) This axis is primarily funded by BNDES and FINEP, using competitive credit instruments and non-reimbursable resources from FNDCT and private sector investments.

3.2.2.5. Axis 5: Support for AI Regulation and Governance

Axis 5 foresees an R$ 100 million investment allocated to two key programs.

a) AI Regulatory Framework Improvement Program includes initiatives for developing and publishing guidelines on responsible AI and creating the National Center for Algorithmic Transparency and Trustworthy AI. R$ 40 million is allocated for these initiatives, funded through non-reimbursable FNDCT resources and public budget allocations.

b) AI Governance Support Program includes actions such as the Brazilian AI Observatory (OBIA) and creating a network to strengthen Brazil's participation in international discussions on responsible and ethical AI. This program is expected to receive R$ 50 million, primarily from non-reimbursable FNDCT resources, with a smaller portion coming from budgetary funds.

3.3. Other public AI investment initiatives and programs

Beyond EBIA and PBIA, several other financing initiatives and investment calls for AI have been issued in Brazil. Among them, the IA² program from MCTI, launched in 2020, stands out, supporting technology projects in the development of AI-based solutions that can be applied across various market sectors. Across its two editions, approximately R$ 35.6 million have been invested, with R$ 5.6 million coming from private sector contributions[1].

1 Source: https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/noticias/2024/03/em-sua-segunda-edicao-o-programa-ia2-mcti-impulsionara-a-inteligencia-artificial-por-meio-de-35-projetos-de-pesquisa

Another MCTI initiative in artificial intelligence is the MCTI/Embrapii Innovation Network in Artificial Intelligence, which mobilizes 19 research units to carry out projects in the AI field. By 2021, more than R$ 210 million had been invested in R&D&I projects within the Network[2].

Other public funding calls for artificial intelligence in Brazil have been promoted by organizations such as Finep, BNDES, Fapesp, MCTI, CNPq, Embrapii, among others. The main funding calls total just over R$ 2.2 billion and are detailed in Table 1 (at the end of this section).

The funding data reveals strategic prioritization across three key sectors. Healthcare appears as a prominent focus area, with multiple dedicated initiatives including the FAPESP-UKRI (MRC) AI in Health Funding (R$45.6 million), FAPESP Research Centers in AI Applied to Health (R$10 million), and the Grand Challenges Brazil Program for LLMs in public health (R$4.5 million). Digital transformation represents another significant investment area, with the largest single allocation being R$300 million to UOL's Innovation Plan, alongside substantial funding for Quality Software S.A. (R$35.8 million) and Squadra Tecnologia (R$20 million). Government applications form the third major focus, with three rounds of the "AI Solutions for the Public Sector" program receiving consistent funding of R$36 million per round, which PBIA has included among its actions with plans to revise the scope and format of these calls.

The temporal distribution of funding shows sustained commitment to AI development since 2019, with a notable intensification in 2022-2024. The single largest investment was allocated in December 2024 (R$300 million for UOL), indicating growing recognition of AI's strategic importance. Funding approaches are diversified across research centers, economic subsidies, and scholarships, suggesting a comprehensive ecosystem development strategy. Research institution collaborations are particularly evident, with partnerships between FAPESP and international organizations (UKRI, ANII, CONICET, IDRC) and private sector entities (IBM, Claro) revealing a collaborative approach to AI advancement.

Brazilian AI funding demonstrates balanced attention to both fundamental research and practical applications. Support for AI research appears consistently across the timeline, with substantial investments in research centers (IBM-FAPESP: R$39.5 million) and academic programs at undergraduate, master's,

2 Source: https://embrapii.org.br/wp-content/images/2021/05/Folder-Digital_Rede-MCTI-EMBRAPII-de-Inovacao-em-IA.pdf

and doctoral levels. Simultaneously, application-focused investments target specific sectors including agriculture, tourism, cities, and crisis management, indicating a recognition of AI's cross-sectoral potential.

The total accumulated investment is over than R$ 2.2 billion shown in the table represents just the beginning of Brazil's AI funding commitment. When combined with the projected R$23+ billion allocation under PBIA through 2028, Brazil's total AI investment since the formulation of EBIA in 2021 reaches approximately R$24 billion, demonstrating a substantial national commitment to establishing the country as a competitive player in the global AI landscape.

Date	Investment focus/ Call name	Description	Responsible entities	Topics	Investment (in reais)
27/12/2024	Digital Service (Uol)	Support for UOL's Innovation Plan, based on AI, including investments for Digital Transformation of clients and development and updating of products.	BNDES	Digital Transformation; Companies; Generative AI	300.000.000
18/11/2024	Claro-FAPESP Engineering Research Center in 5G and Generative AI[3]	Development of innovative solutions in the fields of 5G connectivity and generative artificial intelligence.	FAPESP; CLARO	Connectivity; 5G; Generative AI; Support for AI research	20.000.000
18/10/2024	Quality Software S.A. - BNDES Mais Inovação	Investments in two Digital Transformation Platforms, incorporating AI technologies tailored to specific sectors.	BNDES	Digital Transformation; Companies	35.800.000
n/a	Squadra Tecnologia S.A. - Programa BNDES Mais Inovação	Investment in the development of a digital transformation platform that integrates artificial intelligence technologies, comprehensive design, and hyper-automation of processes.	BNDES	Digital Platforms; Digital Transformation	20.000.000
09/04/2024	FAPESP – UKRI (MRC) AI in Health Funding[4]	Funding for research projects in health and biomedicine.	FAPESP; Medical Research Council	Health; Biomedicine; Support for AI research	45.600.000

3 https://fapesp.br/16941/centro-de-pesquisa-em-engenharia-claro-fapesp-em-5g-e-ia-generativa

4 https://fapesp.br/16664/fapesp-ukri-mrc-oportunidade-de-financiamento-para-iia-em-saudei

Date	Investment focus/ Call name	Description	Responsible entities	Topics	Investment (in reais)
26/02/2024	Public Selection MCTI/ FINEP/FNDCT/MGISP/ ENAP – AI Solutions for the Public Sector – Round 3[5]	Support for projects aimed at developing AI-based solutions for Technological Challenges in Federal Public Sector entities.	MCTI; Finep; FNDCT; MGISP; ENAP	Government	24.000.000
06/02/2024	Public Selection MCTI/FINEP/FNDCT – Continuous Flow Economic Subsidy for Innovation – More Innovation Brazil – Digital Technologies	Granting economic subsidy resources for innovative projects with technological risk.	MCTI; MDIC; MCOM; MGISP; Finep	Technological risk projects	41.560.910,20
01/12/2023	FAPESP Call for Proposals for Research Centers in Artificial Intelligence Applied to Health – 2023[6]	Creation of up to two Research Centers in AI Applied to Health.	FAPESP	Health; Support for AI research	10.000.000
17/10/2023	Grand Challenges Brazil Program – AI Solutions for Health. FIOCRUZ/ MS/CNPq/FBMG[7]	Innovative approaches for the use of LLMs to promote global public health.	FIOCRUZ; Ministério da Saúde; CNPq; Fundação Bill & Melinda Gates	Health; Generative AI	4.500.000
21/08/2023	Public Selection MCTI/ FINEP/FNDCT/MGISP/ ENAP – AI Solutions for the Public Sector – Round 2	Support for projects aimed at developing AI-based solutions for Technological Challenges in Federal Public Sector entities.	MCTI; Finep; FNDCT; MGISP; ENAP	Government	36.000.000
15/08/2022	CNPq/SEMPI/MCTI Call No. 57/2022 – Master's/ Doctorate in Quantum Computing, Integrated Photonics, and AI	Granting of master's and doctoral scholarships for the training of human resources in strategic areas.	CNPq; SEMPI; MCTI	Support for AI research; Graduate Studies	12.096.875

5 http://www.finep.gov.br/images/chamadas-publicas/2024/11_04_2024_IA_Poder_Publico_R3_Edital.pdf

6 https://fapesp.br/16450/chamada-de-propostas-fapesp-para-centros-de-pesquisa-em-inteligencia-artificial-aplicada-a-saude-2023

7 https://portal.fiocruz.br/sites/portal.fiocruz.br/files/editais/chamada_cnpq_ms_e_fbmg_ai_brasil_port_09_de_outubro2023v2.pdf

Date	Investment focus/ Call name	Description	Responsible entities	Topics	Investment (in reais)
02/08/2022	Public Selection MCTI/ FINEP/FNDCT/ME/ ENAP – AI Solutions for the Public Sector – Round 1[8]	Support for projects aimed at developing AI-based solutions for applications in Technological Challenges of Federal Public Sector entities.	MCTI; Finep; FNDCT; MGISP; ENAP	Government	36.000.000
01/08/2022	CNPq/MCTI/SEMPI Call No. 56/2022 – Support for AI Undergraduate Thesis [9]	Granting of scholarships for undergraduate students in Computer Science and related fields with research focused on Artificial Intelligence.	CNPq; MCTI; SEMPI	Support for AI research; Undergraduate Studies	742.000
19/07/2022	Public Selection MCTI/ FINEP/FNDCT – Economic Subsidy for Innovation 11/2022 Finep + ABDI Challenge Program[10]	Support for Brazilian technology-based startups and emerging companies to develop an AI system for Work Permit Monitoring.	MCTI; Finep; FNDCT	Companies; Startups	1.500.000
21/03/2022	MCTI/Finep Startups AI – Economic Subsidy for Innovation [11]	Select AI innovation projects within the thematic areas of Agro 4.0, Health 4.0, Industry 4.0, Smart Cities, and Tourism 4.0.	MCTI; Finep; FNDCT	Agriculture; Health; Industry; Cities; Tourism	80.000.000
08/03/2022	Public Call FAPESP-FACEPE 08/2022 – Support for Research in Applied Artificial Intelligence (AI)[12]	Opportunity for collaborative research for researchers affiliated with Higher Education or Research Institutions in both states.	FAPESP; FACEPE	Support for AI research	1.100.000
26/07/2021	Joint Call for Proposals: FAPESP, ANII, CONICET, and IDRC 2021 – AI for Crisis Management and Resilience Building[13]	Submission of AI projects related to Geospatial Data (GD) for the development of regional intelligent systems.	FAPESP; ANII; CONICET; IDRC	Crisis management; Geospatial data	750.000

8 http://www.finep.gov.br/images/chamadas-publicas/2022/12_12_2022_IA_2a_rerratificacao.pdf

9 https://www.univates.br/media/editais/erm-editais-externos-abertos/2022/tcc_em_ia_2022.pdf

10 http://www.finep.gov.br/images/chamadas-publicas/2022/19_07_2022_Edital_Desafio_Finep_ABDI_Nestle.pdf

11 http://www.finep.gov.br/images/chamadas-publicas/2022/07_10_2022_IA_3a_Rerratificacao.pdf

12 https://fapesp.br/15354/chamada-publica-fapesp-facepe-082022-apoio-a-pesquisas-em-inteligencia-artificial-aplicada-ia

13 https://fapesp.br/15014/chamada-de-propostas-conjuntas-fapesp-anii-conicet-e-idrc-2021-inteligencia-artificial-para-gestao-de-crises-e-construcao-de-resiliencia

Date	Investment focus/ Call name	Description	Responsible entities	Topics	Investment (in reais)
14/07/2021	CNPq/MCTI/SEMPI Call No. 14/2021	Scholarships for undergraduate students in Computer Science whose research focuses on AI.	CNPq; MCTI; SEMPI	Support for AI research; Undergraduate studies	1.200.000
15/04/2019	IBM-FAPESP Engineering Research Center in Artificial Intelligence[14]	Creation of an Artificial Intelligence Center (AI Center) to conduct fundamental and applied research in artificial intelligence.	FAPESP	Support for AI research	39.500.000

Table 1: Public Calls and Artificial Intelligence Projects

3.4. Private investment in AI in Brazil

Regarding private investment in artificial intelligence, it is estimated that in 2022, global investment surpassed $90 billion, with the United States leading at $47.5 billion, followed by China, which invested $13.4 billion. While there is no consolidated estimate of the total private AI investments in Brazil, various indicators suggest significant growth in this sector in recent years. According to an estimate by the technology consulting firm IDC, in 2022, Brazilian companies invested $504 million (approximately R$ 2.61 billion) in artificial intelligence. While it is just a fraction (0.6%) of global private investments, it represents a 28% increase of private investments in AI in Brazil when compared to the previous year.[15]This figure is expected to double in the years ahead, with the AI sector in Brazil projected to attract over $1 billion in private investments annually starting in 2023.[16]

In addition, multinational companies have announced significant investments in the country. In September 2024, Microsoft announced an investment of R$ 14.7 billion ($2.7 billion) over three years to enhance its

14 https://fapesp.br/12504/centro-de-pesquisa-de-engenharia-em-inteligencia-artificial-ibm-fapesp

15 https://www.cnnbrasil.com.br/economia/financas/empresas-brasileiras-devem-investir-us-504-milhoes-em-ia-em-2022-diz-pesquisa/

16 Source: Brasscom. Relatório Setorial 2022 Macrossetor de TIC.

cloud and AI infrastructure in Brazil[17]. The data center sector has also attracted substantial investments, driven by the growing demand for AI solutions. By 2030, Brazil will receive approximately $6.5 billion in investments in this area, consolidating its position as a strategic hub for data centers in Latin America[18].

In the Brazilian financial market, technology and AI assets traded on the Brazilian Stock Exchange reached R$ 98.7 billion in 2024, indicating a significant increase in investor interest and confidence in this sector[19].

These private investment patterns reveal Brazil's emerging role in the global AI ecosystem, characterized by three key developments. First, the rapid growth rate of domestic private investment suggests increasing recognition of AI's strategic importance among Brazilian enterprises, despite relatively modest absolute figures compared to global leaders. Second, major multinational commitments are accelerating infrastructure development critical for advanced AI applications. Third, the valuation of technology and AI assets on the Brazilian Stock Exchange represents a significant maturation of the financial ecosystem supporting AI ventures.

3.5. Concluding remarks on public and private investments in AI in Brazil

The parallel trajectories of public and private investments represent a coordinated ecosystem approach to technological development. The federal government's strategic allocation of approximately R$23 billion through PBIA provides essential long-term infrastructure and research stability, with 66% coming from FNDCT (non-reimbursable funding, credit or equity) and 11% from BNDES (credit or equity). This funding structure significantly increases implementation confidence, as FNDCT resources are legally protected from austerity measures and credit operations do not impact the central government's primary fiscal result.

17 https://www.reuters.com/technology/microsoft-make-27-billion-cloud-ai-investments-brazil-2024-09-26/

18 https://proximonivel.embratel.com.br/mercado-de-data-centers-chega-a-investimento-bilionario-ate-2030/

19 https://borainvestir.b3.com.br/tipos-de-investimentos/renda-variavel/confira-os-ativos-de-ia-e-tecnologia-mais-negociados-na-b3-em-2024-volume-chegou-a-r-987-bi/

Meanwhile, the rapidly accelerating private sector engagement – growing 28% year-over-year and projected to exceed $1 billion annually from 2023 – drives market-responsive innovation. This growth is reflected in the Private Sector Mobilization Ratio for AI, which ranges from 1.17x (reflecting historical R&D investments in Brazil) to 3.34x (based on 2023 AI investment estimates). This ratio indicates that for every public real invested in AI, the private sector contributes between R$1.17 and R$3.34, which would indicate significant market confidence in Brazil's AI ecosystem and the catalytic effect of public investment in stimulating private sector participation.

This public-private synergy positions Brazil distinctively among emerging economies, combining government-led strategic direction with market-driven implementation. The resulting investment environment balances foundational research initiatives with commercial applications. As these complementary investment streams mature through 2028 and beyond, Brazil is establishing itself as Latin America's AI development hub with the potential for significant regional influence in shaping AI applications tailored to emerging market context.

4. Research, Development and Innovation (RD&I): Geographical Distribution and Sectoral Scope of RD&I centers

4.1. Brazil's Consolidating AI Research, Development and Innovation Infrastructure

Brazil is consolidating its AI Research, Development and Innovation (RD&I) infrastructure through both dedicated centers and a broader ecosystem of research units. The country has made significant progress in establishing specialized hubs for AI development, with 13 Applied Research Centers (CPAs) in Artificial Intelligence contributing to foundational and sectoral research, training a skilled workforce, and facilitating technology transfer to industry.

These CPAs represent a key outcome of the Brazilian Artificial Intelligence Strategy (EBIA) and serve as innovation hubs connecting academic research to industry needs and policy priorities. Beyond these specialized centers, Brazil hosts 144 research units working on AI-related topics, representing 110 individual research centers nationwide, according to a CGEE survey. These units are engaged in diverse primary research areas, ranging from foundational research to specialized sectoral applications.

Several initiatives have been established to support AI RD&I in Brazil:

- **IA² MCTI:** This program develops innovative AI solutions in partnership with startups and research institutions.
- **MCTI/Embrapii Network:** This network mobilizes 19 research units to support industrial R&D projects in AI, focusing on accelerating technology applications across productive sectors.
- **Regional Support Programs:** Led by Research Support Foundations (e.g., FAPESP, FAPEMIG, FAPERJ), these programs fund collaborative AI projects between universities and companies.
- **PBIA's regional focus:** The Brazilian AI Plan includes initiatives to establish new CPAs in underrepresented Brazilian regions.

Infrastructure development for AI RD&I is also advancing through:

- **Computing Resources**: Acquisition of supercomputers and strengthening of AI infrastructure.
- **Data Repositories:** Creation of open data platforms and public repositories for training AI models, such as SUS and IBGE databases.

- **Integration Hubs**: Technology Parks at UFRJ and the Innovation Hub at SENAI CIMATEC serve as environments for academia-industry integration.
- **C4AI Partnership (USP + IBM + FAPESP)**: Enabling high-impact R&D projects and promoting AI applications across sectors.

4.2. Geographical Distribution of AI Research Centers

Eleven Applied Research Centers (CPAs) in AI are already operational, with two more selected by FAPESP that will carry out RD&I in healthcare:

- **BI0S – UNICAMP/FEEC (SP):** Focus on health, agribusiness, and AI research
- **C4AI – USP (SP):** Multidisciplinary approach to AI
- **CDI2 – USP/UNICAMP/UNESP (SP)**: Smart industry applications
- **CEIARE – UFRJ/COPPE (RJ):** Renewable energy
- **CEIASC – UFPE/CIn (PE)**: Cybersecurity
- **CEPAII – SENAI CIMATEC (BA):** Industrial applications
- **CEREIA – UFC (CE):** Health
- **CIIA–Saúde – UFMG/ICEX (MG):** Healthcare
- **CPAI4.0 – IPT (SP):** Industry 4.0
- **IARA – USP/ICMC (SP):** Smart cities
- **PRAIA Educação – UFPE/CIn (PE)**: Education

The 11 operating centers provide an environment conducive to the development of fundamental research and AI applications in areas of great interest and are expected to contribute to the training of skilled labor in Brazil. Additionally, another expectation is that the centers will facilitate the transfer of technology and scientific knowledge to companies and organizations. Currently, the CPA are concentrated in the Southeast (7 centers, with 5 in the state of São Paulo) and Northeast (4 centers) regions. Therefore, the PBIA foresees investing in the creation of new CPA in other Brazilian regions.

In addition to the CPA, Brazil also has a broad and diverse network of Science and Technology Institutions (ICT) that conduct research and innovation in AI. According to research by the Center for Strategic Studies and Management (CGEE), the country is home to 144[20] research units working on topics related to artificial intelligence. Many of these units, including ICT, play a strategic role as they bring together specialized researchers, foster scientific and technological production, and collaborate with companies and public agencies in the application of AI-based solutions.

Figure 6 presents a survey of the geographical distribution of the main AI research laboratories in Brazil. Despite the presence of laboratories in all regions of the country, the map highlights that AI investments and infrastructures are still primarily concentrated in the Southeast and Northeast regions – with the notable exception of the Amazon state, in the North region, which is the second largest hub after the state of São Paulo. This distribution reflects regional inequalities in terms of scientific production and technological capacity.

The geographical distribution of AI research units in Brazil shows significant concentration in the Southeast and Northeast regions, with São Paulo (41 units) and Amazonas (22 units) serving as the largest hubs. Rio de Janeiro (14 units), Minas Gerais (13 units), and Pernambuco (10 units) also host substantial AI research activity. This distribution reflects both historical patterns of scientific investment and emerging regional strengths.

20 The number, however, represents the total units operating in Brazil. Some units (or laboratories) are affiliated with the same research center. Therefore, the actual number of individual centers in the CGEE survey is 110.

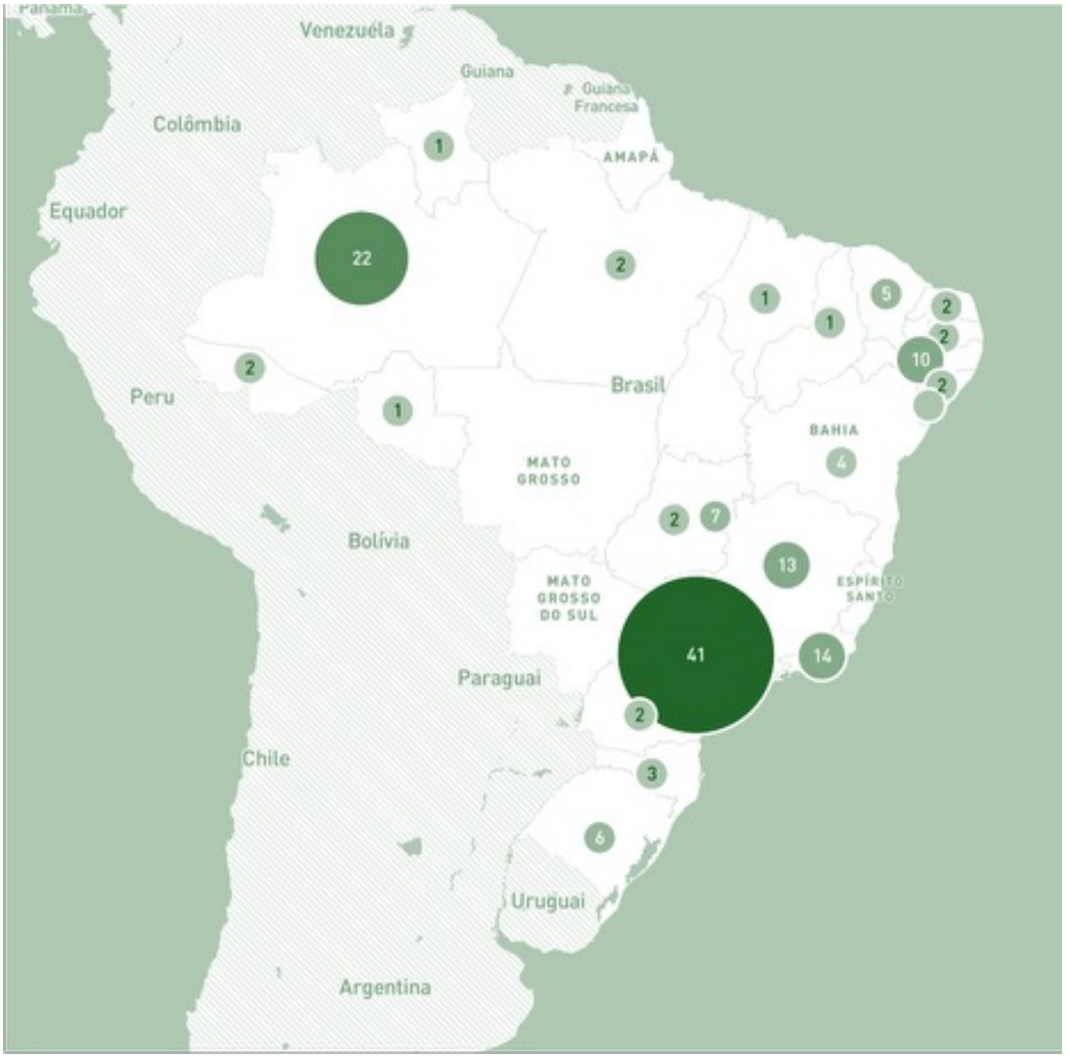

Figure 6. Geographical Distribution of Artificial Intelligence Research Laboratories in Brazil.
Source: Observatório de Tecnologias Digitais (CGEE) - Observatory of Digital Technologies.

4.3. Sectoral Focus of AI Research in Brazil

Brazil's AI research units span a diverse range of sectors (Figure 7 and Table 2), demonstrating the broad application of AI technologies across the economy. Industry and manufacturing lead with 30 research

units, followed closely by healthcare with 25 units. Corporate and management applications account for 20 units, while mobility and logistics are the focus of 15 units.

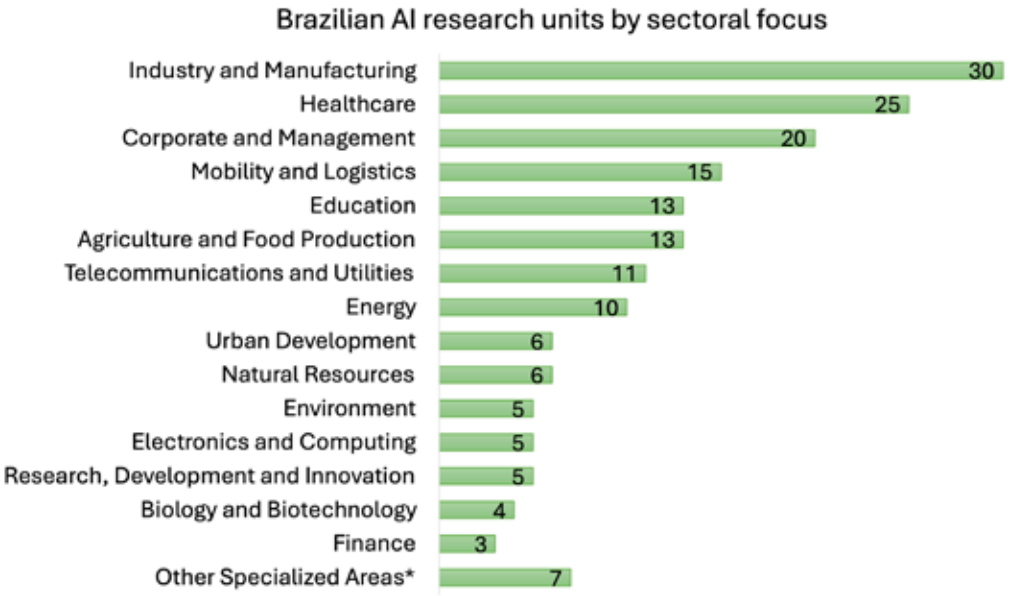

Figure 7. Sectoral Scope of Artificial Intelligence Research Laboratories in Brazil

Application Area	Number of Centers	Component Categories
Industry and Manufacturing	30	Industry (31), Steel Industry (1)
Healthcare	25	Healthcare (25)
Corporate and Management	20	Companies (18), Administration (2)
Mobility and Logistics	15	Automotive (7), Transport (2), Logistics (5), Mobility (1)
Education	13	Education (13)
Agriculture and Food Production	13	Agriculture (6), Agribusiness (5), Livestock (2)
Telecommunications and Utilities	11	Telecommunications (10), Utilities (1)
Energy	10	Energy (11)

Application Area	Number of Centers	Component Categories
Urban Development	6	Cities (5), Sanitation (1)
Natural Resources	6	Oil and Gas (5), Mining (1)
Environment	5	Environment (6)
Electronics and Computing	5	Electronics (4), Electronics (1), Computing (1)
Research, Development and Innovation	5	ICTs (4), Startups (1)
Biology and Biotechnology	4	Biology (1), Biotechnology (3)
Finance	3	Finance (2), Financial (1)
Other Specialized Areas	7	Renewable Materials (1), Security (1), Law (1), Astronomy (1), Entertainment (1), Retail (1), Culture (1)

Table 2: Distribution of AI Research Units Across Sectors in Brazil

The sectoral distribution reveals both traditional strengths and emerging focus areas:

- **Industry and Manufacturing** (30 units): Includes industrial automation, quality control, predictive maintenance, and smart factory applications.
- **Healthcare** (25 units): Encompasses medical diagnostics, treatment planning, hospital management, and biomedical applications.
- **Corporate and Management** (20 units): Focuses on business process optimization, decision support systems, and administrative applications.
- **Mobility and Logistics** (15 units): Includes transportation optimization, route planning, fleet management, and supply chain applications.
- **Education** (13 units): Focuses on personalized learning, educational content development, and administrative tools for educational institutions.
- **Agriculture and Food Production** (13 units): Encompasses precision agriculture, crop monitoring, livestock management, and food supply chain optimization.

Other significant sectors include telecommunications and utilities (11 units), energy (10 units), urban development (6 units), natural resources (6 units), environment (5 units), electronics and computing (5 units), research and development services (5 units), biology and biotechnology (4 units), and finance (3 units). An additional 7 units operate across specialized domains including renewable materials, security, law, astronomy, entertainment, retail, and culture.

This sectoral diversity demonstrates Brazil's multifaceted approach to AI implementation, with strong emphasis on industrial applications, healthcare innovations, and corporate solutions.

4.4. Concluding Remarks on AI Innovation Hubs in Brazil

Brazil's AI research infrastructure shows significant geographical concentration in the Southeast and Northeast regions, with São Paulo (41 units) and Amazonas (22 units) emerging as key hubs. This pattern reflects both historical investment trends and recent policy efforts to develop regional capabilities.

The concentration of research units in certain regions also appears to align with sectoral specialization. Industry and manufacturing (30 units) and healthcare (25 units) lead the sectoral focus, demonstrating both geographic centralization and strategic domain prioritization. This pattern suggests the development of regional innovation ecosystems where geographic proximity facilitates knowledge exchange and collaboration between academic institutions, industry, and government.

Brazil's AI innovation hubs are positioned to become research powerhouses that can drive technological development and economic growth. However, the current geographic distribution also highlights the need for policies that promote more balanced regional development, which the PBIA aims to address through its focus on establishing new research centers in underrepresented regions.

The broader RD&I ecosystem for AI in Brazil extends beyond formal research units to include public-private partnerships, technology transfer mechanisms, and international collaborations. As these elements mature, Brazil's AI innovation hubs have the potential to develop into globally competitive centers of excellence in specific AI domains, particularly those aligned with the country's strategic priorities and competitive advantages.

5. Research, Development and Innovation (RD&I): Scientific knowledge base (dissertations, theses and articles)

5.1. Graduate research on AI in Brazil

Brazil shows steady growth in AI academic research volume and relative importance, with dissertations tripling and theses quadrupling over the past decade. Based on the analysis of the CAPES Theses and Dissertations Catalog covering the years 2013 to 2022, the number of AI-related theses and dissertations has grown substantially. The data shows that dissertations related to AI have nearly tripled (from 1,098 in 2013 to 3,234 in 2022), while theses have nearly quadrupled (from 428 in 2013 to 1,585 in 2022) over this ten-year period (Figure 8). Such a significant increase reflects the growing importance of AI in academic research and the expanding interest in the field among graduate students.

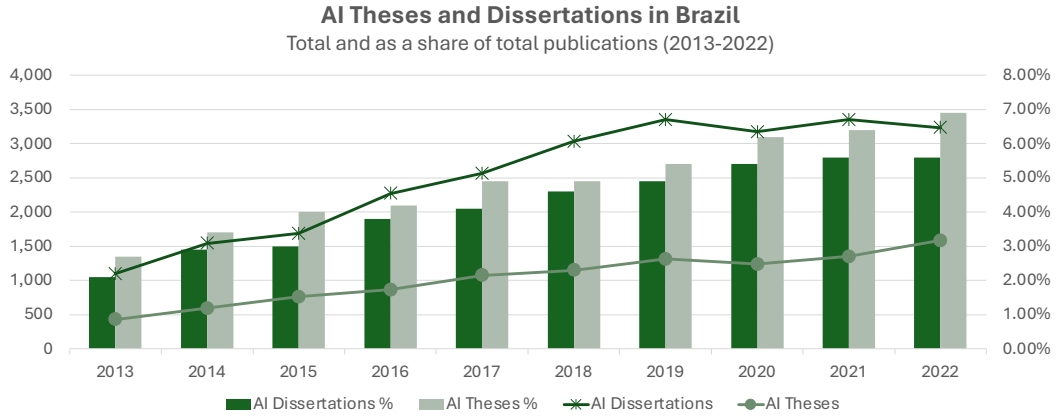

Figure 8. Graduate AI Research Production in Brazil

The relative importance of AI within Brazil's graduate research landscape has increased dramatically. AI-related dissertations grew from 2.1% of all dissertations in 2013 to 5.6% in 2022, representing more than a doubling of relative importance. The growth is even more pronounced for doctoral theses, where AI-related research increased from 2.7% of all theses in 2013 to 6.9% in 2022, indicating a growing prioritization of AI at the highest levels of academic research.

AI-related graduate research is predominantly concentrated in the Southeast region, yet other regions have been gaining ground. While São Paulo, Minas Gerais, and Rio de Janeiro remain leading states, the growth rate of AI research has been strongest in the North (+507%), Northeast (+340%), and Central-West (+327%) regions from 2013 to 2022, compared to 156% in the Southeast and 231% in the South.

This changing regional distribution aligns with broader trends in Brazil's academic landscape. The study "Mestres e Doutores 2024" (CGEE, 2024) found that while 67.4% of master's degrees were awarded in the Southeast in 1996, this figure dropped to 43.5% by 2021, with significant increases in Northeast (from 10.6% to 20.5%) and South (from 17.3% to 21.9%) regions. Similarly, doctoral degrees, which were 88.8% concentrated in the Southeast in 1996, fell to 52.5% by 2021, with significant growth in the Northeast (from 1.4% to 15.8%).

Brazil's leading institutions in AI graduate research include the University of São Paulo (USP), which contributes the highest number of theses and dissertations, followed by UNICAMP, UFMG, UFPE, and UFRJ. These institutions are characterized by broad research funding, strong graduate programs, and partnerships with industry and government. Recent initiatives like the Applied AI Research Centers (CPAs) have further supported new research hubs across Brazil, including centers in Bahia, Ceará, and Pernambuco, aiming to increase regional AI production with upcoming federal investments.

Regarding research areas, the CAPES research areas associated with AI theses and dissertations show that Computer Science leads in volume, followed by Electrical Engineering, Interdisciplinary Studies, Mechanical Engineering, and Production Engineering. Medicine and Law rank 11th and 17th, respectively.

The research landscape of theses and dissertations reveals five distinct dominant thematic areas:

a) **Optimization & Computational Methods**: Encompassing algorithms, heuristics, metaheuristics, simulation, and computational modeling for engineering, logistics, and industrial processes.

b) **Artificial Intelligence & Machine Learning**: Covering deep learning, neural networks, and automated learning systems for predictive analytics and decision-support.

c) **Environmental & Sustainability Studies**: Including climate science, sustainable energy, ecological conservation, and resource management.

d) **Engineering & Technology:** Focusing on automation, robotics, structural engineering, and control systems.

e) **Health & Biomedical Research**: Addressing medical diagnostics, disease modeling, hospital management, and biomedical engineering.

5.2. Academic papers on AI in Brazil

AI research in Brazil has experienced significant growth over time. From its beginning with the first master's thesis on AI in Brazil defended in 1971 at the Pontifical Catholic University of Rio de Janeiro (PUC-RJ), the field has expanded dramatically. A key milestone was the first Brazilian Symposium on Artificial Intelligence (SBIA) organized in 1984, which has since evolved into the Brazilian Conference on Intelligent Systems (Bracis).

To analyze Brazilian scientific achievements in AI subjects, data was collected for 39,558 articles from the Web of Science. The temporal evolution shows that the number of AI-related publications by Brazilian researchers has experienced accelerated growth, particularly after 2015, reflecting a global trend (Figure 9).

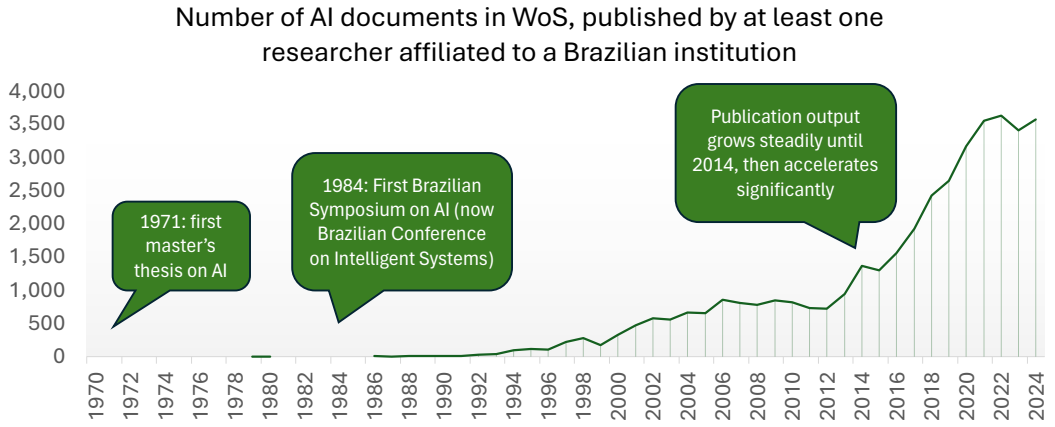

Figure 9. Academic Papers on AI in the Web of Science (WoS) Database with at Least One Author from a Brazilian Institution

Brazil's AI research output has seen exponential growth since 2015, reflecting increased investment and strategic prioritization. From 1971 to 2014, publication output grew steadily, but after 2014 it accelerated significantly, coinciding with global trends in AI development and Brazil's increasing focus on the field through national strategies and funding initiatives.

While not yet at its full potential, Brazil has established itself as a significant contributor to global AI knowledge production and the regional leader in Latin America. Brazil contributes approximately 1.8%

of global AI research output since 2010, placing it among the top 20 countries globally in AI research production (Figure 10). This contribution is slightly below Brazil's average scientific output in other fields (~2%). However, Brazil clearly ranks as Latin America's leading country in AI research output, demonstrating its regional leadership in the field.

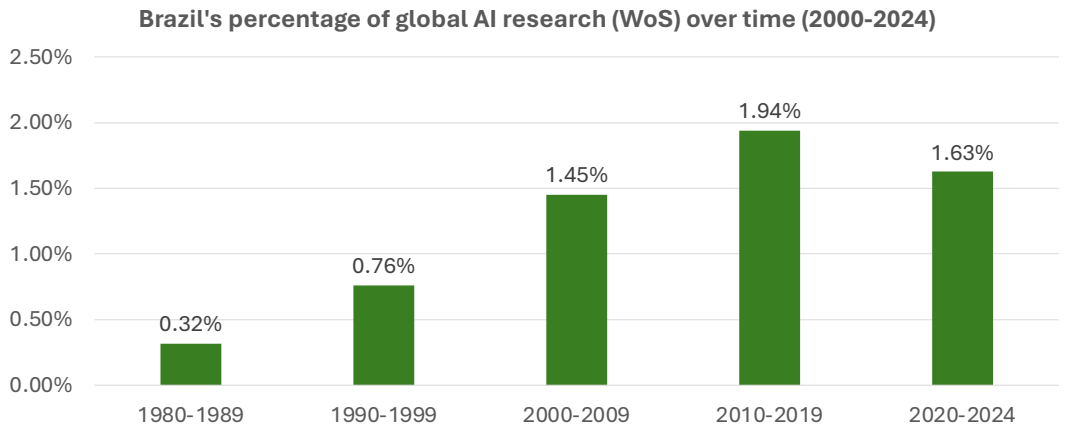

Figure 10. Brazil's Relative Contribution to Global AI Research.

Brazil has established strong capabilities in core AI technologies, while developing distinctive competencies in high-value application domains (decision sciences, health, energy, cybernetics). Among the research areas in which Brazilian AI researchers are engaged, data from the Web of Science (WoS) indicate that production is distributed across various themes (Figure 11).

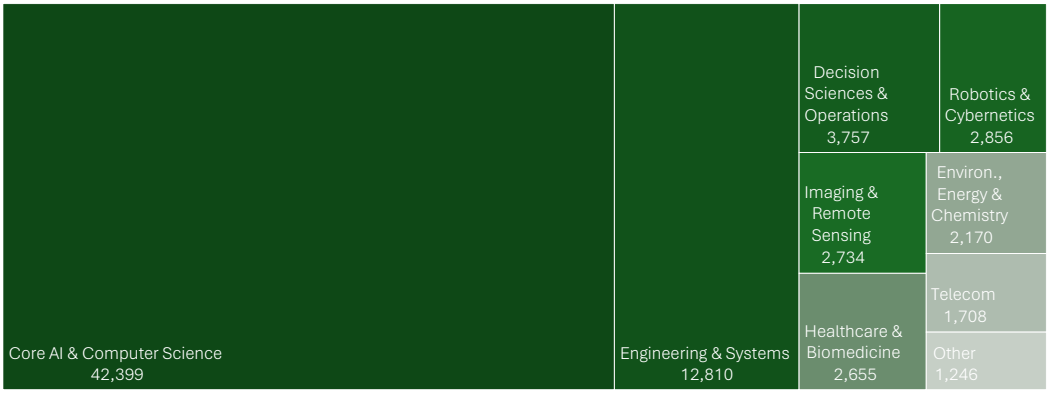

Figure 11. Research Fields of Brazilian Academic Papers on AI (Grouped WoS categories)

AI research in Brazil, as reflected in publications authored or co-authored by Brazilian researchers, exhibits a strong tendency toward applied AI and performance optimization, particularly in the medical field. Key areas include image processing and pattern recognition for diagnostics, as well as applications in operational analysis, optimization, and logistics. Another prominent research focus is data analysis, especially in the context of the Internet of Things (IoT) and its applications in soil and crop monitoring for precision agriculture. Additionally, studies have explored the socioeconomic implications of AI, particularly its role in social media, political processes, and public opinion manipulation, with growing attention from the social sciences. Analysis of the most frequent keywords in AI papers by Brazilian authors (Figure 12) reveals four key insights:

a) **Strong focus on fundamental AI methodologies** such as "machine learning", "neural networks", and "optimization".

b) **Practical approach to AI research with concrete applications** ("computer vision", "internet of things", "genetic algorithms").

c) **Research spanning both traditiona**l ("fuzzy logic") and cutting-edge AI methods ("deep learning", "reinforcement learning").

d) **Significant work in specialized research areas**, such as data preprocessing and analysis fundamentals, which underpin many AI applications.

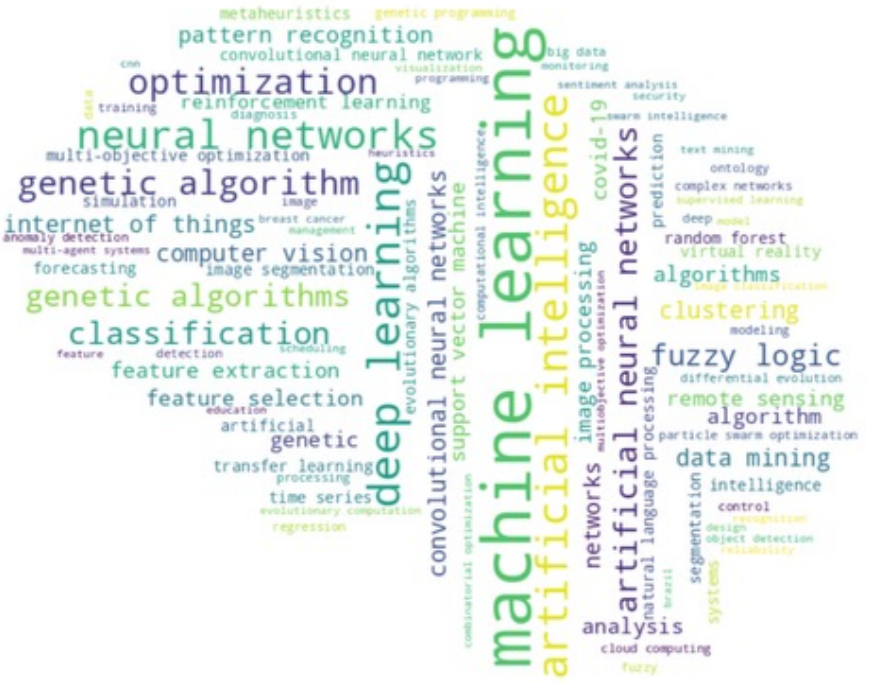

Figure 12. Most Frequent Keywords in AI Papers by Brazilian Authors

5.3. Internationalization of Brazil's AI research

Brazil's AI research ecosystem has rapidly internationalized, enhancing knowledge transfer and positioning Brazilian institutions within the global innovation network. Until the early 2000s, scientific article production in AI was almost exclusively endogenous, but this scenario has been changing over the past two decades. By 2025, it is expected that half of the scientific articles in the field will be produced in collaboration with international institutions (Figure 13).

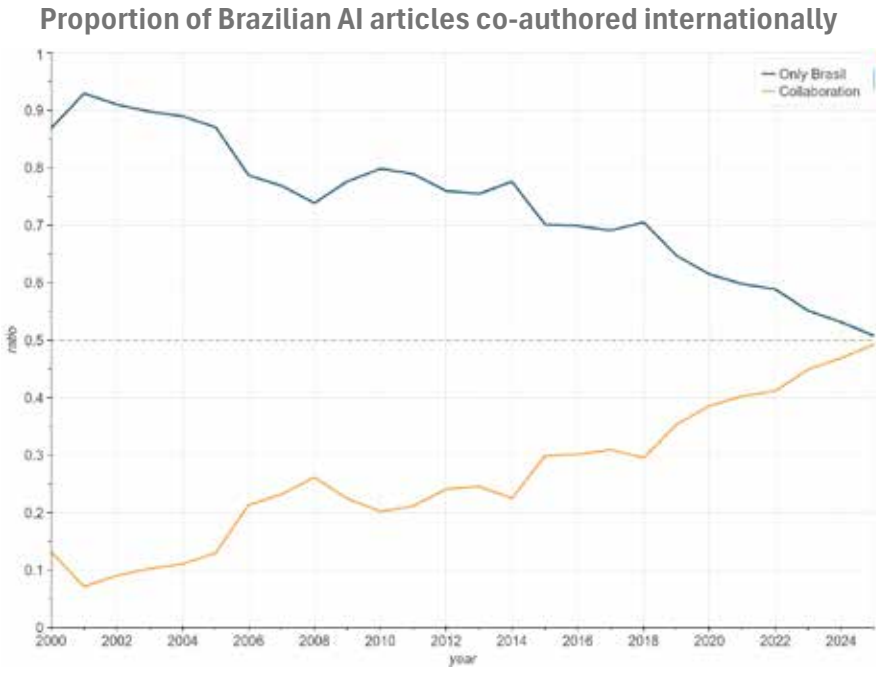

Figure 13. Proportion of Brazilian Articles on AI Co-authored Internationally

The increase in international collaborations is a natural outcome of global scientific and technological advancements and a tangible result of government strategies to internationalize science. This includes expanding cooperation agreements in Science, Technology, and Innovation (ST&I) with foreign institutions as a way to overcome the limitations of Brazil's peripheral position in relation to the so-called central zone of science. The National Science, Technology, and Innovation Strategy emphasized ST&I as a decisive element in strategic international partnerships, with a particular focus on cooperation within the BRICS group (Brazil, Russia, India, China, and South Africa).

A cumulative analysis showed that most of the AI publications produced by Brazilian researchers involve internal collaboration of Brazilian institutions (26,190 articles), but this has been changing in time. Many publications also have international collaborators, notably from the United States (3,550 articles), England (1,688 articles), Portugal (1,638 articles), and France (1,452 articles).

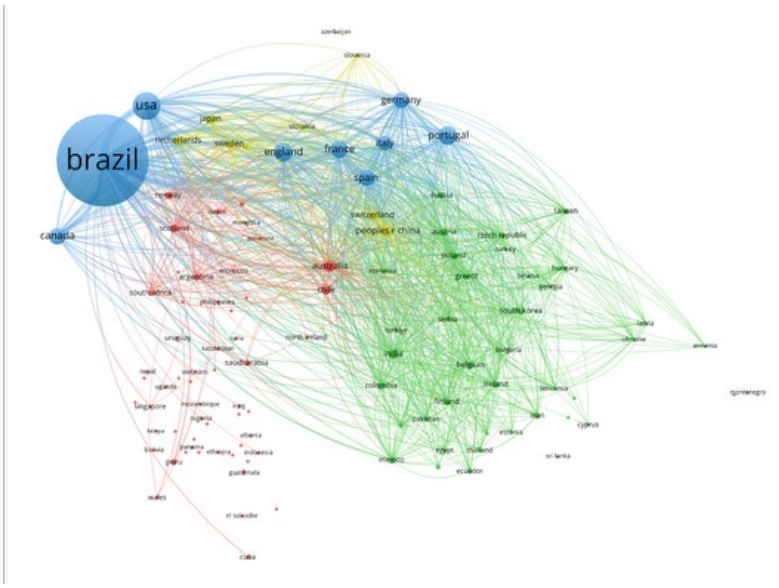

Figure 14. Network of Brazilian International Collaboration on AI Scientific Papers

The network of Brazilian and world organizations cooperating on AI scientific papers shows a diverse and growing AI collaboration between Brazil and international partners (Figure 15). In terms of institutions, the top ten Brazilian universities in the AI collaboration network are:

a) Universidade de São Paulo

b) Universidade Federal de Pernambuco

c) Universidade Federal do Ceará

d) Universidade Federal do Paraná

e) Universidade Estadual Paulista

f) Universidade Federal de Juiz de Fora

g) Universidade Federal de Mato Grosso do Sul

h) Universidade Federal de São Carlos

i) Universidade Federal de Alagoas

j) Universidade Federal do Rio de Janeiro

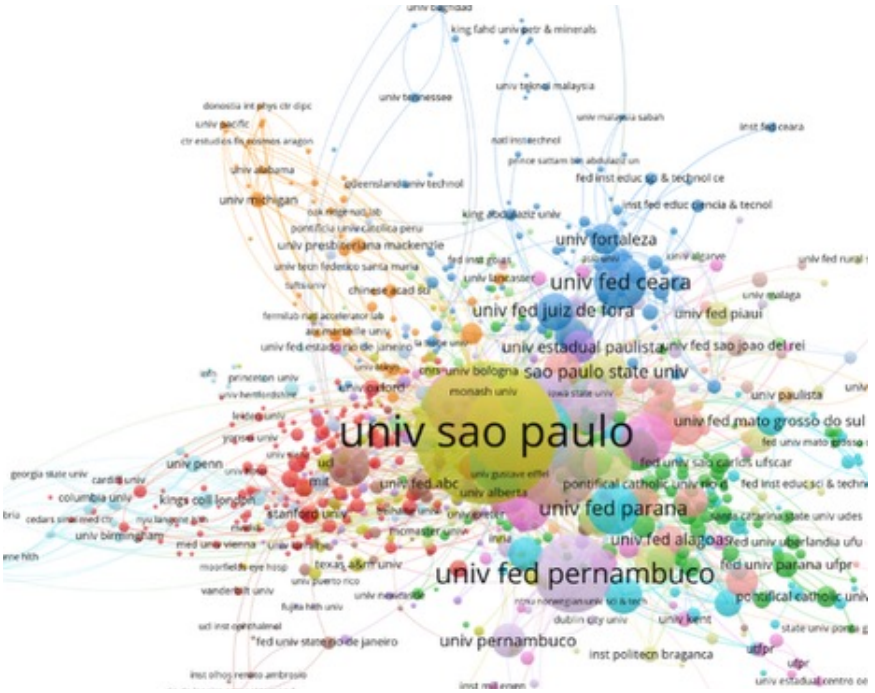

Figure 15. Network of Brazilian and World Organizations Cooperating on AI Scientific Papers

These institutions serve as bridges between domestic research capabilities and international knowledge networks, facilitating the flow of expertise and innovation in both directions.

However, international collaboration networks can also expose existing imbalances due to Brazil's less prominent position compared to its main partners. Therefore, despite the benefits of these collaborations, it is necessary to develop a clearer strategy for attracting and diversifying partnerships, enabling the country to take on a more influential role in research conducted with other nations.

5.4. Concluding Remarks on the Scientific Knowledge Base on AI in Brazil

Brazil has demonstrated remarkable growth in AI academic output with dissertations tripling and theses quadrupling over a decade, contributing approximately 1.8% of global AI research while establishing leadership in Latin America. The country has developed distinctive competencies in decision sciences, healthcare, energy, and cybernetics.

With continued investment in research infrastructure, international collaborations, and expanding regional capabilities, Brazil is well-positioned to increase its global contribution to AI research in the coming years. The significant growth in AI-related graduate research indicates a strong pipeline of future researchers and practitioners who will contribute to the country's AI ecosystem.

The diversification of AI research across different regions of Brazil and the expansion beyond traditional computer science fields into areas such as healthcare, environmental sciences, and engineering demonstrates the increasing recognition of AI's potential to address complex challenges across multiple domains of economic and social importance.

The Brazilian AI research surge has positioned the country as a regional leader with potential to become a more significant global contributor. With continued strategic investment and focus on areas of distinctive competence, Brazil can leverage its research strengths to drive innovation and address complex societal challenges through AI technologies.

6. Research, Development and Innovation (RD&I): Technological Knowledge Base (Patents) – International Patent Holders

6.1. Brazil's Emergence as a Key Market for AI Patents

Brazil is becoming an increasingly important market for artificial intelligence, as evidenced by the steady growth in patent filings at the National Institute of Industrial Property (INPI). Analysis of patent data reveals that 20,821 AI-related patents were filed at INPI by 7,972 assignees between 2000 and 2024. The temporal distribution shows consistent growth until 2020, when filings reached their peak at 1,543 annual submissions (Figure 16). The subsequent decline observed in more recent years can be attributed to the patent analysis period and confidentiality requirements that typically delay the publication of more recent filings.

A notable characteristic of Brazil's AI patent landscape is the clear distinction between patents of national and international origin. Of the total AI-related patents filed:

- 89% are international patents (18,565)
- 11% are Brazilian patents (2,256)

This significant proportion of international filings demonstrates the strong interest from multinational corporations in protecting their AI innovations within the Brazilian market, highlighting the country's strategic importance in the global AI ecosystem.

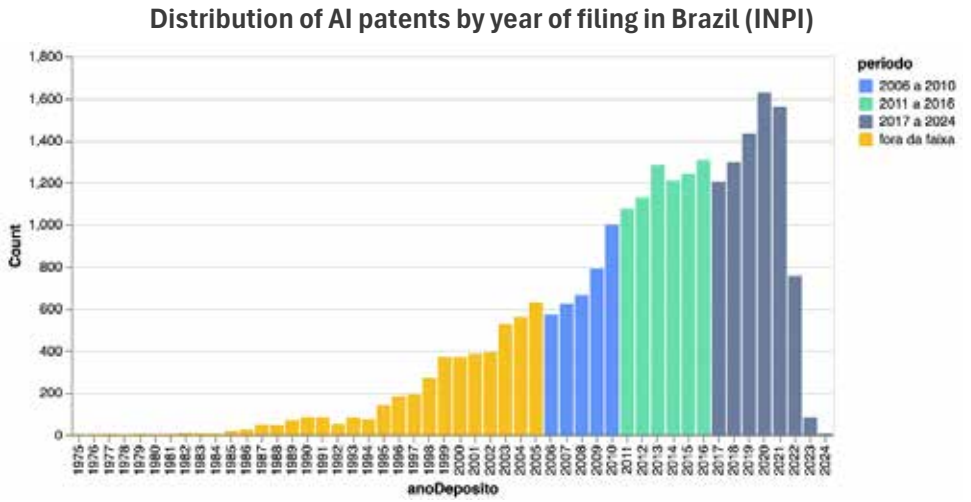

Figure 16. Total AI Patents Filed in the Brazilian Patent Office (INPI) per Year

6.2. Leading International Patent Holders in Brazil

The AI patent landscape in Brazil is characterized by significant multinational interest, with a relatively concentrated distribution among top patent holders. Analysis reveals that Philips and Qualcomm alone hold 6% of all AI patents filed in Brazil, while the top 10 companies collectively account for 15% of all AI patents.

The leading companies in AI patent filings demonstrate the global nature of AI innovation, with strong representation from the United States, Asia, and Europe:

- Koninklijke Philips N.V. (Netherlands) leads with 752 patents
- Qualcomm Incorporated (US) follows with 559 patents
- Toyota Jidosha Kabushiki Kaisha (Japan) ranks third with 283 patents
- Other major contributors include General Electric Company (US), Nissan Motor Co. Ltd. (Japan), The Boeing Company (US), and Samsung Electronics Co., Ltd (South Korea)

Among the top 25 AI patent holders in Brazil, there is a clear dominance by multinational corporations (MNCs), with the United States having the strongest presence (11 of 25 companies), followed by Asian countries (Japan, South Korea, China) and European nations (Netherlands, Germany, Switzerland, Sweden). This pattern reflects Brazil's position as an important market for AI innovations, although the country is not yet a major innovator itself.

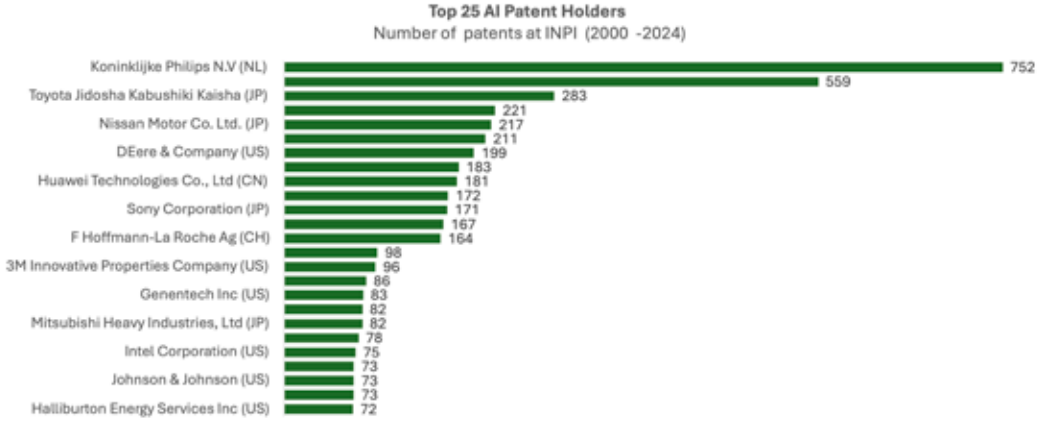

Figure 17. Significant Multinational Interest in Protecting AI Inventions in the Brazilian Market

The sectoral distribution of these patent holders reveals important patterns:

- Electronics and telecommunications companies lead (including Philips, which is also very active in health, Qualcomm, Samsung, Huawei)
- Automotive sector has significant representation (Toyota, Nissan, Scania)
- Healthcare and pharmaceutical firms are prominent (Philips, F. Hoffmann-La Roche, Genentech, Novartis)
- Industrial and energy companies maintain a strong presence (General Electric, Boeing, Siemens)

This diversified sectoral representation demonstrates the cross-cutting nature of AI technologies and their wide-ranging applications across industries, as well as the strategic importance international companies place on protecting their intellectual property in the Brazilian market.

6.3. Sectoral Distribution of International AI Patents

The distribution of AI patent activities across technological sectors in Brazil shows the predominance of healthcare, biotechnology, and digital technologies (Table 3). When analyzing the International Patent Classification (IPC) codes associated with AI patents, several key areas emerge as focal points for innovation.

Category	IPCs	IPC Descriptions	Total
Healthcare and Medicine	A61K; A61P; A61B	Preparations for medical, dental, or toilet purposes; Specific therapeutic activity of chemical compounds or medicinal preparations; Diagnosis, surgery, identification	78,003
Chemistry and Biotechnology	C12N; G01N; C07K; C07D; C12Q	Microorganisms or enzymes, genetic engineering, culture media; Measuring or testing – chemical or physical property analysis; Organic chemistry – Peptides; Organic chemistry – heterocyclic compounds; Testing processes involving enzymes or microorganisms	52,539
Computing and Data Processing	G06F; G11B; G06N; G06K; G06Q; G06T	Computing, digital data processing; Information storage; Computing arrangements based on specific computational models; Graphical data reading, data presentation; Data processing for administrative or commercial purposes; Image data processing	29,347
Communications Technology	H04L; H04N; H04W	Transmission of digital information; Electric communication technique – pictorial communication; Wireless communication networks	27,450
Materials and Manufacturing	B29C; B32B	Shaping plastics, after-treatment of shaped products; Layered products	10,780
Automotive	B60W	Control systems for vehicle sub-units and hybrid vehicles	3,460

Table 3. Distribution of AI Patents across Technological Sectors in Brazil

- Healthcare and medicine lead with 78,003 IPC occurrences, covering preparations for medical and dental purposes, specific therapeutic activities, diagnosis, surgery, and identification. This is followed by chemistry and biotechnology with 52,539 occurrences, including microorganisms, enzymes, genetic engineering, chemical property analysis, and organic chemistry.

- Computing and data processing rank third with 29,347 occurrences, encompassing digital data processing, information storage, computational models, graphical data reading, and image processing. Communications technology follows closely with 27,450 occurrences, covering digital information transmission, pictorial communication, and wireless networks.

- Materials and manufacturing (10,780 occurrences) and automotive applications (3,460 occurrences) also represent significant technological sectors, though with substantially fewer patent activities compared to the leading categories.

This sectoral distribution highlights the diverse applications of AI technologies across the Brazilian innovation landscape, with a particularly strong focus on health-related applications, reflecting global trends in AI development priorities.

6.4. Technological Mapping of AI Patents

To visualize the evolution of technological focus in AI patents, thematic mapping analysis was conducted to organize patent concepts based on their densities (internal cohesion) and centralities (strategic importance). This approach identifies four strategic quadrants in the innovation landscape (Figure 18):

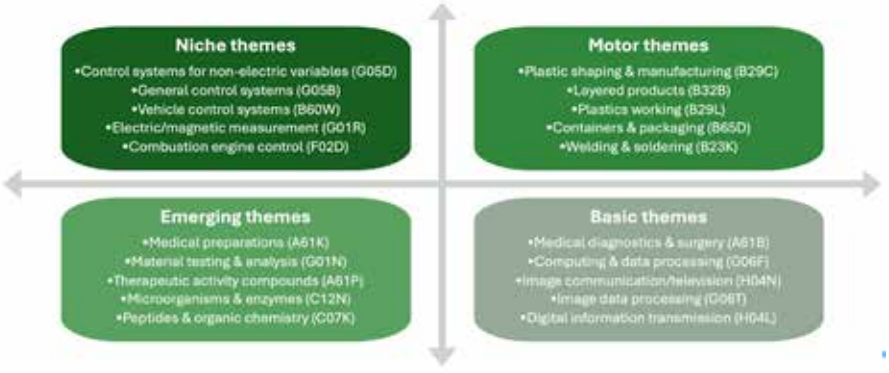

Figure 18. Thematic Map of Brazil's AI Patent Landscape

- **Motor Themes** (high density, high centrality): These represent mature and fundamental technologies, particularly in advanced manufacturing processes. The cluster includes plastic shaping and manufacturing (B29C), layered products (B32B), plastics working (B29L), containers and packaging (B65D), and welding and soldering (B23K). These technologies are driving industrial applications of AI, including process optimization, quality control, and automation.

- **Basic Themes** (low density, high centrality): These are central to the AI landscape but still developing their internal cohesion. The cluster includes medical diagnostics and surgery (A61B), computing and data processing (G06F), image communication (H04N), image data processing (G06T), and digital information transmission (H04L). These represent growing areas where AI is increasingly applied, especially in healthcare and digital communications.

- **Emerging Themes** (low density, low centrality): These represent peripheral but promising fields for future AI applications. The cluster includes medical preparations (A61K), material testing and analysis (G01N), therapeutic activity compounds (A61P), microorganisms and enzymes (C12N), and peptides and organic chemistry (C07K). This suggests significant growth potential for AI in drug discovery, diagnostics, and biotechnology.

- Niche Themes (high density, low centrality): These represent specialized technologies with high internal development but limited connections to other domains. The cluster includes control systems for non-electric variables (G05D), general control systems (G05B), vehicle control systems (B60W), electric/magnetic measurement (G01R), and combustion engine control (F02D). These technologies may remain specialized or potentially evolve into more strategic areas as their connections to other technologies increase.

Therefore, Brazil's AI patent landscape is uniquely structured with healthcare applications split between established uses (diagnostics/surgery) and emerging opportunities (pharmaceuticals/therapies), while manufacturing and materials processing technologies have unexpectedly matured into driving forces for innovation.

In the healthcare sector (Figure 19), Philips dominates health-related AI patents, highlighting its strategic focus on the Brazilian healthcare market. The company's consistent leadership across all time periods demonstrates its long-term commitment to health technology innovation in Brazil. Pharmaceutical MNCs also maintain a significant presence, underscoring the transformative potential of AI in this sector.

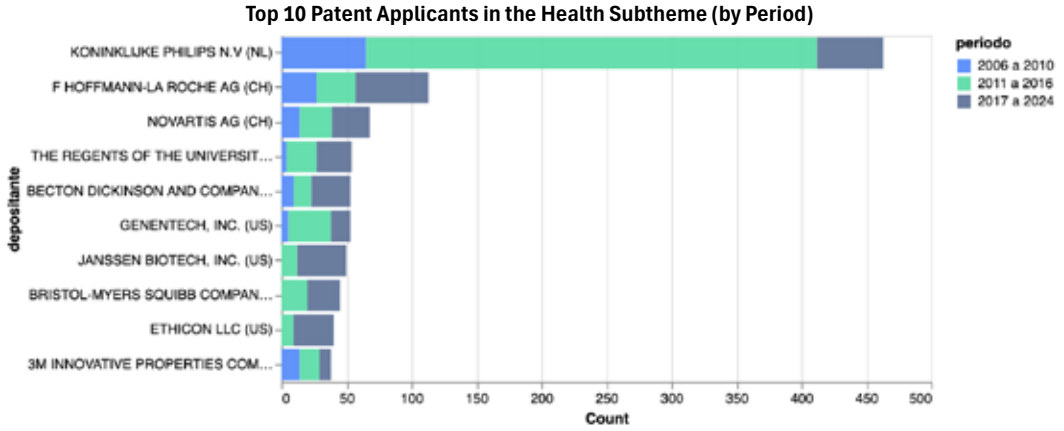

Figure 19. Top Holders of Health-related AI Patents in Brazil

For energy applications (Figure 20), General Electric leads AI patent applications, followed closely by Siemens and Wobben Properties. The sector has shown consistent growth in patent activity from 2006 to 2024, indicating sustained interest in AI applications for energy optimization, renewable energy management, and grid intelligence.

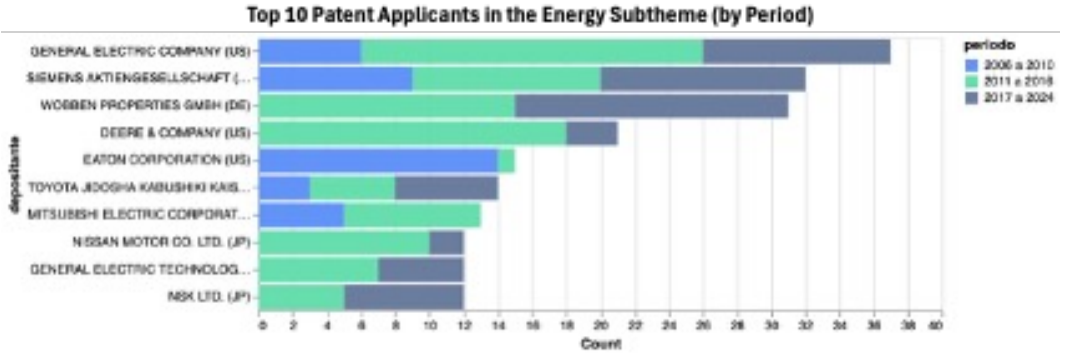

Figure 20. Top Holders of Energy-related AI Patents in Brazil

6.5. Implications of International Patent Activity in Brazil

The analysis of international AI patent holdings in Brazil reveals several important implications for the country's technology landscape:

- **Market Recognition:** The substantial interest from global technology leaders confirms Brazil's status as a strategically important market for AI innovations.
- **Technology Transfer Potential:** The concentration of international patents creates opportunities for knowledge transfer and potential collaborations with Brazilian institutions and companies.
- **Competitive Landscape:** The dominance of international patent holders presents both challenges and opportunities for domestic innovators seeking to develop competitive AI solutions.
- **Sectoral Priorities:** The strong focus on healthcare, biotechnology, and communications technologies provides clear signals about which sectors are likely to see the most significant AI-driven transformations in the Brazilian context.
- **Innovation Gaps:** The relatively limited representation of Brazilian entities among top patent holders highlights the need for continued investment in domestic AI research capabilities and IP protection awareness.

The Brazilian AI patent landscape reflects strong multinational interest with Philips and Qualcomm holding 6% of all AI patents filed at INPI. The overall concentration of patents in healthcare, biotechnology, and digital technologies demonstrates Brazil's emergence as a strategically important market for global AI innovation, even as the country works to strengthen its own domestic innovation capabilities.

7. Research, Development and Innovation (RD&I): Technological Knowledge Base (Patents) – Brazilian Patent Holders

7.1. Overview of Brazilian AI Patents

Out of the 18,867 AI-related patents filed at INPI (Brazilian Patent Office), only 1,208 patents have Brazilian applicants among their assignees, representing just 6.4% of all AI patents filed in Brazil. This relatively small percentage highlights the significant gap between international and domestic AI patent production, reflecting Brazil's current position as primarily a market for AI technologies rather than a major producer of patentable AI innovations.

The distribution of Brazilian AI patent holders over time shows fluctuations with some growth trends, particularly in more recent periods (Figure 21). When examining the filing patterns by year, it's clear that Brazilian institutions have increased their participation in the AI patent landscape over time, particularly since 2017.

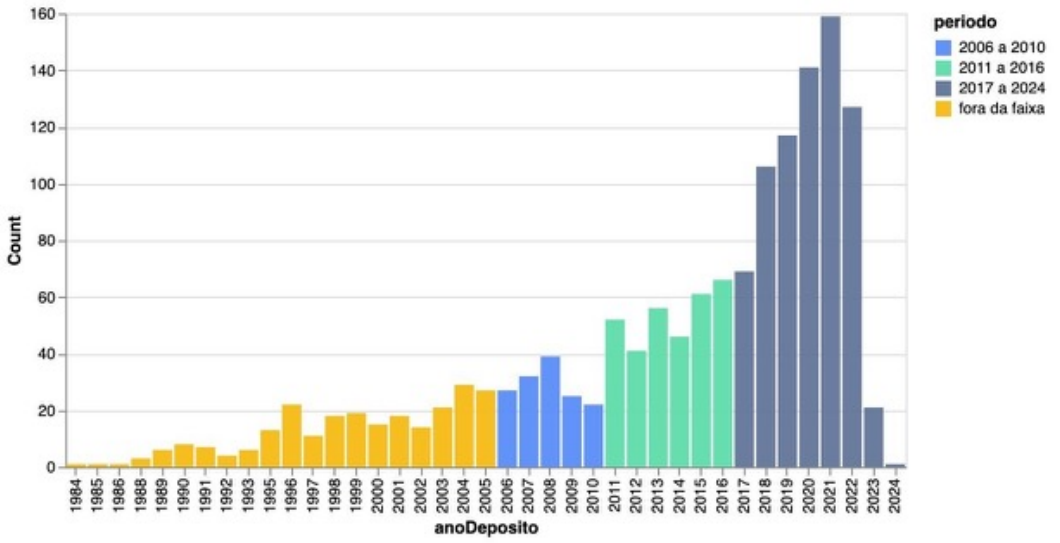

Figure 21. Distribution of Brazilian AI Patent Holders by Year of Filing in Brazil (INPI)

Between 2000 and 2024, 2,256 patent documents of Brazilian origin were recorded, accounting for 10.84% of total INPI AI patent filings. The average age of these documents, approximately 10.5 years, raises important questions about technological renewal and innovation lifecycles within the Brazilian AI ecosystem. The relatively young average age suggests that Brazilian AI patenting activity has increased

more significantly in recent years, reflecting growing awareness of both AI's potential and the importance of intellectual property protection.

7.2. Top Brazilian AI Patent Holders

In the AI patent landscape with Brazilian participation, no single applicant dominates significantly (Figure 22). The top patent applicant across all three analyzed periods (2006-2010, 2011-2016, and 2017-2024) is the Federal University of Minas Gerais (UFMG), with 39 patents, followed by PETROBRAS (34 patents) and the State University of Campinas (UNICAMP) (31 patents).

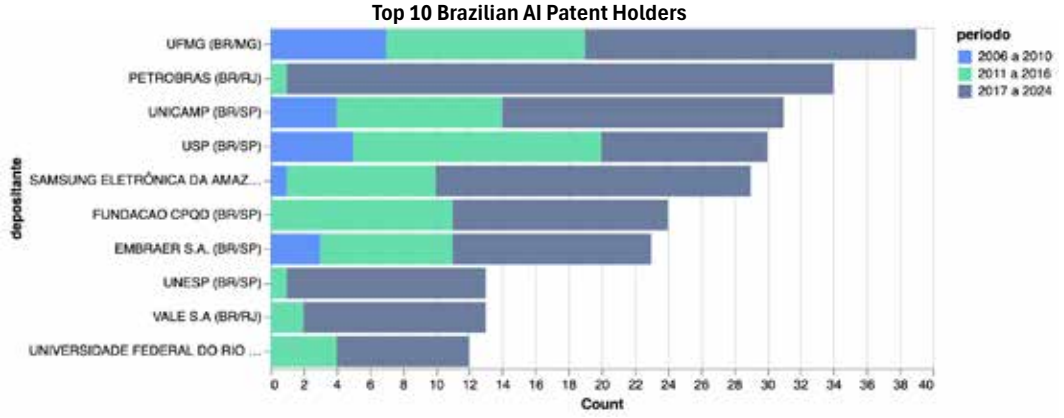

Figure 22. Top 10 Brazilian Patent Applicants

Several key observations emerge from the analysis of top Brazilian AI patent holders:

- Academic Leadership: Brazilian universities and research institutions dominate the patent landscape, with UFMG, UNICAMP, and USP (University of São Paulo) featuring prominently. This contrasts with the international pattern where corporations lead patent filings.

- Strategic State Enterprises: Petrobras, Brazil's state-controlled oil company, ranks second among Brazilian patent holders, highlighting the role of state enterprises in driving technological innovation in strategic sectors. Note that the Brazilian state also holds golden shares in Embaer (aviation) and Vale (mining).

- Temporal Patterns: Research institutions and Embraer were notably active in the 2006-2010 period, while most other applicants showed stronger participation after 2017, indicating shifting priorities and capabilities in AI research.
- Research Funding Agencies: The presence of FAPEMIG (Research Support Foundation of Minas Gerais) among top applicants signals the important role of funding agencies in supporting and participating in the patent process, particularly in collaboration with universities.
- Private Sector Participation: Companies like Samsung and Vale demonstrate that private sector engagement in AI patenting exists, though at a more modest level compared to academic institutions.

This distribution reveals a patent landscape that is primarily driven by academic and governmental research rather than corporate R&D, contrasting sharply with the pattern observed in international AI patent filings in Brazil, which multinational corporations dominate.

7.3. Sectoral Distribution of Brazilian AI Patents

Figure 23 presents the subthemes associated with the top 10 Brazilian applicants. This visualization does not represent the total number of patents but rather serves as a guide for understanding the main focus areas of Brazilian AI innovation.

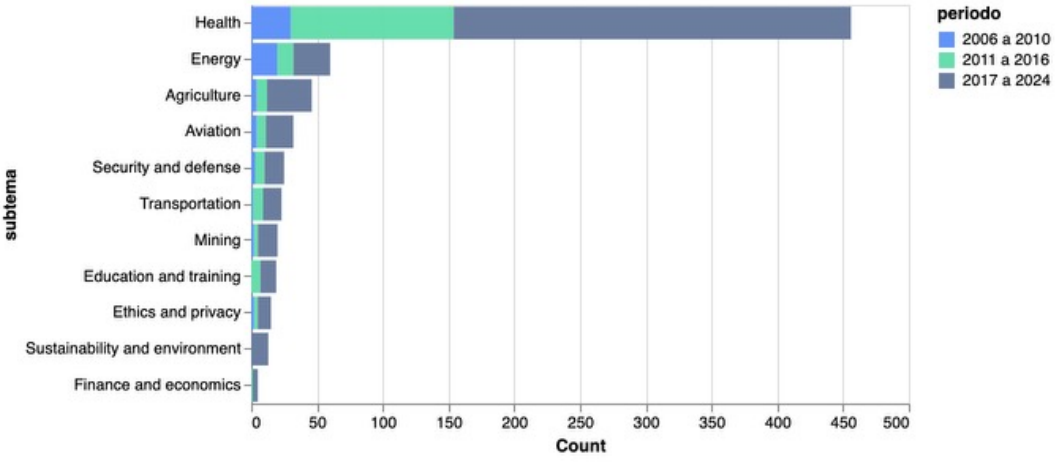

Figure 23. Patent Subthemes for the Top 10 Brazilian AI Patent Holders

Brazilian AI patent holders focus predominantly on healthcare and digital technologies, with distinctive strengths in energy systems and resource extraction compared to multinational corporations. A key highlight is Brazil's strong presence in AI applications for healthcare, which emerges as the primary subtheme for Brazilian applicants. Note, however, that many patents do not fit neatly into predefined subthemes, reinforcing the need for further refinement of IPC-based subtheme classification and indicating the diverse and potentially novel applications being developed by Brazilian innovators. Despite this caveat, the technological landscape of Brazilian AI patents can be divided into distinctive clusters (Table 4):

- **Healthcare and Medicine** represent the dominant cluster, revealing opportunities for transformative AI applications that could include predictive diagnostics using deep learning algorithms, personalized treatment planning with machine learning, AI-powered medical imaging analysis, precision medicine through genomic data interpretation, and robotic-assisted surgical systems.

- **Computing and Data Processing** suggests the potential for advanced machine learning algorithms for complex problem-solving, intelligent decision support systems, optimization of computational processes, adaptive AI systems for dynamic environments, and enhanced data privacy and security technologies.

- **Communications Technology** include AI innovations such as natural language processing for multilingual communication, advanced speech recognition and synthesis, intelligent network management, real-time translation and communication technologies, and predictive maintenance of communication infrastructure.

- **Energy and Motors** encompass innovations predictive maintenance for industrial machinery, smart grid optimization, energy consumption forecasting, autonomous control systems for renewable energy, and efficiency optimization in transportation and industrial processes.

- Other **emerging and specialized domains** include Chemistry/Biotechnology, Materials/Manufacturing, Transportation, and Resource Extraction.

Category	IPCs	IPC Descriptions	Total
Healthcare and Medicine	a61b; a61k; a61p	Diagnosis, surgery, identification; Preparations for medical, dental, or toilet purposes; Specific therapeutic activity of chemical compounds or medicinal preparations	2,558
Computing and Data Processing	g06f; g06n; g05d; g06k; g06t; g06q	Computing, calculating or counting - electric digital data processing; Computing arrangements based on specific computational models; Systems for controlling or regulating non-electric variables; Computing - graphical data reading; Computing - image data processing; Computing - data processing for administrative, commercial, financial purposes	2,321
Communications Technology	h04n; h04l; h04w; h04b	Electric communication technique - pictorial communication; Electric communication technique - transmission of digital information; Electric communication technique - wireless communication networks; Electric communication technique	1,737
Energy and Motors	f02d; f03d; h02p	Controlling combustion engines; Wind motors; Control or regulation of electric motors, generators or converters	1,060
Chemistry and Biotechnology	c12n	Microorganisms or enzymes, compositions thereof; propagating, preserving, or maintaining microorganisms; mutation or genetic engineering; culture media	280
Materials and Manufacturing	b29c	Shaping or joining of plastics; shaping of material in a plastic state; after-treatment of the shaped products	301
Traffic and Transportation Systems	g08g	Signalling - traffic control systems	297
Resource Extraction and Mining	e21b	Fixed constructions - earth or rock drilling; obtaining oil, gas, water, materials from wells	247

Table 4. Distribution of AI Patents Held by Brazilians across Technological Sectors in Brazil

This analysis highlights AI's transformative impact across diverse Brazilian sectors, from pharmaceuticals and healthcare to automotive and energy industries. The focus on health applications, energy systems, and resource extraction demonstrates Brazil's distinctive innovation priorities compared to international patent holders.

To better understand the strategic positioning of Brazilian AI technologies, a technological mapping analysis was conducted that classifies patents according to their density (internal cohesion) and centrality (strategic importance) within the innovation landscape (Figure 24).

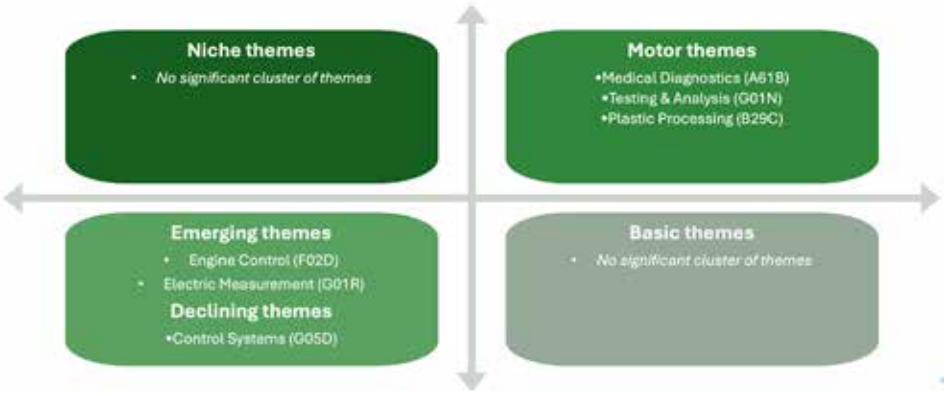

Figure 24. Technological Map of National AI Patents

This analysis further underscores that Brazilian AI patent holder strengths primarily lie in healthcare applications, computing, materials analysis, and advanced manufacturing, which appear as Motor Themes with both high centrality and density. These represent mature technology areas where Brazilian institutions have established significant expertise and cohesive development. Meanwhile, the Emerging Themes quadrant highlights engine control (F02D) and electric measurement (G01R) technologies as areas with high strategic potential but still developing internal cohesion. These energy systems and engine technology applications represent promising growth opportunities for Brazilian innovators. Control Systems (G05D) appear in the Declining quadrant, suggesting these technologies may be becoming less central to Brazil's AI innovation landscape. This strategic mapping provides valuable guidance for prioritizing future research and development investments in Brazilian AI innovation.

7.4. AI in Health: The Leading Subtheme for Brazilian Applicants

Health emerges as the primary AI application field among Brazilian patent filings, reflecting a strong focus on leveraging artificial intelligence for advancements in the healthcare sector. This trend highlights the growing interest and potential impact of AI-driven innovations in medical research, diagnostics, and treatment.

UFMG leads the Brazilian AI patent landscape in healthcare with 24 filings, twice as many as USP, the second-largest applicant in the country (Figure 25). This highlights UFMG's strong engagement in AI-driven research and innovation, particularly in healthcare and related fields. The university has demonstrated continuous patent activity since 2008, reinforcing its long-term commitment to technological advancements.

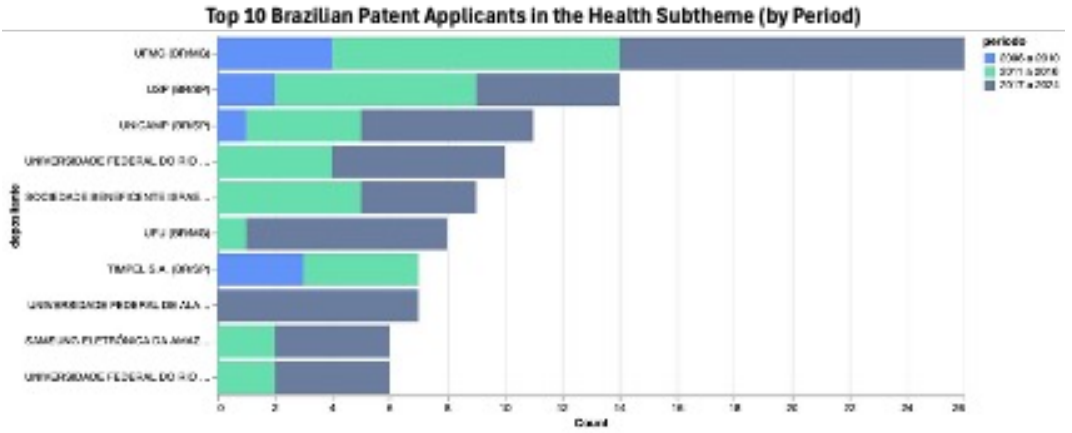

Figure 25. Top 10 Brazilian Patent Applicants in the Health Subtheme (by Period)

Notably, FAPEMIG played a key role between 2017 and 2021, supporting research initiatives and fostering innovation through funding and collaboration. This partnership underscores the importance of institutional backing in sustaining AI-related research efforts in Brazil. Meanwhile, SAMSUNG stands out as a leading private-sector player, showing a steady increase in patent filings since 2014, with notable growth in 2021. Its presence reflects the growing involvement of multinational corporations in the Brazilian AI ecosystem, bridging the gap between academic research and industrial applications.

A notable increase in patent activity occurred between 2017 and 2024, suggesting a recent surge in AI-related developments within the country. This growth may be attributed to advancements in machine learning, increased access to computational resources, and a broader recognition of AI's transformative potential across various domains, particularly in health.

The strong presence of universities, research institutions, and funding agencies indicates that Brazilian efforts remain concentrated on basic and experimental research. Unlike some countries where private-sector investments predominantly drive AI patents, Brazil's AI patent landscape appears to be fueled largely by academic and governmental initiatives. This pattern suggests that while significant knowledge production is taking place, there may be a gap in the commercialization and industrial application of these innovations.

These findings can guide future research and development priorities, helping stakeholders identify areas where academic strengths can be translated into industrial applications. The health sector, in particular, represents a promising domain for developing more structured technology transfer mechanisms and public-private partnerships that can accelerate the translation of AI innovations from research to clinical practice.

7.5. AI in energy-related themes

The energy sector is also a relevant field for patent filings in Brazil, with participation from both companies and universities. The total number of patents by assignee is, however, low – a reflection of Brazilian organizations' low and dispersed patenting activity. Whirlpool S.A. leads the ranking with six filings between 2006 and 2016, without any new patents filed since. The Companhia Paulista de Força e Luz (CPFL) and the Universidade Estadual de São Paulo (UNESP) are tied in second place with three patents filled between 2017 and 2024 (Figure 26). Research organizations such as CPqD also appear among the top applicants, showing activity across different periods. It is worth noting that Brazilian Institutions, namely CPFL, UNESP, and CPqD lead energy-related AI patent applications between the years of 2017 and 2024. Such an increase in the same time frame may reflect recent developments in the sector.

The data points to a distribution of patent activity between private companies and academic or research institutions. This balance may create opportunities for collaboration and for the development of new technologies in the energy area.

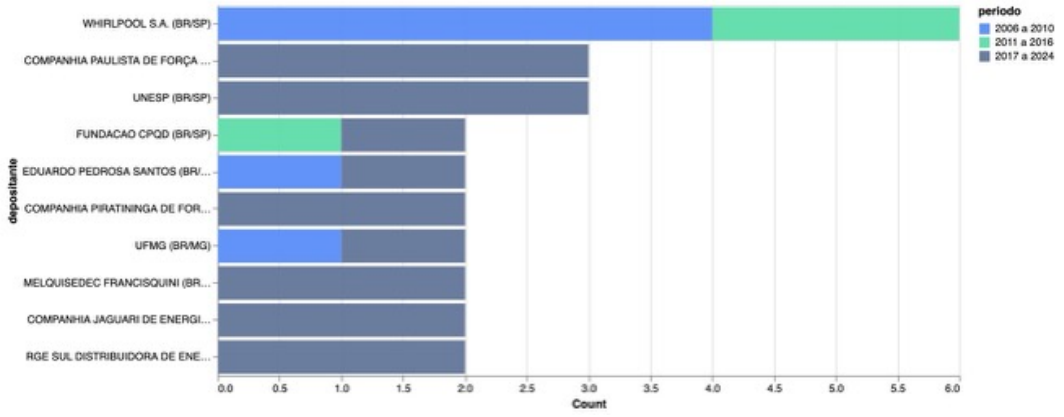

Figure 26: Top 10 Brazilian Patent Applicants in the Energy Subtheme (by Period).

7.6. Concluding Remarks: Brazilian vs. International AI Patent Holders

When comparing Brazilian and international AI patent activity in Brazil, several distinctive patterns emerge that highlight the unique characteristics of the domestic innovation landscape (Table 5).

	Multinational Corporations	Brazilian Institutions
Focus areas	Electronics, telecommunications, automotive, pharmaceuticals	Healthcare, energy systems, resource extraction, agricultural technology
Institutional types	Global technology corporations, pharmaceutical companies	Universities (UFMG, USP, UNICAMP), state enterprises (Petrobras, Vale), research institutes
Patent volume	89% of AI patent filings in Brazil (18,565 patents)	11% of AI patent filings in Brazil (2,256 patents)
Growth trends	Steady growth since 2010, peak in 2020	Accelerated growth 2017-2024, 3× increase in university patents
Strategic priorities	Market protection, global portfolio development	Technological sovereignty in strategic sectors, knowledge transfer
Technology maturity	Advanced consumer applications, general AI infrastructure	Applied sector-specific solutions, adaptation to local contexts
Geographical pattern	Global with protection in Brazilian market	Concentrated in Southeast (São Paulo, Minas Gerais) and Amazon regions
Collaboration model	Corporate R&D centers, limited academic partnerships	University-industry-government partnerships (triple helix model)
Competitive advantages	Global scale, advanced infrastructure, talent pool	Domain expertise in strategic sectors, contextual knowledge of local challenges
Potential synergies	Technical infrastructure and advanced AI methods	Application expertise in healthcare, energy, and natural resources

Table 5. Comparison between Multinational Corporations and Brazilian Institutions in AI Patent Activity

Multinational Corporations (MNCs) focus primarily on electronics, telecommunications, automotive, and pharmaceutical applications, while Brazilian institutions concentrate on healthcare, energy systems, resource extraction, and agricultural technology. This reflects the alignment of innovation priorities with national strategic advantages and needs.

In terms of institutional types, global technology corporations and pharmaceutical companies dominate international filings, whereas Brazilian patents originate primarily from universities (UFMG, USP, UNICAMP), state enterprises (Petrobras, Vale), and research institutes. This fundamental difference in the source of innovation shapes the nature and application of patented technologies.

The volume disparity is significant: 89% of AI patent filings in Brazil (18,565 patents) come from international entities, while Brazilian institutions account for only 11% (2,256 patents). However, Brazilian patents have shown accelerated growth between 2017-2024, with a threefold increase in university patents, indicating growing domestic capacity and awareness of intellectual property importance, and the impact of recent policy initiatives. Furthermore, Brazilian institutions are developing specialized expertise in strategically important sectors for the national economy.

Thus, strategic priorities also differ markedly. While MNCs focus on market protection and global portfolio development, Brazilian institutions emphasize technological sovereignty in strategic sectors and knowledge transfer to address local challenges. This influences the nature of the innovations and their intended applications.

In terms of technology maturity, international patents typically reflect advanced consumer applications and general AI infrastructure, while Brazilian patents demonstrate applied sector-specific solutions adapted to local contexts. Geographically, MNC patents are part of global protection strategies that include Brazil, while Brazilian innovation remains concentrated in the Southeast (São Paulo, Minas Gerais) and Amazon regions.

Collaboration models also differ significantly. Corporate R&D centers with limited academic partnerships characterize international patent development, whereas Brazilian innovation follows a university-industry-government partnership model (the triple helix approach). Each approach carries distinct advantages: global scale, advanced infrastructure, and talent pools for MNCs versus domain expertise in strategic sectors and contextual knowledge of local challenges for Brazilian institutions.

These differences point to potential synergies where collaborations could leverage MNCs' technical infrastructure and advanced AI methods with Brazilian contextual expertise in healthcare, energy, and natural resources. Such partnerships could accelerate innovation while ensuring relevance to local needs and priorities.

Brazil has made significant strides in artificial intelligence over the past decade, establishing itself as Latin America's leading AI hub while navigating a complex landscape of opportunities and challenges. This concluding section synthesizes the multidimensional analysis presented throughout the report, offering both a strategic assessment of Brazil's current position and a framework for productive international collaboration.

8. The Brazilian AI Landscape: SWOT Analysis and Framework for International Collaboration

8.1. SWOT Analysis of Brazil's AI Ecosystem

A comprehensive evaluation of Brazil's AI landscape reveals a nuanced picture of the country's strategic position in the global AI ecosystem. The following analysis synthesizes the diverse elements explored in previous sections into a cohesive assessment of strengths, weaknesses, opportunities, and threats (Figure 27).

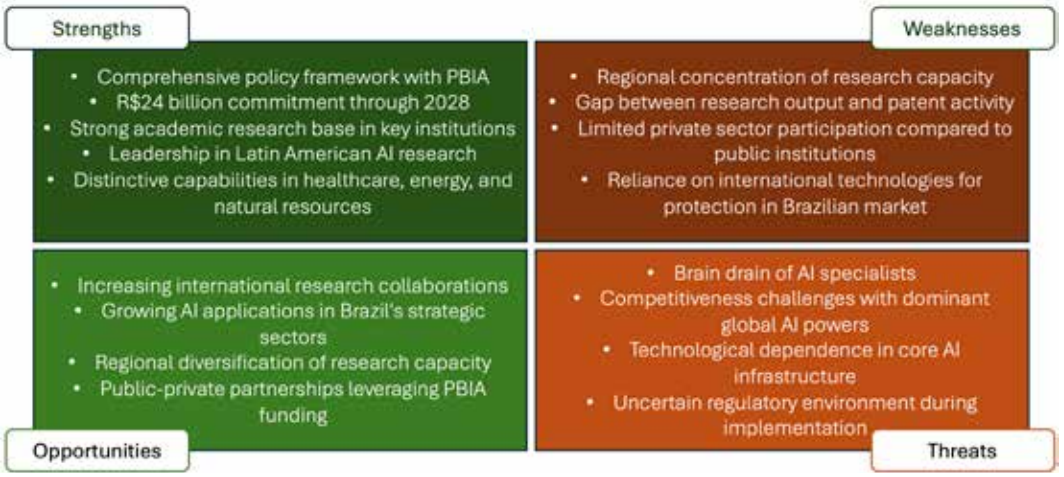

Figure 27. Brazil's AI Landscape: SWOT Analysis

8.1.1. Strengths

Brazil has established several foundational strengths that position it favorably within the global AI landscape. The comprehensive policy framework developed through the Brazilian AI Plan (PBIA) represents a significant advancement over the earlier Brazilian Artificial Intelligence Strategy (EBIA), providing clearer directives and more robust implementation mechanisms. This policy maturation is backed by substantial financial commitment, with R$24 billion allocated through 2028 to support AI development across multiple sectors.

The country's strong academic research base in key institutions, particularly in São Paulo, Minas Gerais, Rio de Janeiro, and Amazonas, provides the intellectual foundation for continued innovation. This academic strength has established Brazil's leadership in Latin American AI research, contributing approximately

1.8% of global AI research output. As evidenced by the rapid growth in master's and doctoral research related to AI, the country is developing a pipeline of specialized talent that can drive future innovation.

Brazil has also developed distinctive capabilities in several strategic domains. In healthcare, as demonstrated in Sections 5 and 7, Brazilian institutions have established significant expertise in AI applications for medical diagnostics and treatment planning. Similarly, in energy systems, natural resources, and agricultural technology, Brazil is leveraging AI to address challenges unique to its economic profile and natural advantages.

8.1.2. Weaknesses

Despite these strengths, Brazil faces several structural weaknesses in its AI ecosystem. The regional concentration of research capacity, primarily in the Southeast region, limits the country's ability to develop and implement AI solutions that address diverse national needs. As shown in Section 4, while there are emerging centers in other regions, particularly in the Northeast and the Amazon, this geographic imbalance remains pronounced.

A persistent gap exists between research output and patent activity, with Brazilian institutions accounting for only 11% of AI patents filed in Brazil despite producing a proportionally larger share of global research publications. Such a discrepancy indicates challenges in translating academic research into commercial applications and intellectual property.

The limited private sector participation compared to public institutions represents another significant weakness. Unlike countries where corporate R&D drives AI innovation, Brazil's AI development remains predominantly within universities and state enterprises. The pattern, detailed in Section 7, may limit the commercialization potential and economic impact of Brazilian AI research.

Another notable weakness is Brazil's reliance on international technologies for market protection. As demonstrated by the patent analysis, 89% of AI patents filed in Brazil originate from international entities, which would indicate technological dependence in many core AI domains.

8.1.3. Opportunities

Brazil's position in the AI landscape presents numerous opportunities for strategic development. The increasing international research collaborations, with nearly half of recent scientific papers being co-authored internationally, provide channels for knowledge exchange and capacity building. International collaborations can contribute to Brazil's access to cutting-edge methodologies while contributing unique contextual insights.

The growing application of AI across Brazil's strategic sectors – including healthcare, agriculture, energy, and manufacturing – represents a significant opportunity to address national priorities through technological innovation. As detailed in Section 6, AI applications are increasingly aligning with Brazil's economic strengths and development needs.

The regional diversification of research capacity, though still in the early stages, offers an opportunity to develop AI solutions tailored to different regional contexts within Brazil. It is through a diversification strategy that Brazil may be able to address the regional concentration weakness while fostering innovation that responds to Brazil's diverse socioeconomic and environmental challenges.

Public-private partnerships leveraging PBIA funding provide mechanisms to bridge the gap between academic research and commercial application. When effectively structured, partnerships can leverage private sector participation in Brazil's AI ecosystem.

8.1.4. Threats

Several external and internal factors threaten Brazil's progress in artificial intelligence. The brain drain of AI specialists to global technology hubs represents a significant challenge to building and maintaining domestic capacity. Without adequate retention strategies, Brazil risks losing its most talented researchers and developers to international competitors.

Competitiveness challenges with dominant global AI powers, particularly the United States and China, threaten to marginalize Brazil's position in the global AI landscape. These established powers benefit

from massive investment, large talent pools, and advanced technological infrastructure that Brazil currently cannot match.

Technological dependence in core AI infrastructure, including computing resources and foundational models, limits Brazil's ability to develop sovereign AI capabilities. The patent analysis shows that Brazil relies heavily on international technologies, potentially constraining its autonomy in strategic applications.

The still uncertain regulatory environment during the implementation of new AI policy frameworks may create barriers to innovation and investment. While Brazil has made significant progress in developing regulatory frameworks, as detailed in Section 2, the translation of these frameworks into effective governance remains a challenge.

8.2. Framework for International Collaboration on AI in Brazil

Building on the SWOT analysis, a strategic framework for international collaboration can help Brazil leverage external partnerships to enhance its strengths and address its weaknesses. The suggested framework for international collaboration consists of three interconnected pillars: complementary expertise, strategic collaboration mechanisms, and knowledge transfer protocols.

8.2.1. Complementary Expertise

Effective international collaboration requires recognizing and capitalizing on the complementary nature of expertise between multinational corporations and Brazilian institutions. Multinational corporations bring sophisticated AI methodologies and global technological best practices, creating a robust technical infrastructure that spans cutting-edge algorithms and advanced computational approaches. Their global perspective, resources, and experience implementing AI at scale provide valuable technical foundations.

Brazilian institutions complement these technical capabilities with deep contextual understanding, offering nuanced insights into local challenges, sector-specific complexities, and unique problem-

solving perspectives that transform global technologies into locally relevant solutions. As demonstrated throughout this report, Brazilian researchers have developed distinctive expertise in applying AI to healthcare, energy systems, and natural resource management – domains where contextual knowledge is particularly valuable.

The complementarity is particularly evident in healthcare applications, where Brazilian institutions like UFMG have developed significant expertise in AI applications for medical diagnostics and treatment planning (Section 7). By combining contextual expertise with the advanced technical capabilities of multinational corporations, collaborative initiatives can lead to AI solutions that are both technically sophisticated and contextually appropriate.

8.2.2. Strategic Collaboration

Collaborative research centers represent a promising approach to bridging technological gaps, by establishing interdisciplinary teams that transcend traditional institutional boundaries. The 13 Applied Research Centers (CPAs), described in Section 4, provide an existing infrastructure for such collaboration, creating platforms where researchers from multinational corporations and Brazilian institutions can work together on shared challenges.

The establishment of collaborative research centers can facilitate knowledge exchange, providing structured platforms for researchers to collaborate, share resources, and develop innovative AI solutions that address global standards and local needs. The mechanism goes beyond simple knowledge sharing, creating integrated research environments that foster technological synergy.

The geographical distribution of these CPAs, though currently concentrated in the Southeast and Northeast regions, provides opportunities for broader regional engagement. Future collaboration centers could strategically target underrepresented regions (a strategy already envisioned in the PBIA), addressing the regional concentration weakness identified in the SWOT analysis while leveraging the distinctive perspectives and challenges of different Brazilian contexts.

8.2.3. Knowledge Transfer

Effective collaboration requires knowledge transfer protocols that go beyond traditional technology licensing. These protocols would create frameworks for intellectual property sharing and capacity- and capability-building, ensuring that technological innovations benefit both parties equitably. The patent analysis in Sections 6 and 7 shows that the current disparity between international and Brazilian patent holdings indicates the need for more balanced approaches to intellectual property development and protection.

The approach involves developing mutual capacity- and capability-building programs, creating transparent mechanisms for technology adaptation, and establishing clear guidelines that align innovation objectives while respecting each institution's strategic interests and maintaining ethical standards of technological development. These protocols are particularly important in strategic sectors like healthcare, energy, and natural resources, where Brazilian institutions have developed significant contextual expertise.

Knowledge transfer mechanisms should recognize the distinctive institutional contexts of Brazilian and international partners. While multinational corporations typically operate through corporate R&D centers with limited academic partnerships, Brazilian innovation follows a university-industry-government partnership model (the triple helix approach). Effective knowledge transfer protocols must bridge these different institutional arrangements to facilitate productive collaboration.

8.3. Cross-Cutting Themes and Strategic Priorities

Throughout the analysis of Brazil's AI landscape, several cross-cutting themes emerged that warrant strategic attention from policymakers, researchers, and industry leaders. These themes represent areas where Brazil has distinctive strengths or opportunities for development, and where focused effort could yield significant returns.

8.3.1. Healthcare as a Strategic Domain

Healthcare emerges consistently as a dominant theme across multiple dimensions of Brazil's AI landscape. Brazil displays an array of AI research units dedicated focused on health and medical solutions, including three already operational and two new CPAs. In scientific production, healthcare applications represent a significant portion of research output (Section 5). Similarly, in patent activity, both Brazilian and international entities have focused extensively on healthcare applications, with UFMG leading Brazilian healthcare-related patent filings (Section 7).

The concentration in healthcare reflects both global trends in AI applications and Brazil's distinctive needs and capabilities. The country's universal healthcare system (SUS) provides a unique context for AI implementation, offering opportunities to address challenges in service delivery, resource allocation, and preventive care. Additionally, Brazil's diverse population and epidemiological profile present distinctive challenges and opportunities for AI applications in precision medicine, disease surveillance, and health system optimization.

The strength in healthcare AI positions Brazil for strategic international partnerships that leverage this domain expertise while addressing technological limitations. Such partnerships could focus on developing AI solutions that respond to Brazil's healthcare challenges while contributing to global advances in medical AI applications.

8.3.2. Energy Systems and Natural Resources

Brazil's distinctive expertise in energy systems and natural resource management represents another strategic domain for AI development. The patent analysis in Section 7 highlighted significant activity in these areas, particularly from state enterprises like Petrobras. This focus aligns with Brazil's economic profile, which includes substantial natural resource extraction and renewable energy development.

The application of AI to optimize energy systems, enhance resource extraction efficiency, and manage environmental impacts represents a domain where Brazil can develop globally relevant expertise. The

country's leadership in biofuels, hydroelectric power, and emerging renewable energy sources provides a distinctive context for AI innovation that addresses both economic and environmental objectives.

International collaborations in this domain could leverage Brazil's contextual expertise while accessing advanced AI methodologies for optimization, predictive maintenance, and system management. Such partnerships could accelerate Brazil's technological capabilities while contributing to global efforts in energy transition and sustainable resource management.

8.3.3. Regional Development and Inclusion

The geographic distribution of Brazil's AI ecosystem, with its current concentration in the Southeast region, highlights the need for strategies that promote regional development and inclusion. As shown in Section 4, while São Paulo, Minas Gerais, and Rio de Janeiro lead in research output and patent activity, emerging centers in the Northeast and Amazon regions demonstrate the potential for broader regional engagement.

Expanding AI research and development capacity across Brazil's diverse regions would serve multiple strategic objectives. It would enhance the relevance of AI solutions to regional challenges, expand the talent pool for AI development, and contribute to more equitable economic development. Additionally, it would leverage the distinctive perspectives and knowledge of different regional contexts, potentially leading to more innovative and diverse AI applications.

International collaborations that explicitly address regional development could help overcome the resource and infrastructure limitations that currently constrain regional AI capacity. By establishing collaborative research centers in underrepresented regions and developing targeted knowledge transfer programs, international partnerships could contribute to a more balanced and inclusive AI ecosystem in Brazil.

8.4. Conclusion and Future Directions

Brazil's position in the global AI landscape reflects a complex interplay of strengths, weaknesses, opportunities, and threats. The country has established itself as Latin America's leader in AI research, developed distinctive capabilities in strategic domains, and implemented comprehensive policy frameworks to guide future development. However, challenges remain in translating research into commercial applications, expanding private sector participation, and developing sovereign technological capabilities.

The framework for international collaboration presented in this section offers a strategic approach to leveraging external partnerships to enhance Brazil's AI capabilities while addressing its limitations. By focusing on complementary expertise, establishing effective collaboration mechanisms, and developing equitable knowledge transfer protocols, Brazil can accelerate its AI development while maintaining alignment with national priorities and values.

Looking forward, Brazil's AI trajectory will likely depend on several key factors: the effective implementation of the Brazilian AI Plan (PBIA), the development of mechanisms to translate academic research into commercial applications, the expansion of AI capacity across diverse regions, and the strategic cultivation of international partnerships that enhance domestic capabilities while respecting national sovereignty and priorities.

By building on its distinctive strengths in healthcare, energy systems, and natural resource management, while addressing structural weaknesses through targeted policy interventions and international collaborations, Brazil can establish a more prominent and influential position in the global AI ecosystem. This position would not only contribute to economic development and social welfare within Brazil but also enable the country to shape the evolution of AI in ways that reflect its values, priorities, and distinctive perspective on global challenges.

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