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PANORAMA AND REGIONAL INEQUALITY OF ARTIFICIAL INTELLIGENCE PATENTS IN BRAZIL (2006-2026)

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Abstract

The study analyzes the panorama of Artificial Intelligence (AI) patents published in Brazil, based on 152 documents identified in the database of the National Institute of Industrial Property (INPI), in the period from 2006 to 2026. The research has a qualitative approach and exploratory-descriptive character, using techniques of technological prospecting, and bibliometric analysis. The results show a temporal evolution marked by three phases: low activity (2008-2016), moderate growth (2017-2020), and accelerated expansion (2021-2025), with continuity in 2026. From the technological point of view, there is a strong regional concentration in the Southeast, followed by the South, while the Northeast, Central-West, and North regions have a reduced participation. This pattern indicates the absence of regional balance in technological production. The analysis of the applicants reveals a fragmented ecosystem, with a predominance of individual inventors and academic institutions, in addition to a significant presence of international actors. It is concluded that, although there has been progress in the production of AI patents in Brazil, structural challenges related to regional inequality and low technological density persist, demanding public policies aimed at the decentralization of innovation.

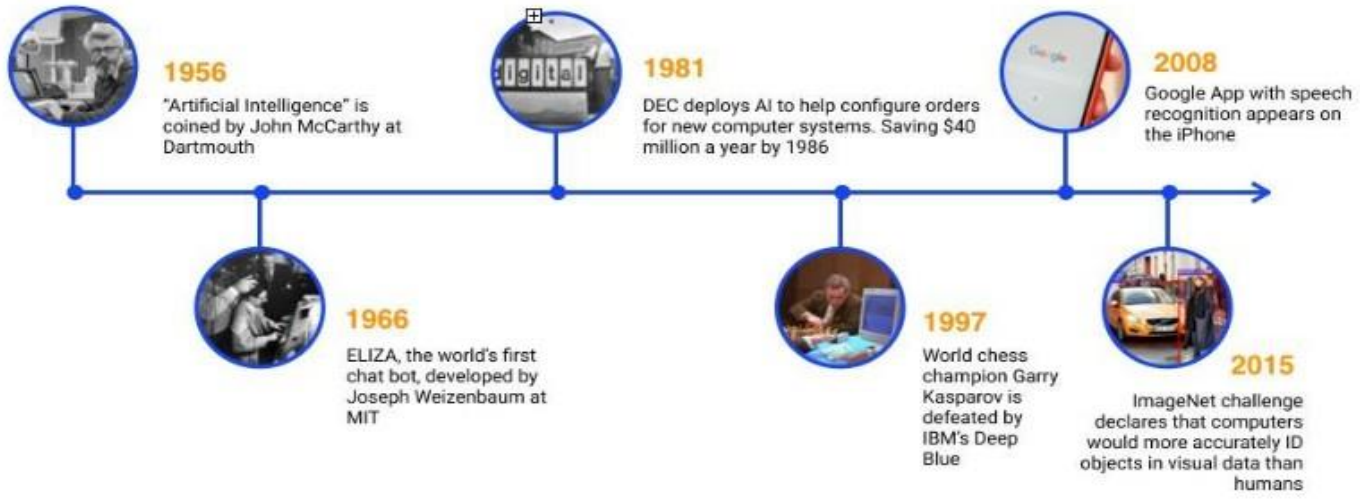
Keywords: *Technological development, Innovation, INPI, Intellectual Property, Technological prospecting.*

INTRODUCTION

Technological advancement plays a fundamental role in the transformation of various aspects of society, especially from the twenty-first century onwards, with the development of digital technologies, which have assumed a preponderant role in the process of expanding communications and connectivity. This advance has a direct impact on people's lives, influencing the social, individual, and professional dimensions, and is widely applied in areas such as health, education, among others, through projects conducted by public and private entities [1], [2], [3], [4], [5], [6].

Artificial Intelligence (AI) is a branch of computer science that covers areas such as robotics, image recognition, and language, as well as expert systems, among others. The term was coined by John McCarthy in 1956 during the *Dartmouth* Conference, considered a milestone in the history of AI. At this event, AI was defined as an area of science and engineering focused on the development of intelligent machines capable of simulating human intelligence and performing cognitive activities, from the simplest to the most complex. It is one of the fields of greatest growth and technological potential today, leading research that aims to promote significant advances and improvements in the quality of life of humanity. In the Brazilian context, the analysis of AI patents allows us to understand the panorama of trends in research and development, highlighting innovation dynamics and strategic areas of investment [7], [8], [9], [10], [11], [12], [13]. The evolution of AI over time can be seen in Figure 1.

Figure 1 – Evolution of AI



Source: https://www.blip.ai/blog/tecnologia/inteligencia-artificial/ (2021)

Currently, AI is fundamental to the field of knowledge, especially in the development of systems that think and act like human beings, and can be subdivided into four technological subfields: reasoning and problem solving, machine learning, network structures, and knowledge processing systems [14], [15]. Table 1 presents this classification.

Table 1 – Classification of AI systems

	Human being	Rationality
Thinking	Systems that think like humans	Systems that think rationally
Take action	Systems that act like humans	Systems that act rationally

Source: Authorship (2026), based on [16] Russell and Norvig (2013)

AI classifications are associated with specific definitions, as shown in Table 2.

Table 2 - Definitions of AI classifications

Line of thought	Definition
Thinking like a human being	"The new and interesting effort to make computers think... machines with minds, in the total and literal sense." (HAUGELAND, 1985).
Act like a human being	"The art of creating machines that perform functions that require intelligence when performed by people." (KURZWEIL, 1990)
Thinking rationally	"The study of mental faculties by their use of computational models." (CHARNIAK; MCDERMOTT, 1985)
	"The study of computations that make it possible to perceive, reason and act". (WINSTON, 1992).
Act rationally	"Computational Intelligence is the study of the design of intelligent agents." (POOLE *et al*., 1998).

Source: Authorship (2026), based on [16] Russell and Norvig (2013)

Several countries, such as China, France, Japan, among others, have launched strategic programs with the aim of developing this technology at different levels of approach. In 2023, the United States of America (USA) invested about 67.2 billion dollars in AI, while China invested approximately 8.7 times less, however, the number of Chinese patents in 2023 was about 4.6 times higher than the number of US publications [7], [9], [10], [11], [12], [13].

In Brazil, the main programs to encourage the development of AI are:

- Brazilian Artificial Intelligence Strategy (EBIA), launched in 2021 by the Ministry of Science, Technology and Innovations, which aims to promote the development and adoption of AI [17];
- National Internet of Things (IoT) Plan, instituted in 2019, which addresses the integration of AI in various applications aimed at the health, agriculture, and smart city sectors [17].

The evolution of AI generates significant impacts on society, with repercussions on education, health, and people's daily lives and, depending on its application, can generate problems related to privacy and ethics [18], [19], [20], [21].

The expansion of AI in Brazil and in the world is indispensable, as it intensifies the flow of knowledge, data, communications, among others, in addition to generating competitive advantages in various economic sectors, such as agriculture, livestock, petrochemicals, among others, which reinforces its strategic importance for nations [22], [23], [24], [25].

AI has grown in importance due to its role in economic and social development, being essential not only for Brazil, but also for developing countries, by enabling greater insertion in the market, reducing socioeconomic inequalities, and stimulating innovation.

Patents are relevant instruments to assess the level of scientific and technological development of a country, allowing the analysis of the evolution of technologies, innovations and techniques over time, in addition to providing strategic information on technological potential. The protection of AI innovations through patents is a topic of great relevance for academia, researchers, and the industrial sector [11], [26], [27], [28], [29].

In Brazil, patents are regulated by Law No. 9,279/1996, known as the Industrial Property Law [30].

Research is the driving force of innovation, encouraging the protection of results through the filing of patents, which is influenced by favorable environments for innovation, with incentives, investments, and strategies implemented by public and private entities [31], [32].

In general, residents tend to initially protect their inventions in their countries of origin and, subsequently, seek international markets, especially those with greater economic relevance [31], [32].

Public policies should be directed at inventors, especially independent inventors, *startups*, and universities, which are important centers for generating innovation and, in Brazil, often lead patent filings compared to the private sector [33], [34], [35], [36], [37].

Patent analysis is essential to understand the state of technological innovation in Brazil, allowing the identification of investment opportunities, fostering partnerships between public and private actors, and mapping regions with greater technological dynamism. In addition, it subsidizes the formulation of strategies aimed at technological development.

Brazil is a relevant country in South America, in the process of development, and concentrates a large part of the patent filings in the region. However, regional inequality is a complex and persistent phenomenon, manifesting itself in the economic, educational, and social dimensions, among others, and is one of the main challenges faced by the country [38], [39], [40], [41], [42], [43].

The degree of inequality between the Brazilian regions is significant and can be observed both in the participation in the national income and in social indicators, such as access to basic infrastructure. The Southeast region has a higher level of industrialization, while the North and Northeast regions face greater structural limitations. This concentration of wealth results in problems such as poverty, social exclusion, inequality of opportunity and migration [38], [39], [40], [41], [42], [43].

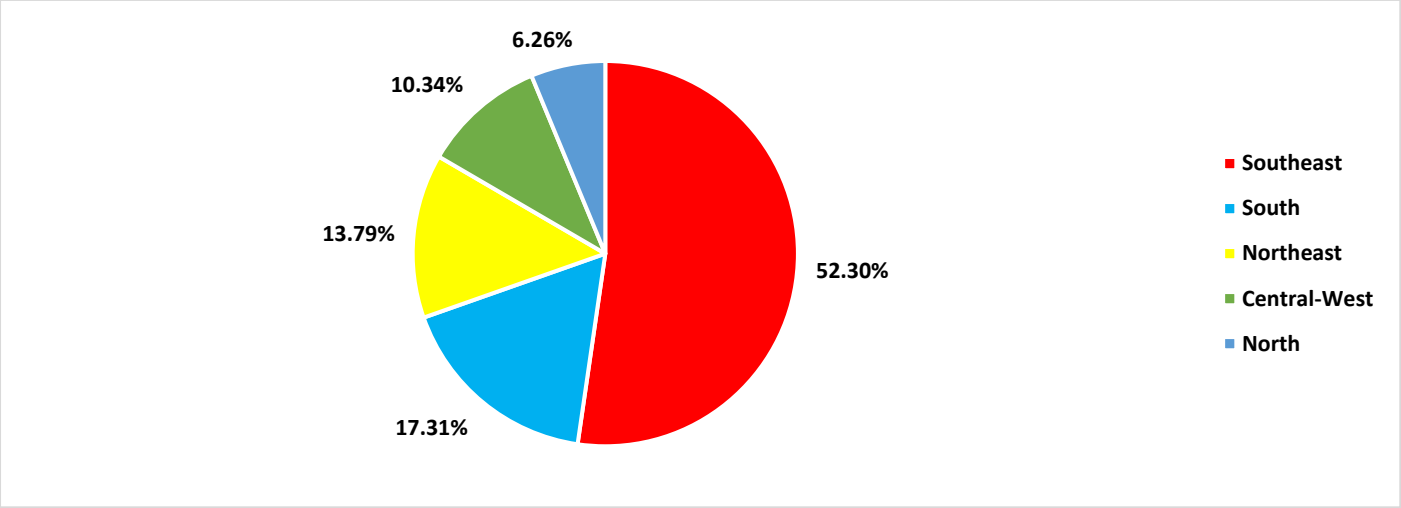
Historically, this inequality intensified with the transition from an agrarian-export economy to an urban-industrial economy, starting in the nineteenth century, with a strong concentration in the states of São Paulo and Rio de Janeiro, which promoted the spatial concentration of investments and the migration of labor [38], [39], [40], [41], [42], [43].

The main initiatives to reduce regional inequality include income transfer policies, such as Bolsa Família, expanding access to basic education, investments in infrastructure, and regional development policies.

The Gross Domestic Product (GDP) corresponds to the sum of all final goods and services produced by a country, state or city in a given period, usually a year. In 2023, the Brazilian GDP reached R$ 10.9 trillion. According to the IBGE (2024), the GDP represents the flow of production and not the stock of wealth. Its measurement is based on several data sources, such as industrial research and agricultural production. In Brazil, it is generally published

quarterly [38], [39], [40], [43], [44]. The participation of the regions in the national GDP in 2023 can be seen in Figure 2.

Figure 2 – Participation of the regions in the National GDP in 2023



Source: Authorship (2026) based on IBGE data (2023)

Figure 2 shows regional inequality, highlighting that the Southeast Region, led by São Paulo, concentrates more than half of the national GDP, while the North Region has a share of less than 10.0%. This scenario persists over the decades, with no clear signs of reversal.

This paper presents an analysis of AI patents published in Brazil, considering both residents and non-residents, integrating qualitative data for their interpretation.

The study addresses AI patents in Brazil, focusing on quantitative indicators, such as temporal distribution, by country of origin and by federative unit, without delving into specific qualitative aspects.

Understanding the landscape of AI patents in Brazil is essential to support the formulation of public and private strategies aimed at innovation, as well as for the creation of favorable environments for research and development.

Despite the growth in the number of patent publications, challenges related to the protection of innovation persist, such as bureaucracy and the shortage of specialized professionals for analysis, which may encourage inventors to seek protection in other countries.

In this context, the present work aims to analyze the AI patents published in Brazil, in order to verify the existence of balance between the Brazilian regions.

METHODOLOGY

The research was divided into two stages: qualitative analysis and technological prospecting.

The methodology adopted was predominantly based on the qualitative analysis of AI technological patents, since inferential statistical methods were not applied. In addition, patents at the national level were examined with the objective of verifying the existence of a balance in development between Brazilian regions [45], [46], [47].

As for the methodological classification, the research is characterized as basic in nature, with a qualitative approach, exploratory and descriptive objectives and a bibliographic technical procedure.

Basic research aims at the theoretical understanding of phenomena, without immediate practical application. In this context, the analysis of AI technological patents sought to observe their evolution over time, contributing to the advancement of academic knowledge, based on the theoretical foundations of the area [45], [46], [47].

The qualitative approach allows for a deeper understanding of the object of study and its phenomena, exploring subjective and contextual aspects. In the case of AI patents, this approach makes it possible to analyze their applications, identify regions with greater technological dynamism, potential partners and researchers, as well as areas of application in the field of knowledge [45], [46], [47].

As for the descriptive objectives, the research sought to map and characterize the phenomenon, identifying and describing the patents published in Brazil, the technological types, the filing and publication periods, in order to understand the current scenario and its trends [45], [46], [47].

Regarding the exploratory character, the study sought to investigate and raise guiding questions for future research, identifying gaps, relationships between patents and the

market, as well as ethical and legal challenges associated with AI [45], [46], [47].

The bibliographic procedure consisted of a literature review, used as a theoretical support for the research, including the collection and analysis of books, scientific articles and relevant documents. This stage allowed us to understand the relationship between previous studies and the present investigation, as well as to identify convergences, divergences and methodological contributions, subsidizing the contextualization and analysis of the results [45], [46], [47].

Data collection was an essential step for the qualitative analysis, involving the selection of works and documents related to the theme, excluding those that did not fit the scope of the research. The time limit adopted was 20 years, covering the period from 2006 to 2026.

The stages of the bibliometric analysis included: definition of the scope of the study; preparation of the research protocol; choice of analysis techniques; data collection; treatment and analysis of information; and presentation of the results.

Patent databases can be public or private, free or paid, offering different analytical functionalities. Among the main ones, *Espacenet, Google Patents, PatentScope, Orbit* and the database of the National Institute of Industrial Property (INPI) stand out. Considering the focus on Brazilian patents, the INPI's database was chosen, which due to its relevance and scope in the national context.

The choice of the theme is justified by the need to understand the panorama of technological development in AI, especially with regard to innovations developed by residents, whose volume of patents can indicate the level of technological maturity of the country.

The database used was that of the INPI. The search term adopted was "artificial intelligence", applied in the "abstract" and "title" fields. Data collection was carried out on April 9, 2026, following a systematic procedure to ensure the reliability and validity of the information. The data were organized in electronic spreadsheets and analyzed with the aid of Microsoft Excel, allowing the elaboration of graphs and tables.

The time frame was limited to the period from January 1, 2006 to April 9, 2026. A total of 152 AI-related patents were identified in Brazil, however, after applying the selection and exclusion criteria, all were considered eligible for analysis. A higher concentration of applications in the industrial area was observed.

The INPI's database was selected for its relevance as a primary source of information on patents in Brazil, allowing us to understand the dynamics of the national innovation system and identify trends in the registration of AI patents.

The technological prospecting procedures began with the definition of objectives and identification of the relevant databases. In the INPI's database, an advanced search was performed using keywords combined by Boolean AND operators. Subsequently, the abstracts and, when necessary, the complete documents were read to verify adherence to the scope of the research, composing the qualitative stage.

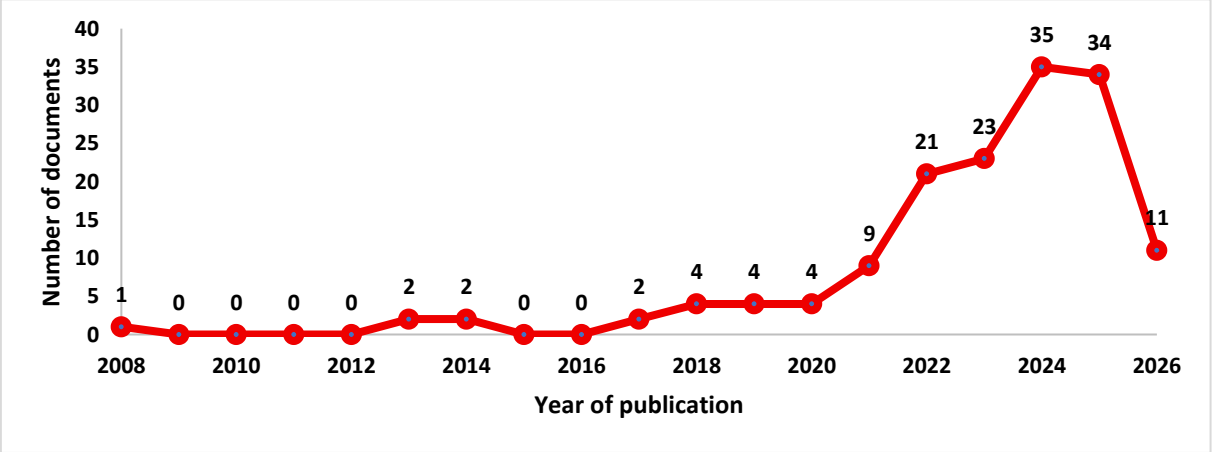
The quantitative dimension of the research consisted of the count of patents published in the analyzed period and the geographical distribution. However, inferential statistical techniques were not applied, which is why the study is not characterized as quantitative in the strict sense.

RESULTS AND DISCUSSIONS

TEMPORALITY OF PATENTS

AI-based technology has been widely used in various fields of human knowledge, especially in the twenty-first century. Figure 3 shows the evolution of AI patent publications from 2008 onwards.

Figure 3 – Evolution of the publication of AI patents between 2008 and 2026



Source: Authorship, based on data from the INPI (2026)

Figure 3 shows that the temporal distribution of the 152 patent documents related to AI in the INPI's database shows a clear process of emergence, accelerated growth, and recent technological consolidation. The analysis can be structured in three main phases:

1 Embryonic stage and low activity (2008–2016)

Between 2008 and 2016 (total of 5 patents and an average of 0.55 patents/year), there was an extremely low volume of publications, with several years without registrations (2009-2012, 2015-2016) and few isolated peaks (2013-2014, with 2 documents in each year).

This scenario suggests that AI was still incipient in Brazil, from a patent perspective. In this period, it can be inferred the predominance of academic research without conversion into intellectual property assets; as well as the low maturity of the national digital innovation ecosystem.

It is observed that, in this phase, there were only publications of patents owned by Brazil, involving two independent inventors, a management and consulting company and a university. As for the areas of application, two patents are identified in the health area, one in the agricultural/livestock farming (fishing), one in the industrial/chemical area and one of a mixed nature (technology and entertainment). Only one patent was granted, with an interval of 12.6 years between filing (2006) and granting (2019). The average time between deposit and publication ranged between 600 and 1,000 days, significantly higher than the current standard. In addition, no external influence was observed, since all patents were national and without unionist priority.

2 Phase of recovery and gradual growth (2017-2020)

Between 2017 and 2020, 14 patents were published, with an average of 3.5 publications/year, representing a growth of approximately 280% compared to the previous phase.

The average time between deposit and publication was approximately 21.7 months (about 1.8 years). Most of the applications had an interval between 18 and 24 months, indicating a relatively stable behavior and close to the expected standard of secrecy of 18 months in the patent system. However, some records had longer terms (between 29 and 36 months), raising the overall average, which may be associated with factors such as administrative delays; insufficient personnel at the INPI; accumulation of processes (backlog); and adjustments in the preliminary examination flows.

In addition, it is observed that older orders tend to have longer publication times, while the most recent ones converge to the standard of 18 months, indicating a gradual improvement in the efficiency of the system over time.

From the technological point of view, the following distribution is observed, as shown in Table 3.

Table 3 Distribution by technological area

Area	Quantity	Percentage
Industrial / Automation	5	36%
Business / Retail / Finance	4	29%
Health / Medical	1	7%
Environmental / Energy	1	7%
Education / IT	1	7%
Mixed (IT & Services)	2	14%

Source: Authorship (2026)

It is observed that the industrial area has the highest representativeness, followed by the business/retail/finance sectors. On the other hand, the areas of health/medicine, environmental/energy and education/IT have a lower participation, indicating a still incipient stage of development in the period analyzed.

Foreign influence in patent filings, identified through the unionist priority (initial filing abroad with subsequent entry into Brazil), corresponds to 35.71%, showing significant growth. The predominant areas in these warehouses are mixed (IT/services), business/retail, industrial/logistics, industrial/cyber, and mixed (IT/services). The main countries of origin are the USA, Lithuania and Australia.

The patents of predominantly national origin are concentrated in the industrial (3 publications), industrial/business, education/IT, environmental/sanitation, business/retail (2) and health areas. Regarding the applicants, it is observed that only two patents belong to legal entities, while most are from independent inventors.

From 2017 onwards, there was the beginning of a moderate growth trajectory, with two documents in 2017 and stability between 2018 and 2020, with 4 annual documents.

The results of this period indicate the beginning of the incorporation of AI into practical applications; reflecting the global diffusion of technologies such as machine learning and big data; as well as the initial structuring of strategies by companies and science and technology institutions (ICTs). It should be noted that, during this period, there was no granting of patents.

3 Accelerated expansion phase (2021–2025)

This period represents the most significant jump in the time series with 9 publications in 2021, 21 in 2022, 23 in 2023, 35 in 2024 and 34 in 2025, totaling 122 patents published, with an average of 24.4 patents/year. The peak was registered in 2024, with 35 patents. Compared to the previous phase, there is a growth of 871.43% (from 14 to 122). There is also a slight reduction in 2025 (about 3% compared to 2024), which may indicate a stabilization process or post-peak adjustment.

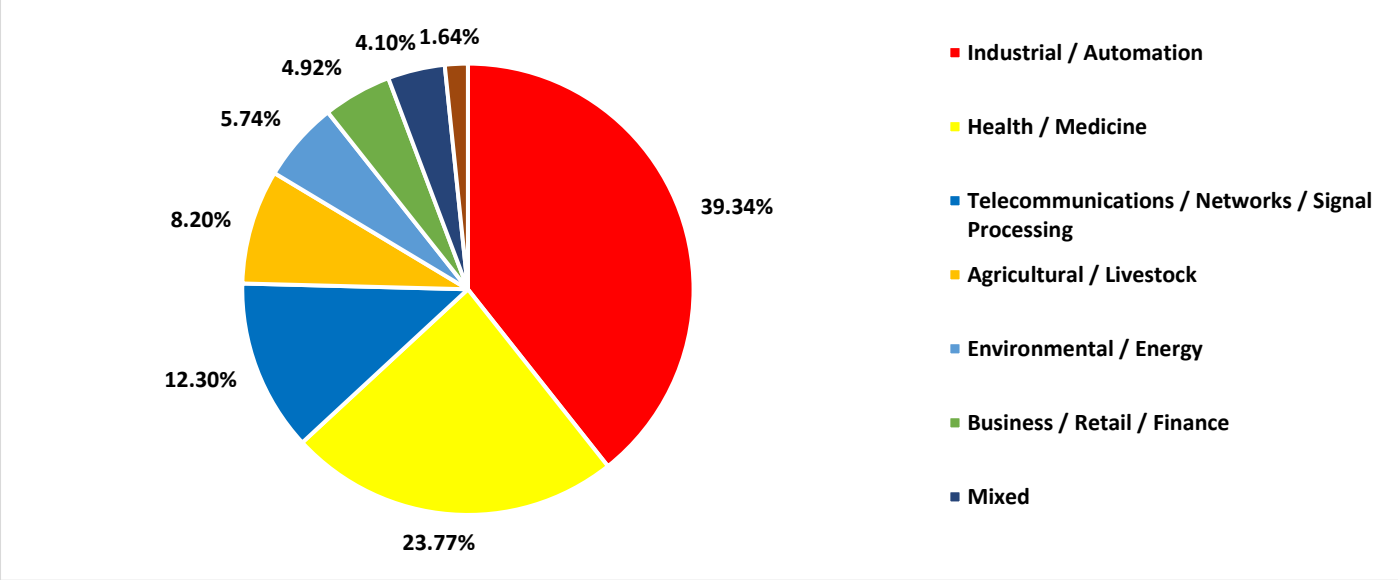
These results suggest the consolidation of AI as a strategic technology; aligned with digital transformation and the principles of Industry 4.0. There is also a significant increase in the demand for intellectual protection, reflecting greater business participation, the advancement of startups and deep techs, in addition to the integration of AI in multiple sectors, such as health, industry, services, agriculture, education, security, among others).

Patent applications filed through the Patent Cooperation Treaty (PCT) represent 42.62% of the total. The average time between deposit and publication in this period was approximately 17.5 months (about 1.46 years), a value close to the international standard of 18 months, indicating regularity in the flow of publication. On the other hand, the average time between deposit and concession was approximately 48 months (about 4 years), which is considered relatively high. The average interval between publication and concession was approximately 30 months (about 2.5 years), configuring the slowest stage of the process, due to technical requirements, substantive examination and the backlog.

In the period analyzed, only six patents were granted, three of national origin and three from the USA via PCT, although two of these are owned by companies based in the Netherlands and Chile.

The application of AI in technological innovation in Brazil can be seen in Figure 4.

Figure 4 – Technological area / application



Source: Authorship (2026)

Figure 4 shows that the industrial/automation area, with 48 published patents, has the highest volume, indicating a strong use of AI in production processes, robotics, predictive maintenance, and increased industrial efficiency. Next, the health/medicine area stands out, with 29 patents, reflecting the growing use of AI in diagnosis, monitoring, and clinical support.

There is a strong concentration in productive and strategic sectors, which is consistent with the standards of patent filings focused mainly on health, industry and agribusiness, especially in automation and efficiency applications (industry), diagnosis and analysis (health) and optimization of complex systems (telecom and agro). In contrast, sectors such as retail (6 patents) and entertainment (2 patents) have a smaller share, possibly because they are associated with

incremental innovations or software solutions that are not always protected by patents.

In summary, AI is strongly directed to technical, industrial, and scientific applications, with a lower incidence in commercial uses or aimed at final consumption.

4 Recent trend (2026 – partial)

This year, until April 9, 11 patents were published, indicating the maintenance of a high trend. Although this is a partial result, there is a continuity of technological dynamism, with an annual projection of approximately 38 patents, possibly exceeding the volume registered in 2025. This performance may also be related to the increase in the number of staff at the INPI, with a view to reducing the time between filing and granting.

The average time between deposit and publication is approximately 645 days (About 21.5 months, or 1 year and 9 months), a value close to the secrecy period of 18 months. Considering only the 2024 deposits, the average time is around 561 days, even closer to the expected standard. The two oldest deposits (2023) slightly raise the overall average.

None of the patents were filed through the PCT, however, approximately 36.36% have foreign applicants. Of the remaining seven patents, two belong to independent inventors.

Overall, only eight patents have been granted, while approximately 94.7% are still in the examination phase. The deposit period covers from 08/04/2006 to 09/02/2024, while publications took place between 03/25/2008 and 03/17/2026. It should be noted that the patent filed in 2006 took 4,589 days (12.6 years) to be granted (02/26/2019), while the patent filed on 06/15/2023 was granted on 02/11/2025, after 607 days (1.7 years), representing the shortest time observed. The average time between deposit and concession was approximately 1,466 days (about 4 years). There is also a backlog of 144 patents awaiting examination, which requires expansion of institutional capacity.

The average time between deposit and publication was 365 days (1 year), ranging from 96 days (minimum) to 1,745 days (4.8 years) (maximum).

The measures of central tendency indicate that, on average, eight documents were published per year in the period analyzed. Half of the years presented two or fewer documents, while the other half registered two or more. Before 2018, the number of deposits was quite low (maximum of four per year); From 2021 onwards, there is a sharp growth. Approximately 80% of the 152 documents were published between 2021 and 2025.

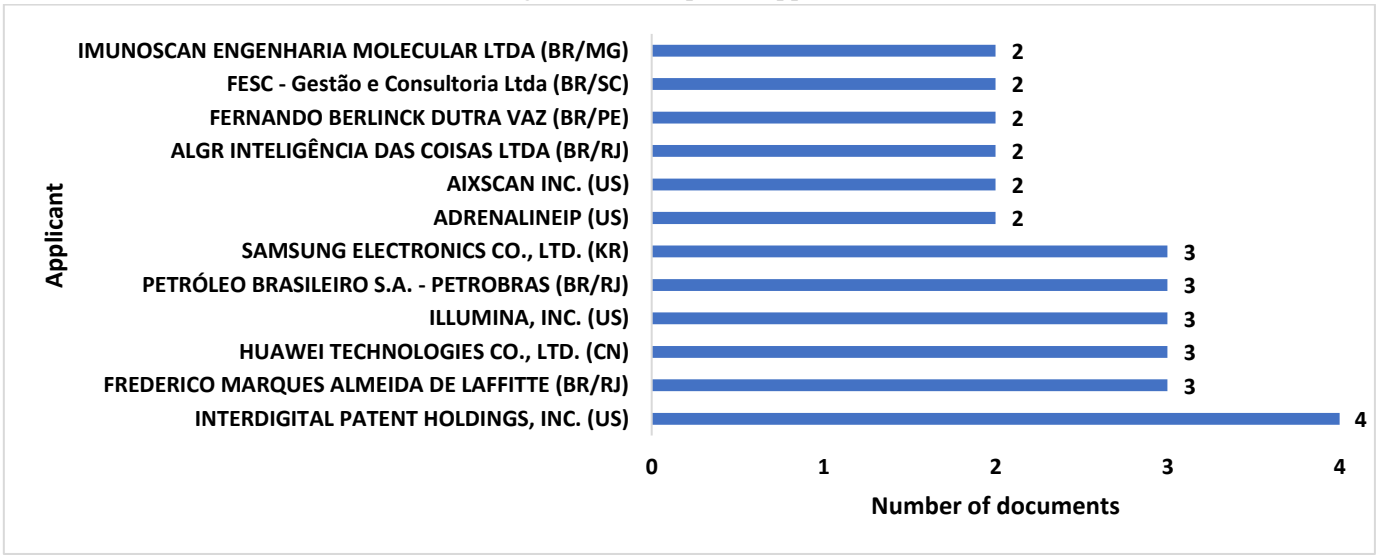
In summary, the results show that the temporal evolution of AI patent publications at the INPI shows an exponential growth pattern from 2021 onwards. After a period of low activity (2008-2016) and a transition phase (2017-2020), there is a significant inflection in the technological trajectory, with a significant increase in the number of documents. The peak recorded in 2024 (35 publications) indicates the consolidation of AI as a strategic vector of innovation in Brazil. In addition, the maintenance of high levels in 2025 and the partial performance in 2026 reinforce the trend of continued growth, signaling technological maturity and intensification of intellectual protection strategies in the field of AI.

In percentage terms, the highest growth was observed in 2022 (133.33%), possibly associated with the increase in the INPI's operational capacity.

APPLICANT

The main applicant was the American company Interdigital Patent Holdings with four patents, while the most prominent Brazilian company was Petrobras, with three patents. The main applicants, as well as the number of documents and the main players in the AI patent landscape at the INPI, can be seen in Figure 5.

Figure 5 – Main patent applicants



Source: Authorship, based on data from the INPI (2026)

The 152 patents analyzed have about 153 holders. Among these, one holder holds four patents (2.63%), five holders have three patents each, 11 have two patents and 136 have only one patent. The average is 1.01 holders per document, which shows a highly fragmented ecosystem, in which the vast majority of applicants appear only once, and only six holders hold three or more patents

Figure 5 shows a low concentration of ownership, with few actors holding three or more documents. The U.S. company Interdigital Patent Holdings (4), the Brazilian Petrobras (3), the Chinese Huawei Technologies Co Ltd (3), the South Korean Samsung Electronics (3) and the American Illumina Inc (3), as well as the Brazilian independent inventor Frederico Marques de Almeida Laffite (RJ), who represents an isolated case of prominence, stand out. This scenario indicates a fragmented technological field, without absolute dominance of a single organization, but with a relevant presence of major global players in strategic sectors.

There is a strong presence of international companies, especially from China, the Republic of Korea, and the USA, such as Qualcomm Incorporated, Intel Corporation, Google LLC, Apple Inc., Nokia Technologies Oy, and ZTE Corporation. This panorama shows a high degree of technological internationalization, indicating that the domain of the emerging technologies analyzed is concentrated in highly innovative economies.

Brazilian participation is characterized by the diversity of actors, but on a small scale (usually between one and two patents per holder), with a large number of applicants. Companies such as Braskem S.A. and Banco do Brasil S.A.; universities such as the State University of Santa Cruz (UESC), Federal University of Alagoas (UFAL), Federal University of Paraíba (UFPB), Federal University of Pernambuco (UFPE), among others; in addition to ICTs and innovation centers, such as the Venturus Center for Technological Innovation. This result shows a pulverized national ecosystem, with a strong academic presence, moderate business participation and low concentration of technological assets, suggesting a still incipient stage of industrial consolidation of innovation.

There is also significant sectoral and technological diversity, with holders operating in multiple segments, such as Information and Communication Technologies (ICT) (Huawei, Samsung, Qualcomm, among others); biotechnology and health (FESC Management and Consulting, IMUNOSCAN, Illumina, Tempus Lab, among others); energy (Petrobras, AES, Eletrobras, among others); financial sector (Banco do Brasil, JPMorgan, among others) and chemical and materials industry (Braskem, SABIC, among others). This panorama indicates that the set of patents has a multidisciplinary character, with transversal applications typical of emerging and convergent technologies.

Some cooperation initiatives between universities and companies are also identified, such as the Federal University of Uberlândia – Imunoscan, the Federal University of Rio de Janeiro – Petrobras and the State University of Campinas (Unicamp) – Piccin.

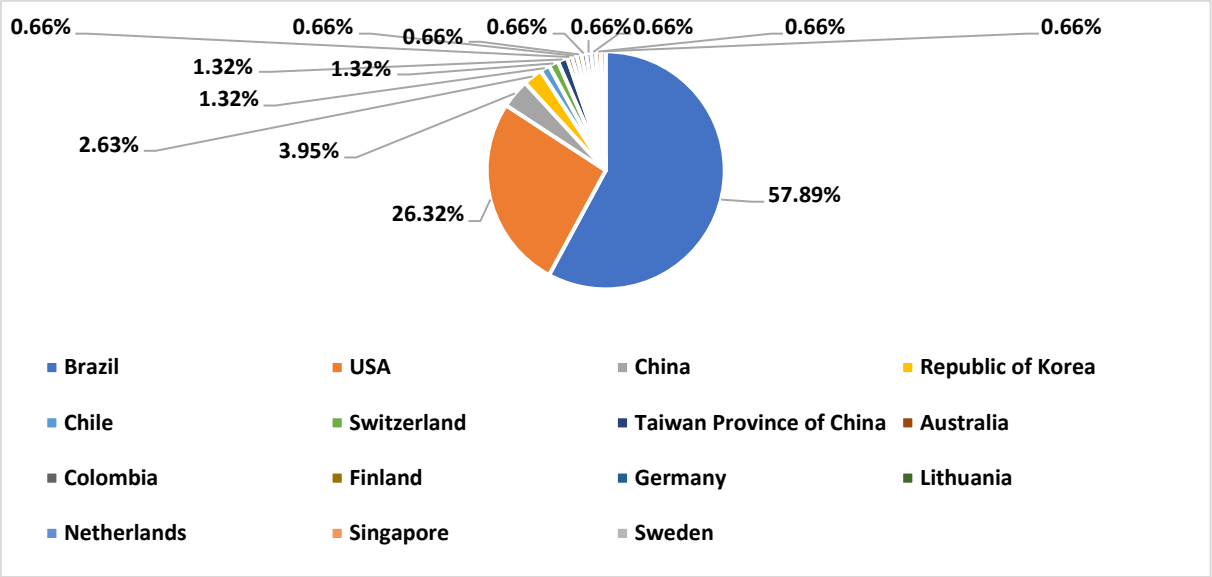
The relevant presence of independent inventors (individuals as owners) is observed, which indicates, in certain cases, a low level of institutionalization of innovation, reflecting independent initiatives or early-stage startups, and suggesting fragmentation in the intellectual property system.

In summary, the distribution of holders shows a technological ecosystem characterized by low concentration and high diversity of actors, in which large multinational corporations, academic institutions, and independent inventors coexist. However, the Brazilian participation, although numerically expressive, presents low technological density per actor, indicating an innovation system still in the process of consolidation. The sectoral diversity reinforces the transversal character of the technologies analyzed, pointing to a convergent and multidisciplinary innovation environment.

GEOGRAPHICAL ORIGIN OF THE APPLICANTS

The geographic origin of the technologies and the degree of internationalization of the analyzed set can be seen in Figure 6.

Figure 6 – Country of the patent holders



Source: Authorship (2026)

In relation to the 152 documents analyzed, 15 countries were identified, with Brazil and the USA concentrating a relevant share, totaling 84.2%. This result indicates that Brazilian applicants tend to initially protect their inventions in the country.

Figure 6 shows the predominance of Brazil, with 88 documents, representing the largest share of deposits. This scenario indicates strong domestic innovation activity, associated with universities, national companies, ICTs and independent inventors. This result may also be related to policies to encourage innovation and intellectual protection in the country, in addition to reflecting greater use of the national patent system by local actors.

In second place, the USA stands out, with 40 documents, of which 39 have unionist priority (via the Paris Convention or PCT) and only one was deposited directly in Brazil, with no claim to foreign priority. This country is the main international player in the INPI, especially in the areas of artificial intelligence (G06N), telecommunications (H04L and H04W) and digital health (G16H). This result highlights the presence of highly innovative global players, with predominant operations in the health/medicine (14), industrial/automation (11), telecom/networks/signal processing (7), mixed (4), entertainment (2), agricultural/livestock farming (1) and environmental/energy (1) sectors. Such a scenario reflects the strategic interest of U.S. companies in protecting technologies in the Brazilian market, indicating a certain degree of technological dependence in knowledge-intensive areas.

The Asian participation is also relevant, with emphasis on China (6 documents), the Republic of Korea (4) and Taiwan (2). These data confirm the role of these countries as leaders in emerging technologies, especially in the areas of telecommunications/networks/signal processing (7), environment/energy (2), mixed (1), industrial/automation (1) and health/medicine (1). In addition, they indicate the growing Asian technological expansion in the international scenario, including in Brazil.

There is a low participation of European countries, with a punctual presence, such as Switzerland (2), Germany (1), Netherlands (1), Sweden (1), and Finland (1), which suggests less strategic interest of these nations in the specific domain analyzed.

The participation of Latin American countries, in addition to Brazil, is limited, with a residual presence of Chile (2) and Colombia (1), evidencing low regional integration in terms of technological innovation and possible weaknesses in Latin America's national innovation systems.

Therefore, the geographic distribution of depositors shows a strong national concentration, led by Brazil, combined with a significant participation of technologically advanced countries, such as the USA, China and the Republic of Korea. This pattern reveals an innovation system characterized by the interaction between local and global actors, in which Brazil acts simultaneously as a producer and receiver of technologies. The significant presence of Asian countries reinforces their competitiveness in sectors of high technological intensity, while the low representation of Latin America indicates regional structural limitations. Taken together, the data point to an internationalized, but asymmetric, technological environment.

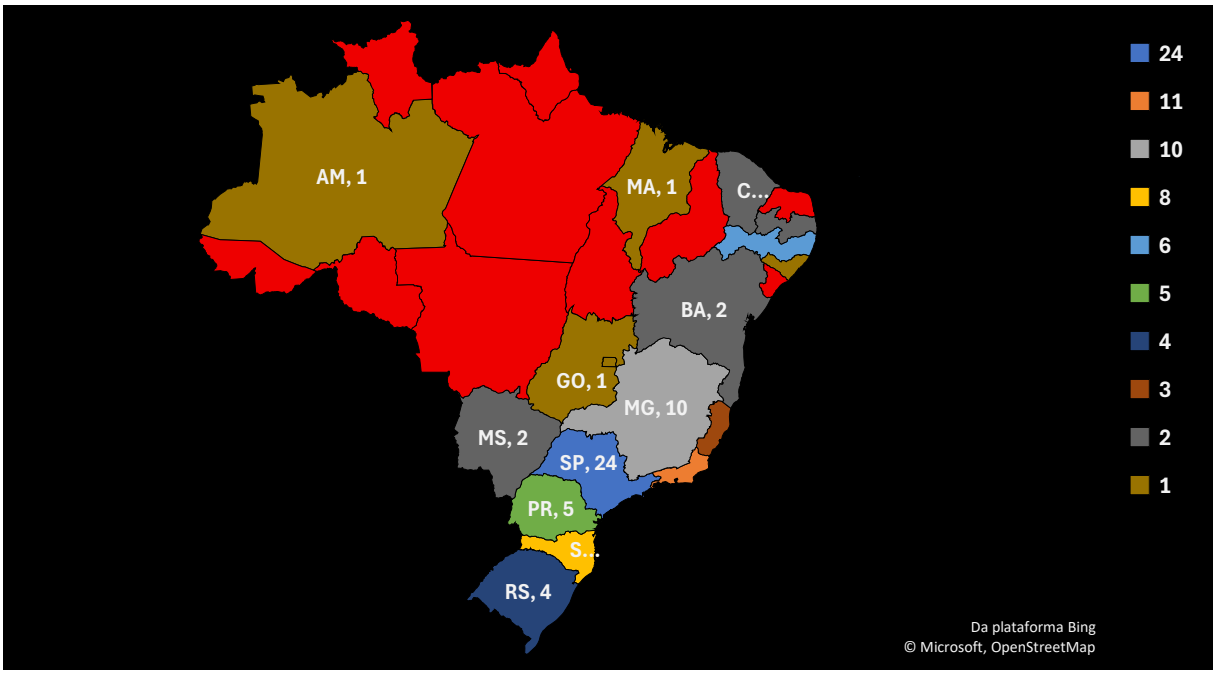
ORIGIN OF BRAZILIAN DEPOSITORS

Brazil has 26 states and a Federal District (DF), with technological and innovative activities in various fields of

knowledge, however, in the period analyzed, only 16 states and the Federal District (Brasília) filed patents related to AI.

The most developed states concentrate most of the deposits, representing about 77.38%, while the others account for approximately 22.62%, evidencing the concentration of technological innovation in the more developed regions. The state of São Paulo stands out, with 28.57% of the deposits Figure 7 shows the result.

Figure 7 - State of Brazilian depositors



Source: Authorship based on data from the INPI (2026)

Figure 7 shows that the states of the Southeast region largely lead the deposits, with emphasis on São Paulo (24), Rio de Janeiro (11), and Minas Gerais (10). São Paulo's leadership reflects its role as the country's main industrial and technological hub. Espírito Santo (3), together with the other states in the region, reinforces its operations in sectors such as industry (8), business (5), and health (5).

The South region stands out as an emerging innovation hub, with a relevant participation of Santa Catarina (8), Paraná (5), and Rio Grande do Sul (4), indicating a consolidated and expanding innovation ecosystem, especially in the industrial (9), health (4), and environmental (2) areas. The presence of innovative small and medium-sized enterprises is a striking feature of the region.

The Northeast region has an intermediate and emerging participation, with emphasis on Pernambuco (6), Bahia (2), Ceará (2), Paraíba (2), Alagoas (1), and Maranhão (1). Pernambuco stands out as the main regional hub, possibly associated with Porto Digital and universities. The other states have an incipient participation, reflecting structural challenges in the innovation system. Bahia, despite its economic potential, has a low participation, indicating the need for institutional strengthening. The region has the highest incidence in the industrial (7), agricultural (2), business (2), health (2), and mixed (1) areas.

The Central-West and North regions have low representation. In the North region, only the state of Amazonas (1) has a patent registration. In the Central-West, Mato Grosso do Sul (2), Brasília (1), and Goiás (1) stand out. This scenario indicates low technological density and lower capacity to generate patents in these regions, with innovation concentrated in specific areas, such as industrial (2), agricultural (1), mixed (1), and health (1).

Cases of interstate co-ownership are observed, such as Alagoas-Federal District, Espírito Santo-Minas Gerais, São Paulo-Minas Gerais, and São Paulo Santa Catarina, evidencing interinstitutional cooperation between universities, companies and research centers, which indicates advances in the logic of collaborative innovation (triple helix). Two patents are the result of cooperation between independent inventors.

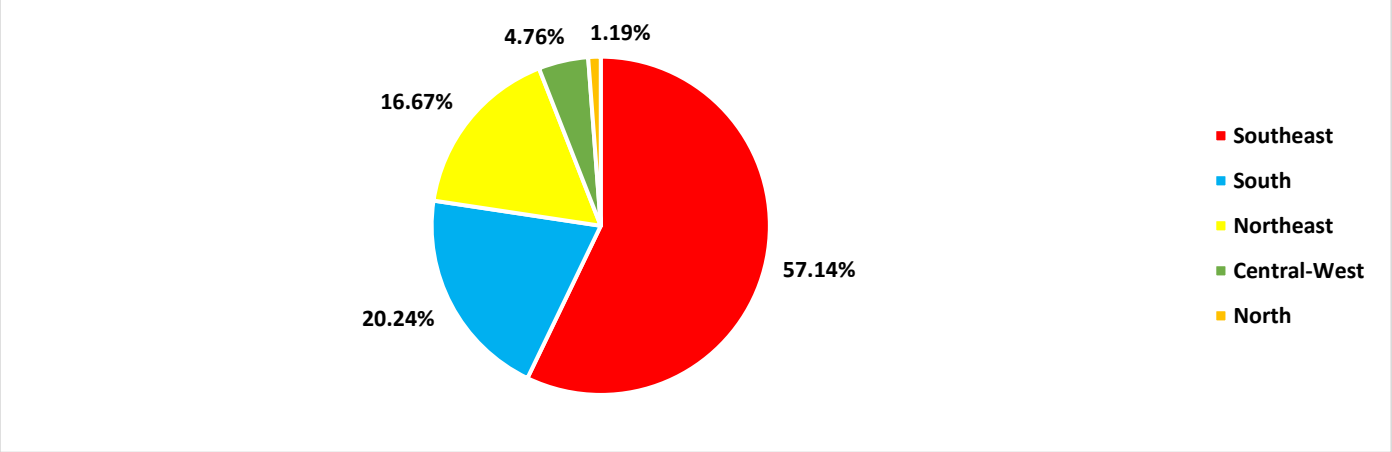
States such as Acre, Amapá, Pará, Tocantins, Rondônia and Roraima (North), Piauí, Rio Grande do Norte, and Sergipe (Northeast); and Mato Grosso (Central-West) do not have deposits related to the technology analyzed.

Thus, the spatial distribution of deposits shows a strong concentration in the Southeast, especially in São Paulo, Rio de Janeiro, and Minas Gerais, confirming the centrality of these regions in the dynamics of Brazilian innovation. The presence of interstate co-ownership indicates the formation

of collaborative networks, still at an early stage. Together, the results point to a geographically concentrated, asymmetric national innovation system in the process of regional diffusion.

The regionalization of innovation, evidencing inequalities and different levels of maturity of regional systems, can be observed in Figure 8.

Figure 8 – Region of patent applicants



Source: Authorship based on data from the INPI (2026)

Figure 8 shows the predominance of the Southeast Region (48), confirming its role as the main center of national innovation, concentrating scientific infrastructure, qualified human capital and investment in Research and Development (R&D). The presence of large universities, research centers and technology-intensive companies explains this performance, evidencing a strong geographical centralization of innovative capacity.

The region has a predominance of the industrial area, in addition to significant participation in the health area, with emphasis on partnerships between universities and companies, such as the cooperation between the Federal University of Uberlândia and Imunoscan, as well as initiatives involving the Albert Einstein Hospital. The main technological axes include medical diagnosis (skin cancer, hepatitis, and parasitosis), telemedicine and teletriage, prediction of clinical outcomes and neuromuscular monitoring and vital signs.

The region is mainly composed of companies, independent inventors and large national corporations, with a recurring highlight for Petróleo Brasileiro S.A. – PETROBRAS, indicating a strong performance in technologies focused on energy, production processes and applied engineering, reinforcing the role of the region as the main industrial and technological center in Brazil. The region's innovation is focused on Industry 4.0, with strong integration between AI, sensors, and automation, reflecting the region's consolidated industrial base.

The Southeast region has a diversified innovation ecosystem, but strongly concentrated in industrial technologies, followed by health and, to a lesser extent, environmental and agricultural.

In general, the Southeast region is characterized by its national leadership in AI patent filings; strong industrial and technological base; diversification of applications such as industry, health, business and energy; and integration between science, market and innovation.

In summary, the Southeast region is the main hub of AI-based technological innovation in Brazil, with emphasis on industrial and medical applications, in addition to growing performance in sustainability and the digital economy.

The South region (17) is the second main innovation hub, with a relatively structured ecosystem, with a very characteristic technological pattern, marked by the predominance of industrial applications, with the complementary presence of agricultural, environmental and health areas.

The strong predominance of the industrial area stands out, which concentrates most of the warehouses and diversified applications, including automation and control; control and mobility systems; intelligent equipment and robotics and automated software development. The solutions indicate an innovation profile focused on operational efficiency, automation and cost reduction, characteristic of economies with a strong industrial base. Applicants include both companies and individual inventors. Companies such as Connectrail and DB1 Global Software. In addition to manufacturers of hydraulic equipment and technological solutions, they indicate a productive base focused on engineering, manufacturing, logistics and applied technology. This profile is in line with the industrial tradition of the South region, characterized by diversified production chains and a strong presence of innovative small and medium-sized companies.

The agricultural area, although less frequent, has strategic relevance, with deposits made by local inventors, reflecting the importance of agribusiness in the region, especially in the development of practical solutions aimed at rural production, mechanization and production efficiency, highlighting the use of AI to monitor animal productivity, reinforcing the connection with agribusiness.

In general, the South region is configured as a center of applied and market-oriented technological innovation, with strong integration between industry, services and digital technologies. It also presents a technological profile strongly oriented to the industry, with a focus on practical solutions and applied engineering, with a relevant presence of incremental innovation, developed by companies and independent inventors, with less participation of universities and ICTs, suggesting less intensity of formal scientific research compared to the Southeast, presenting moderate insertion in the agricultural and environmental areas, reflecting the regional economic base, with low density in high-tech sectors such as biotechnology and telecommunications.

The Northeast region (14) shows a gradual growth in innovative activity, although still below the developed regions, reflecting recent advances in innovation policies, but with structural limitations, indicating potential for expansion, especially in specific hubs such as Pernambuco and Bahia. The region reveals a very dynamic and contemporary technological pattern, marked by a strong presence of solutions applied to different productive and social sectors.

There is a predominance of the industrial area, which concentrates most of the deposits, involving the application of AI in predictive maintenance, process automation, inspection of structures, electrical systems, and petrochemical production, with emphasis on institutions such as the Federal University of Pernambuco (UFPE) and companies such as Braskem S.A.. This pattern indicates that industrial innovation in the region is strongly associated with the digitalization of industry (Industry 4.0), with a focus on operational efficiency and cost reduction.

The agricultural area appears with strategic relevance, presenting solutions such as intelligent irrigation systems and automated grain classification. The participation of the State University of Santa Cruz (UESC) and independent inventors demonstrates the application of AI in regional agribusiness, especially in activities aimed at optimizing agricultural production and efficient use of natural resources.

Therefore, the Northeast region has a technological profile strongly oriented to the application of AI, transversal to different sectors, with a predominance of digital industrial technologies, aimed at automation and intelligent maintenance, with relevant participation of universities and ICTs, evidencing the role of academia in the generation of innovation, with increasing insertion in strategic areas such as smart agriculture, digital health and data economy and with a significant presence of inventors indicating dynamism and decentralization of innovation.

In general. The Northeast region demonstrates a technological leap movement, in which emerging technologies are applied to solve local problems and increase regional competitiveness. This pattern suggests a trajectory of technological convergence, bringing the region closer to more advanced innovation patterns, although on a smaller scale compared to the Southeast.

The Central-West (4) has low participation and technological density, with innovation still little institutionalized, with the regional economy more focused on agribusiness, which may explain the lower volume of formal patent filings, characterized by the transversal application of digital technologies, in different areas.

The mixed category, represented by Banco do Brasil S.A., highlights the use of AI for model evaluation and validation, which suggests applications in finance, risk analysis, and intelligent decision systems. This type of technology is highly strategic and indicates the insertion of the Central-West in advanced areas of the digital economy.

In the agricultural area, there is an important collaboration between the Federal University of Mato Grosso do Sul (UFMS) and the company GSM Biotecnologia, focused on the use of optical spectroscopy and AI to identify the sex of birds. This result reflects the strong agricultural vocation of the region, combined with the incorporation of cutting-edge technologies, characterizing a movement of precision agriculture and applied biotechnology.

The results show the Central-West region with a technological profile highly oriented to the application of AI in all areas analyzed, with a strong interdisciplinary and convergent character, integrating AI, IoT, biotechnology and digital systems, with emphasis on technified agriculture, aligned with regional economic vocations, with relevant participation of public institutions and large organizations, such as universities and banks, with a focus on applied solutions with direct impact, especially in the areas of agribusiness, health and services.

Therefore, the Central-West region presents an emerging but strategic innovation ecosystem, characterized by the adoption of advanced technologies in key sectors of the regional economy. Despite the low volume of publications, the quality and profile of the innovations indicate a significant potential for growth, especially at the interface

between agribusiness, digital services and technological health.

The North region (1) has a residual participation, showing strong regional asymmetry, with limited research and innovation infrastructure, which points to structural challenges related to scientific and technological integration. Although the single record limits the quantitative analysis, it allows a relevant qualitative interpretation of the regional technological profile.

The registration is classified in the industrial area, specifically in automated quality control, monitoring of production processes and optimization of the manufacture of polymers / plastics and consists of a thermal imaging camera integrated with an AI system, specifically applied to quality control in plastic injection processes, authored by an independent inventor from the state of Amazonas. The embedded system is capable of identifying thermal patterns associated with the quality of the parts produced, automatically distinguishing between adequate (good) and defective (bad) standards. In addition, the software allows the definition of specific thermal measurement points, increasing the accuracy of the analysis.

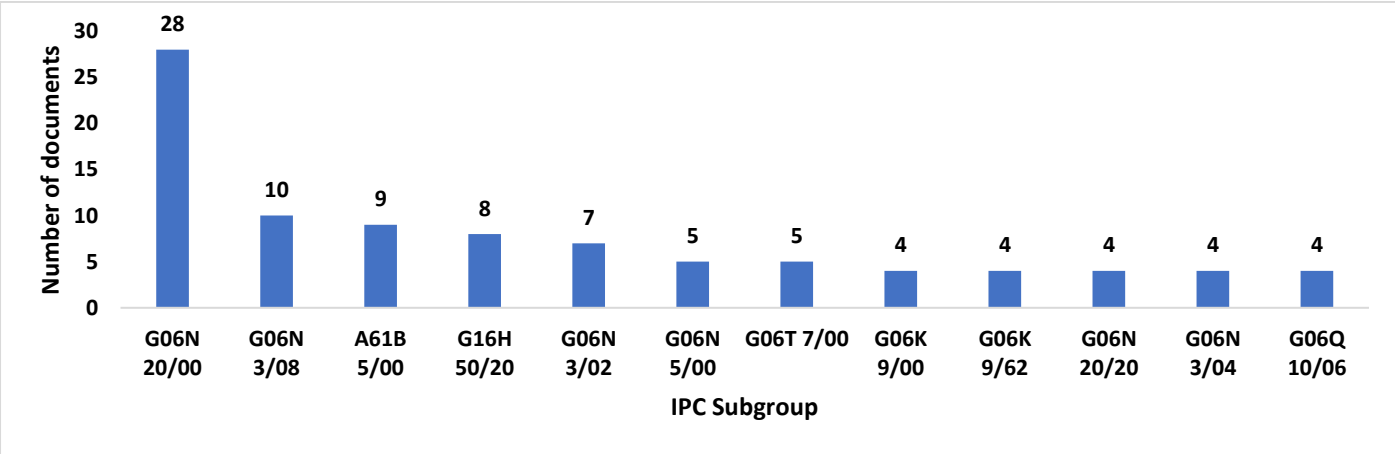
Despite the low volume of publications, there is the presence of technologically sophisticated innovations aligned with global trends in smart manufacturing, with the application of AI in industrial processes, indicating technological modernization; development of solutions with high added value and scalability potential, with a focus on automation and quality control, central elements of contemporary industrial competitiveness and predominance of individual initiatives, suggesting gaps in the institutional structure of innovation.

Therefore, the regional distribution of patent filings shows a strong concentration in the Southeast, followed by a secondary pole in the South, while the other regions present incipient levels of participation. The Northeast shows signs of expansion, while the Central-West and North remain with low insertion in the innovation system. This pattern shows a scenario of regional inequality in technological production, in which innovative capacity is strongly associated with the availability of scientific infrastructure, human capital, and investments in R&D. Such results reinforce the need for public policies aimed at decentralizing innovation and strengthening emerging regional ecosystems.

PATENT IPC CODES

The codes of the International Patent Classification (IPC) refer to the technical classification of inventions, and may be associated with more than one technological field. The distribution of codes related to AI technology over the past 20 years is shown in Figure 9.

Figure 9 – IPC Code



Legend

G06N 00/20 – Machine Learning

G06N 3/08 - Computer systems based on biological models; / using neural network models; / Learning methods;

A61B 5/00 - Measurement for diagnostic purposes; Identification of people

G16H 50/20 - ICT specially adapted for medical diagnosis, medical simulation or medical data mining ICT specially adapted for detecting, monitoring or modelling epidemics or pandemics for computer-aided diagnosis, e.g. based on medical expert systems

G06N 3/02 - Computer systems based on biological models; / using neural network models.

G06N 5/00 - Computer systems using knowledge-based models.

G06T 7/00 - Image analysis, e.g. from *bit-mapped* to *non-bit-mapped*

G06K 9/00 - Methods or arrangements for reading or identifying printed or written characters or for identifying patterns, e.g. fingerprints.

G06K 9/62 - Methods or arrangements for reading or identifying printed or written characters or for identifying patterns, e.g. fingerprints; / Methods or arrangements of recognition, using electronic means.

G06N 20/20 - Machine learning; Teamwork

G06N 3/04 - Computer systems based on biological models; / using neural network models; / Architecture, e.g., interconnected topology.

G06Q 10/06 - Administration; Management; / Management of resources, workflows, human resources or projects, e.g. organization, planning, scheduling or allocation of time, human resources or machine resources; Business planning; Organizational models;

Source: Authorship based on data from the INPI (2026)

Figure 9 shows the predominance of the G06 code, referring to computing systems based on specific computational models, which is expected, considering that these are AI technologies. These technologies are mainly concentrated in sections G (Physics); H (Electricity) and A (Human Need). The most frequent codes are: G06N 20/00 (28); G06N 3/08 (10); G06N 3/02 (7); G06N 5/00; and G06N 20/20 (4). These results indicate a strong concentration on core AI technologies, especially in machine learning, advanced computational modeling, and intelligent data-driven systems, showing that most patents are focused on the development of the underlying technology, and not just its applications.

Thus, the analysis of the IPC codes shows a strong concentration of patents in AI in the G06N domain, especially in machine learning techniques (G06N 20/00) and neural networks (G06N 3/08), indicating a predominance of innovations aimed at the development of the technological core of AI. At the same time, there is a significant presence of codes related to image processing, pattern recognition and computer vision, which reinforces the practical application of these technologies.

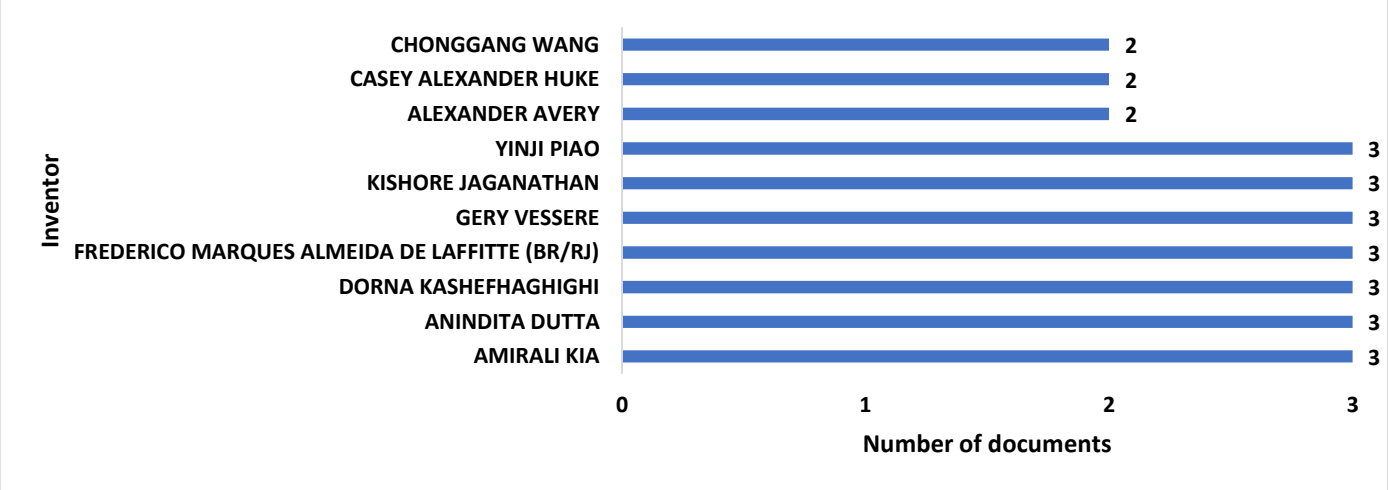
At the sectoral level, applications in the areas of health (A61B; G16H) and business management (G06Q), demonstrating the diffusion of AI in strategic sectors. In addition, the wide dispersion of codes with low frequency reveals the cross-cutting nature of AI, with insertion in various sectors such as agriculture, energy, transportation, and the environment.

In summary, the results point to a technological ecosystem in the process of consolidation, characterized by a strong computational base and growing diversification of applications.

INVENTORS

A distribution of inventors with a highly fragmented and decentralized pattern of technological production is observed, characteristic of emerging and multidisciplinary fields, such as AI, as illustrated in Figure 10.

Figure 10 – Main inventors



Source: Authorship (2026)

The structure of authorship of inventors has three main patterns: (i) individual inventors (low scale, with 1 to 2 inventors), usually associated with incremental innovations, of low technological complexity or at an early stage; (ii) medium teams (3 to 6 inventors), focused on structured technological development and projects with an intermediate level of complexity; and (iii) large teams (8 to 15 inventors), directed to more complex and, in general, multidisciplinary projects, with a higher volume of investment in R&D, often associated with areas such as health and energy.

Figure 10 shows that no inventor has a significant concentration of deposits, with a maximum value of only three documents per inventor. A restricted group leads this production, composed of Amirali Kia, Anindita Dutta, Dorna Kashefhaghighi, Frederico Marques Almeida de Laffitte, Gery Vessere, Kishore Jaganathan and Yinji Piao. These inventors represent the productive elite, but with low relative predominance, which indicates the absence of individual technological monopoly.

The vast majority of inventors (81.49%) have only one deposit, showing a low concentration of knowledge in a few actors, a high diversity of contributors and a constant entry of new inventors into the technological domain. This phenomenon can be associated with low barriers to entry, provided by the use of open frameworks and greater computational accessibility.

This scenario is characteristic of emerging technologies based on digital knowledge, such as AI, in which innovation tends to be widely distributed and collaborative, in contrast to more concentrated traditional sectors, such as pharmaceuticals or chemicals.

CONCLUSIONS

This research analyzed the panorama of Artificial Intelligence (AI) patents published in Brazil, based on 152 processes identified in the INPI's database, in the period from 2006 to 2026. The results show an evolutionary trajectory marked by three distinct phases: an initial period of low activity (2008-2016), a phase of moderate growth (2017-2020) and a recent phase of accelerated expansion (2021-2025), with a continuation of the trend in 2026. This behavior confirms the consolidation of AI as a strategic technology in the context of digital transformation and Industry 4.0.

Regarding the central objective of this study – to verify the existence of balance between the Brazilian regions in the production of AI patents – the results clearly indicate the absence of regional balance. There is a strong concentration of deposits in the Southeast region, especially in the states of São Paulo, Rio de Janeiro, and Minas Gerais, which concentrate most of the innovative activity. The South region is configured as a relevant secondary hub, while the Northeast, Central-West and North regions still have a limited participation, although with signs of growth in specific poles.

This asymmetry shows that the capacity to generate innovation in AI in Brazil is directly associated with the availability of scientific infrastructure, qualified human capital, the presence of universities and research centers, and investments in Research and Development (R&D). Thus, it is confirmed that the national innovation system has a geographically concentrated and unequal structure, reflecting historical and structural disparities between regions.

From a technological point of view, there was a strong concentration of patents in the core of AI, especially in machine learning and neural networks (class G06N), indicating a predominance of innovations aimed at the development of the base technology. At the same time, there is an expansion of applications in strategic sectors, such as industry, agribusiness, health, and services, evidencing the transversal and multidisciplinary character of AI.

The analysis of the depositors revealed a highly dispersed ecosystem, with a low concentration of ownership and a predominance of individual inventors, universities and scientific institutions. Although there is a significant presence of international companies, especially from the United States of America (USA) and Asia, the Brazilian participation is characterized by low technological density per actor, suggesting an innovation system that is still being consolidated. In addition, the significant participation of deposits with foreign priority reinforces technological dependence in areas of greater knowledge intensity.

Regarding the dynamics of inventors, a decentralized and fragmented pattern was identified, typical of emerging technologies, with a high diversity of actors and low productive concentration. This scenario indicates an open and collaborative innovation environment, driven by the democratization of access to digital technologies.

Despite the relevant contributions, the study has limitations. The analysis focused exclusively on the INPI's database, which may not fully reflect the international performance of Brazilian inventors. In addition, the use of specific keywords may have restricted the universe analyzed, excluding AI-related patents that do not explicitly use the selected terms. In addition, the approach adopted was predominantly descriptive, without delving into econometric analyses or the technical content of the patents.

As future perspectives, it is recommended: (i) to expand the analysis to international databases, such as Espacenet, enabling global comparisons; (ii) deepen the qualitative

analysis of patents, considering the level of technological maturity and economic impact; (ii) apply statistical and econometric methods to identify determinants of AI innovation; (iv) to investigate cooperation networks between universities, companies and inventors, in the context of the triple helix; and (v) to evaluate the impact of public policies aimed at reducing regional inequalities and strengthening local innovation ecosystems.

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