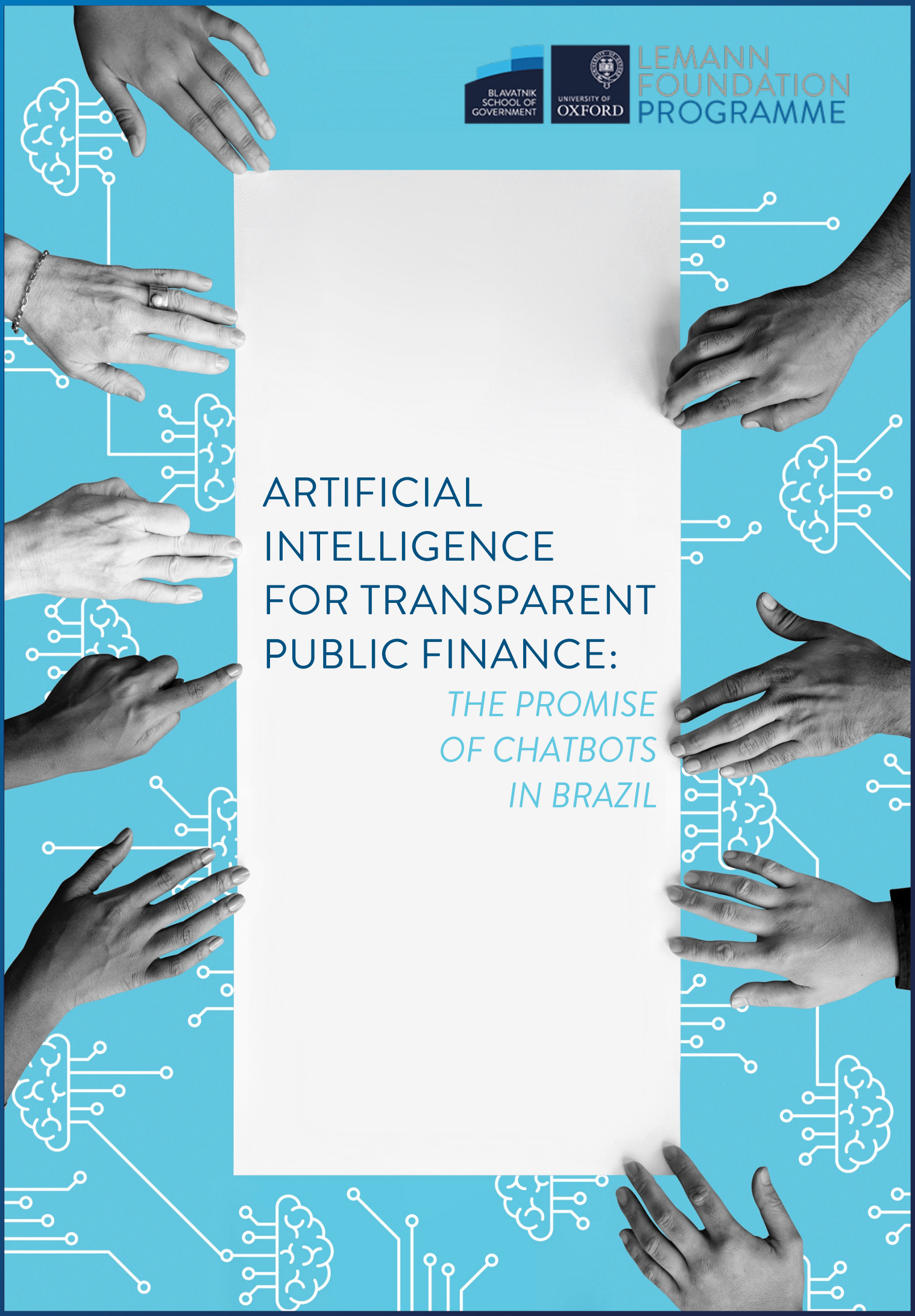


# ARTIFICIAL INTELLIGENCE FOR TRANSPARENT PUBLIC FINANCE:

## *THE PROMISE OF CHATBOTS IN BRAZIL*

## POLICY QUESTIONS

- How can we bridge the gap between the complexity of fiscal reports and the public's need for clear, comprehensible information about government spending?
- Can artificial intelligence provide a viable solution to this challenge in the Brazilian context?

## POLICY ISSUE

In recent years, Brazil has achieved notable success in enhancing fiscal transparency, marked by progress in making crucial financial data publicly available through government portals. This step is pivotal, as evidence suggests that heightened fiscal transparency significantly improves budgetary efficiency. Indeed, when citizens have access to transparent, intelligible information, they have a better capacity to comprehend governmental budgetary practices, fostering a more informed citizenry capable of holding public officials accountable and optimising societal resources.

Nonetheless, achieving complete transparency remains complex. Despite data availability, the inherent complexity of fiscal reports — often riddled with technical jargon and intricate details — renders them largely inaccessible to the layperson. Herein lies the potential of Artificial Intelligence (AI). The advent of chatbots powered by advanced large language models heralds a transformative era in data analytics. These technologies can translate complex financial narratives into simpler, more digestible content, accessible via user-friendly conversational interfaces.

However, the integration of this promising technology in Brazilian public administration is riddled with challenges. Several critical issues persist, including i) the reliability of chatbots in accurately interpreting and conveying sensitive fiscal data, ii) the apprehension among civil servants regarding the initiation of AI chatbot projects, attributable to gaps in technical expertise and resources, and iii) the absence of a comprehensive framework for the implementation of AI systems in the public sector.

Addressing these challenges is imperative for enhancing fiscal transparency in Brazil. In response, this policy brief[1] presents four key recommendations to effectively navigate these complexities, with a focus on the step-by-step process of testing and implementation.

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[1] *This policy brief was developed by Eduardo Araujo, a graduate of the Master of Public Policy program at the Blavatnik School of Government, University of Oxford under the supervision of Filipe Recch, as part of his summer project placement with the Lemann Foundation Programme for the Public Sector. It is based on a series of online interviews conducted from July to October 2023 with experts and representatives from government transparency bodies, academic institutions, and research organizations in Brazil and Europe. We wish to acknowledge the invaluable support and encouragement provided by Prof. Anna Petherick and extend our gratitude to all contributors, interviewees, and colleagues for their insights and guidance..*

## KEY POLICY RECCOMENDATIONS:

- **Establishing an Internal Pilot for Chatbot:** The first recommendation emphasises the importance of initiating a chatbot project with an internal pilot. This initial phase would serve as exploratory research to validate the chatbot's feasibility and effectiveness in enhancing fiscal transparency within a controlled environment before committing extensive public resources to the project. It involves a recruitment process to develop a cost-effective proof of concept (PoC). The success of the pilot would be assessed through rigorous performance evaluations, ensuring the chatbot meets predefined accuracy and cost-effectiveness criteria before proceeding to community testing.

  **Expanding Chatbot Testing to the Community:** The second recommendation outlines the transition from an internal pilot to broader community testing, a critical progression in the chatbot's implementation. This phase proposes an innovation to the technology acquisition process in the public sector by suggesting financial support for developer companies (startups) during testing, governed by Brazil's legal framework of *Contrato Público para Solução Inovadora* (CPSI) – Public Contract for Innovative Solution in English. The process involves a public call for proposals, a streamlined selection process, and community feedback mechanisms to gauge user satisfaction and the chatbot's performance. Key considerations during this phase include data security, scalability, usability, and transparent proposal evaluation. Successful community testing is crucial for advancing to the formal procurement stage.
- **Ensuring Sustained Chatbot Operations:** The third recommendation focuses on the transition to the formal procurement and consolidation phase, including acquisition, licensing, and maintenance essential for the chatbot's sustainable implementation. Tailored strategies are required to meet the specific needs and transparency obligations of public administrations. The procurement process, guided by Complementary Law 182/2021, demands a comprehensive approach, including risk management, continuous system improvement, broad accessibility, active promotion, and stakeholder engagement. Regular performance evaluations are crucial, guiding contract renewals and ensuring the chatbot's alignment with its primary goal of enhancing fiscal transparency.
- **Safeguarding Privacy and Ensuring Security**: The fourth recommendation addresses the critical privacy and security considerations that arise from the deployment of AI chatbots. It highlights the potential risks, including the inadvertent disclosure of sensitive information, susceptibility to cyber-attacks, and the possibility of disseminating erroneous fiscal data. To mitigate these risks, the recommendation calls for the implementation of robust protective protocols, the engagement of cybersecurity experts, and the establishment of clear operational guidelines to prevent data misuse.

Overall, the nascent state of AI chatbots in Brazil's public sector demands a cautious yet proactive approach. This policy brief recognises the existing challenges and advocates for a strategic adoption of third-party Large Language Models to simplify complex fiscal data for the public. These recommendations delineate a path forward, focusing on initial internal pilots and expansive community testing, while ensuring safe and sustained operations, all aimed at enhancing fiscal transparency in an accessible and understandable manner.

# 1. INTRODUCTION

Over the past decade, Brazil has made significant strides in expanding governmental transparency. Pivotal legislation, including the Transparency Law and the Access to Information Law, compelled all levels of government to establish online Transparency Portals [1,2,3]. Over 11,000 such portals were created, propelling Brazil to the 7th position globally on the Open Budget Index [4,5]. While commendable, this proliferation of platforms has yet to sufficiently translate into meaningful public engagement and accountability.

The Open Budget Survey reveals that Brazil falls short in providing readily understandable budget summaries to citizens [5]. Independent research confirms this shortcoming, with approximately 34% of portal users reporting difficulties comprehending disclosed fiscal data [6]. User feedback further pinpoints complex language, clumsy search tools, and lack of informational support as primary obstacles to understanding information from the main transparency portal of the Brazilian government [6]. It is also noteworthy that only 31% of people who use this portal do it mainly to oversee public spending, an indication that merely making data available is not sufficient to get public engagement in budget monitoring [6].

Consequently, the underutilisation of tools available on transparency portals carries significant repercussions for governance and accountability. Extensive literature demonstrates that impenetrable fiscal data prevents citizens from fully harnessing these platforms for oversight [7,8]. Although they provide exhaustive data, the difficulty in understanding complex and specialised terminology in financial reports poses a relevant barrier to public engagement [9,10].

Recent advancements in artificial intelligence, especially chatbots powered by large language models (LLMs), offer promising opportunities to dismantle these barriers by simplifying opaque fiscal terms and enabling real-time query functionality [11,12,13]. Despite the novelty of applying these technologies in public finance contexts, the dissemination of this tool in related domains highlight their potential [14,15,16].

However, the use of this technology into the unique Brazilian context poses complex challenges. Socioeconomic disparities contribute to unequal levels of digital literacy and access. Politically, principal-agent dilemmas suggest politicians may resist transparency-enhancing tools [17]. Competing legal and compliance demands on public administration further complicate matters [18].

Recognising these intricacies, this study explores AI-powered chatbots as instrumental avenues for elevating fiscal transparency and reinvigorating public engagement within Brazilian governance. It examines alternative complementary policy options and concludes with tailored recommendations

designed to overcome contextual barriers. Ultimately, this policy brief advocates for judiciously leveraging AI's possibilities to actualise the vision of participatory democracy in the realm of public fiscal management in Brazil.

## 2. EVIDENCE-BASED BENEFITS OF FISCAL TRANSPARENCY

Fiscal transparency is generally defined as the public availability and dissemination of information about government budgets and fiscal activities [19]. There is evidence that fiscal transparency offers several key advantages, including preventing corruption [20], maintaining fiscal discipline [21], improving financial performance [22], and promoting economic development [23]. Some theoretical arguments suggest that transparency reduces the ability of politicians and bureaucrats to pursue rent-seeking behaviours under asymmetric information [24, 25].

In conjunction with the observations above, Figure 1 encapsulates the findings from 38 studies [26] that explore the multifaceted benefits associated with heightened transparency in public finances. The graphical representation elucidates the implications of transparency in augmenting fiscal discipline, diminishing borrowing costs, mitigating corrupt practices, and stimulating accountability mechanisms. Cross-country studies also underscore the tangible impact of fiscal transparency in both deficits and debt, an enhancement in credit ratings, and the fortification of public service provision.

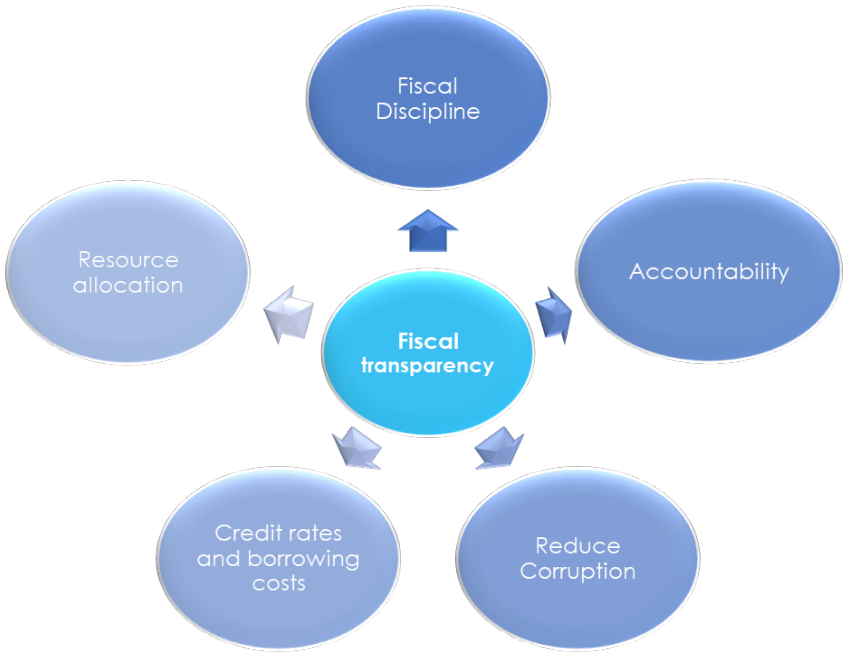


Figure 1. Impacts of Fiscal Openness. Developed by the author.

Recent studies provide evidence on causation, shedding light on the direct effects of transparency on fiscal matters. An experiment conducted by Jung [27] in South Korea illustrates this point. The author compared budget projects affected by a new online open budget system reform (the treatment group) to unaffected projects (the control group). Utilising a difference-in-differences estimation method, the study found that the introduction of the online budget system reduced unused budgets in the treatment group by 22-23% compared to the control. This suggests that, under specific conditions, an increase in fiscal transparency through online open budgeting can lead to substantial improvements in objective measures of budget efficiency.

In the Brazilian context, insights from the domain of budget openness suggest a mutually beneficial relationship between enhanced budget disclosure and improvements in governance [28]. For instance, a study focusing on local governance in Brazil found that participatory budgeting led to a 16% increase in tax revenues and an 18% reduction in infant mortality rates [29,30]. In conclusion, the findings discussed in this section provide strong arguments for policy initiatives aimed at advancing fiscal transparency in Brazil.

## 3. LIMITATIONS OF FISCAL TRANSPARENCY FOR EFFECTIVE ACCOUNTABILITY

While the benefits of fiscal transparency are evident and significant, as previously discussed, it is essential to consider its limitations. Research indicates that the mere availability of fiscal information does not necessarily engender citizen participation or improved governance, as depicted in Figure 2 [31].

Several studies corroborate the idea that transparency initiatives when considered in isolation, fail to instigate collective action or to empower communities to hold governmental bodies accountable [32]. This means enabling capabilities for civic mobilisation, petitioning, and addressing shared public concerns through the platform. This perspective is further substantiated by an analysis conducted by Joshi, which emphasises that positive outcomes are only likely when citizens possess both the resources and the inclination to utilise disclosed information [33].

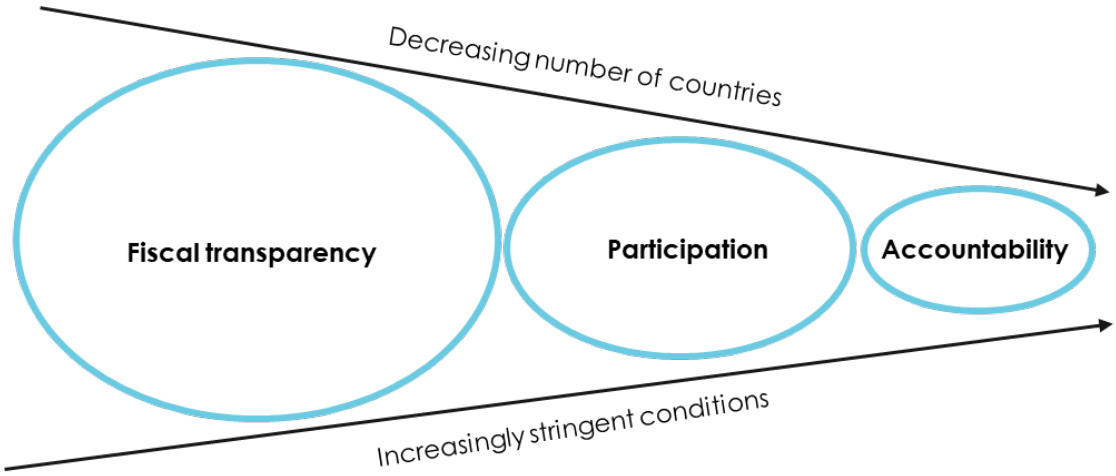


Figure 2. The Transparency, Participation, and Accountability Funnel
Source: Khagram, S.; de Renzio, P.; Fung, A., 2013

A critical analysis of these findings enhances their relevance within the context of this policy brief. While fiscal transparency is undeniably crucial, it must exist within a broader ecosystem that also encourages active citizen engagement and incorporates effective accountability mechanisms.

Carlitz and Bräutigam's works further elaborate on this point by indicating that transparency efforts often do not include corresponding mechanisms for public participation or accountability [34,35]. Consequently, the evidence strongly advocates for a more nuanced approach that not only prioritises fiscal transparency but also actively mobilises and provides enabling conditions for citizens to hold governments accountable.

## 4. TRANSPARENCY PORTALS IN BRAZIL: DISPARITIES AND REGIONAL CONTEXT

Portals or platforms for governmental expenditure transparency are vital instruments of public transparency. Numerous institutions have outlined guidelines for fiscal disclosure [36,37,38], yet there are vast differences in their online presentation. These variations are not simply aesthetic, also profoundly impact public engagement and accountability.

Comparing transparency efforts across nations is insightful. For instance, the United Kingdom emphasises straightforward functionalities [39], whereas the Transparency Portal of Brazil focuses on detailed data visualisations and infographics [40]. This variance extends to subnational governments within Brazil, with states such as Espírito Santo and São Paulo displaying distinct contrasts [41,42].

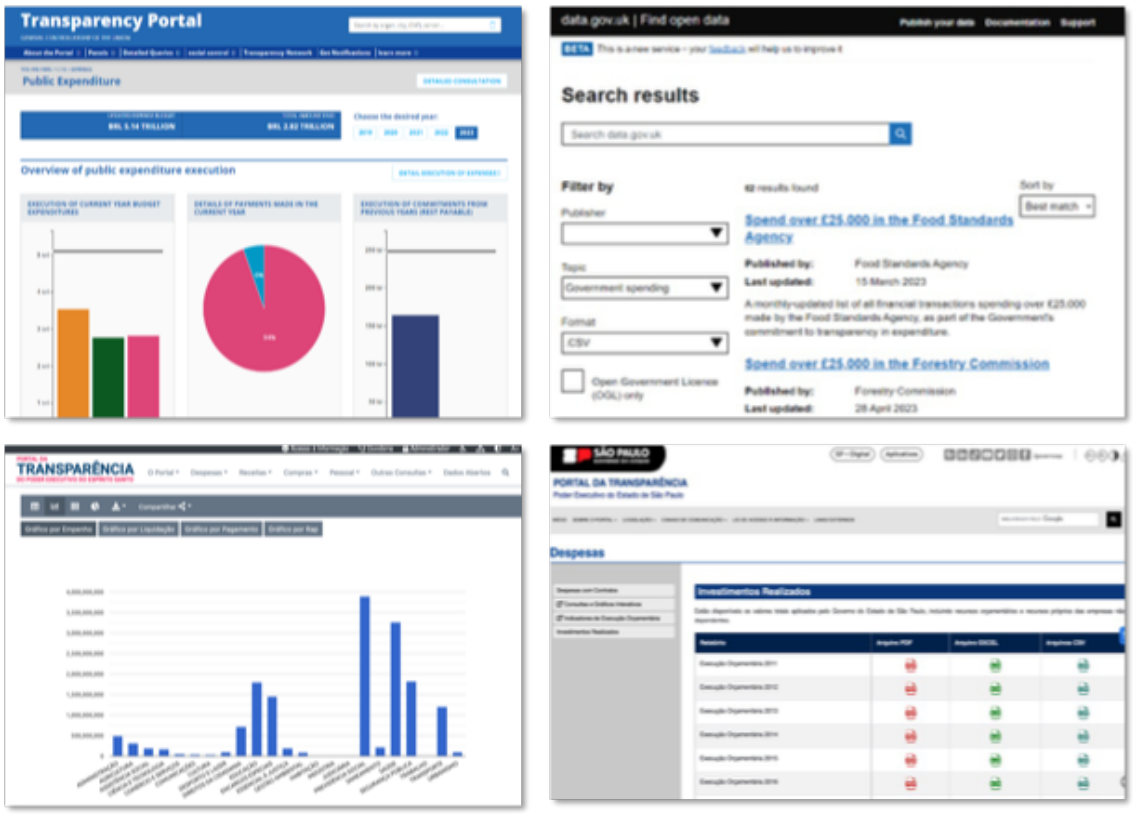


Figure 3. Portal Features Comparison: the Central Government of Brazil, UK, São Paulo and Espírito Santo (clockwise)

An exploration of the scholarly literature provides a comprehensive understanding of the factors that relate to transparency portal efficacy. Lämmerhirt et al. accentuate the importance of usability, suggesting that portal design directly impacts the public's ability to interact with the data [43]. In a similar vein, Srimarga, and Davies and Fumega voice concerns regarding data quality [44,45]. Furthermore, Bauhr and Grimes introduce the concept of public finance literacy and the indispensable role of oversight bodies [46].

Additionally, the principal-agent dilemma, in which government officials may act in self-interest rather than in the citizens' interests, is another key challenge for transparency initiatives, which have the potential empower citizens to monitor public spending [46]. These findings collectively highlight that the efficacy of transparency portals extends beyond mere technological capabilities, encompassing multiple intertwined factors.

The challenges in the Brazilian context are a reflection of the global diagnosis. While Brazil has taken laudable steps by introducing 11,300 transparency portals, there are inconsistencies in data quality and depth across different regions [47]. This is illustrated by the fact that only 22% of state agencies consistently

display high transparency levels, suggesting varied portal quality across regions [48]. Recent assessments about COVID-19 pandemic data disclosure illustrate this argument, revealing stark contrasts in transparency across Brazilian states [49,50]. This pattern emphasises the need for region-specific strategies and interventions.

Amidst these regional nuances, another layer of disparity emerges when analysing resource disclosures on Brazilian online platforms. The federal government stands out, handling 67% of the current national public sector assets , in contrast to the significantly more numerous municipal portals, which manage only 15% of assets [51]. Given this disproportionate fiscal responsibility, optimising the federal government's transparency measures becomes imperative.

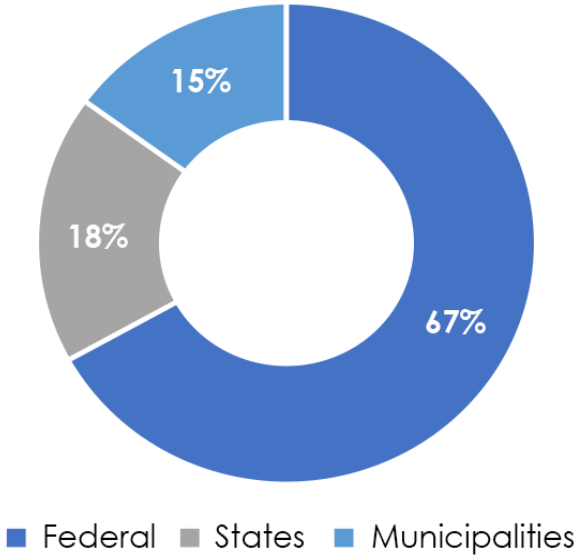


Figure 4. Budget execution by transparency portals level
Source: National Treasury Secretariat, 2023

In line with this concern, a study involving 1,158 users of the Brazilian central government transparency portal highlighted the interaction and usability challenges [52]. Whether it is language clarity or search tool efficiency, user feedback underlines the broader challenges faced by these platforms, as depicted in Table 1. But more strikingly, the same study shows that only one-third of users employ the portal for government oversight, emphasising the need to prioritise user experience.

**Table 1. Users Recommendations for Enhancements in the Transparency Portal**

| Issues / Suggestions | Proportion (%) |
|---|---|
| Language complexity, search mechanisms and information support | **22** |
| Suggestions outside the portal's scope | **19** |
| Unsure / Did not answer | **16** |
| More detailed information and expenses | **15** |
| Other improvements | **13** |
| Raising awareness of the portal | **13** |
| Interaction and portal enhancements | **13** |
| Navigation / accessibility / design | **12** |
| Cross-referencing of information | **5** |
| Data download | **4** |
| Improvements in civil servant earnings query | **4** |
| Graphic presentation of information | **4** |
| Information updates | **4** |

Source: Adapted from Freire & Batista (2016)

This section emphasised the nexus between technology, user experience, and the efficacy of transparency portals. Challenges identified within the Brazilian central government portal serve as an illustration of larger issues impeding public engagement in governmental oversight. Addressing these complexities requires comprehensive solutions that cater to regional distinctions and individual user preferences. The next section will explore policy alternatives designed to address these multifaceted challenges and set the stage for subsequent discussions.

## 5. POLICY OPTIONS FOR ENHANCEMENT IN TRANSPARENCY AND PARTICIPATION

Expanding on the challenges outlined in the previous section, Table 2 presents policy options to enhance governmental transparency in the Brazilian context, recognising the importance of usability and public engagement. The table encapsulates a range of innovative interventions, which not only address the immediate need to improve portal functionalities but also seek to resolve broader issues around public engagement and accessibility. While the focal point of this study remains the implementation of an AI chatbot (Policy 1), the proposed solutions offer a holistic framework that enables policymakers to contemplate a broad spectrum of complementary strategies.

**Table 2. Issues and Policy Alternatives for Brazilian Transparency Portals**

| Policy Option | Description / Rationale |
|---|---|
| 1) AI Chatbot Utilising Language Learning Models (LLM) | In response to the growing utilisation of AI in the Public Sector and the increasing demand for instantaneous services by citizens, this policy integrates an AI-driven chatbot, powered by advanced Language Learning Models, into the transparency portal. This solution intends to simplify intricate fiscal terminology and deliver instantaneous government expenditure data. In scenarios where specific queries are unanswerable, the system will maintain compliance with legal requirements by reverting to passive transparency measures. |
| 2) Enhanced Financial Transparency (EFT) Interface | Given the rapid digital transformation of Brazilian society and the evolving demands of its users, this initiative envisions a revamped transparency portal that pivots towards adaptability and user-centric design. It encompasses elements such as intuitive infographics, concise financial overviews, and dynamic glossaries. A cyclical, data-driven approach, incorporating periodic user feedback, comprehensive website analytics, and open public dialogues, ensures sustained advancement [53]. |
| 3) Literacy Initiatives | Recognising the shift towards improved financial literacy as an empowerment tool for Brazilian citizens, this policy cultivates a dual-faceted educational blueprint. The transparency portal will curate online tutorials and webinars, positioning itself as the epicentre for fiscal information and learning. Concurrently, a specialised financial literacy syllabus will be integrated into national high school curriculums, encapsulating modules like budget management, taxation dynamics, and public expenditure doctrines [54]. |

**Table 3. Issues and Policy Alternatives for Brazilian Transparency Portals**

| Policy Option | Description / Rationale |
|---|---|
| 4) Citizen's Report and Social Media Outreach | Capitalising on the increased role of social media platforms in Brazilian communication patterns, this strategy transmutes intricate financial documents into a comprehensible "Citizen's Financial Report", enriched with layman-friendly verbiage and visual aids. Exploring the pervasive reach of Instagram in Brazil, an engaging, culturally resonant persona, 'Mr. Fiscal,' will elucidate fiscal complexities, thereby amplifying public participation in fiscal oversight activities. |
| 5) Social Accountability Units for Financial Oversight (SAU) | Considering the diverse regional governance structures of Brazil, this policy recommends establishing Social Accountability Units comprised of community volunteers equipped with financial literacy training [55,56]. These units would scrutinise budget execution, a process distinct from participatory budgeting, which focuses on budget formulation. A designated online platform, complete with educational materials and forums, would be launched to underpin SAU activities This community-based approach seeks to deepen financial scrutiny at a grassroots level, thereby enhancing overall transparency and governance outcomes. |

Source: Author

Following the presentation of policy alternatives, Table 3 elucidates the advantages and concerns associated with each option. The AI Chatbot, for instance, stands out for its potential in promoting high levels of public engagement and accessibility, despite the potential high costs, technical complexity and accuracy mistakes associated with system development. The Enhanced Financial Transparency (EFT) Interface is positive due to its user-centric and data-driven design, yet its immediate impact on public engagement may be moderate. Literacy initiatives offer long-term educational value but might not provide immediate widespread accessibility. The Citizen's Report gains points for immediate impact and ease of implementation but may lack depth. Finally, the Social Accountability Units (SAUs) are noteworthy for community involvement but could be hindered by maintenance and training costs, reliance on volunteers, and variations in effectiveness due to regional disparities.

**Table 4. Comparative Analysis of Policy Options: Advantages and Contextual Concerns**

| Policy Option | Advantages | Concerns |
|---|---|---|
| 1) AI Chatbot | **High Public Engagement, Accessibility** | **Cost, Technical Complexity, Hallucination (Accuracy mistakes)** |
| 2) EFT Interface | **User-Centric, Data-Driven** | **Moderate Public Engagement** |
| 3)Literacy Initiatives | **Educational, Long-Term Impact** | **Limited Immediate Accessibility** |
| 4) Citizen's Report | **High Public Engagement, Easy Implementation** | **Limited Depth of Information** |
| 5) SAU Units | **Community Involvement, Democratic Scrutiny** | **Training and maintenance costs, reliance on volunteers, and regional variations** |

Source: Author

When examining the policy options provided, it is clear that the suitability of each depends on specific contextual circumstances. Every policy option has distinct advantages and potential concerns, and each is designed to address regional challenges and constraints. Among these options, this policy brief gives special attention to Policy Option 1 (AI Chatbot). This choice stands out because of its potential benefits in Brazilian urban areas where more people use the internet and are familiar with digital tools. Furthermore, since this policy area is relatively new, discussions surrounding its implementation can shed light on ways to address issues such as technical challenges and cost. The following section will delve into an in-depth analysis of the AI Chatbot solution, aiming to highlight crucial aspects that need consideration for a successful rollout.

## 6. AI CHATBOTS AS A PROMISING SOLUTION

Chatbots, as a software application designed to simulate interactive human conversation, have emerged as a compelling tool for enhancing public engagement in governmental transparency portals. The term originates from 'chatting robot,' capturing the essence of these systems, which can conduct text, audio, or voice-based exchanges [57].

Chatbots can be broadly categorised into three main types based on technological capabilities. Rule-based chatbots operate on predefined scripts and offer limited flexibility [58]. Natural Language Processing (NLP) chatbots leverage linguistic algorithms to better comprehend user queries [59]. Lastly, cutting-edge chatbots, employing Large Language Models (LLMs), can generate remarkably human-like responses [60]. All three types continue to evolve and find use in specific cases [61].

The implementation of chatbots in public administration necessitates a careful evaluation of both potential benefits and drawbacks. On the positive side, research supports the notion that chatbots can provide around-the-clock service at a reduced operational cost [62]. Conversely, the financial gains from such low operational expenses may be offset by substantial initial development costs, with overall cost-effectiveness being dependent on user engagement levels [63].

Chatbots excel in addressing large volumes of routine queries with uniform responses [64], but their limitations emerge when confronted with complex or ambiguous questions. Some individuals find those interactions less intimidating [65], while there are also frustrations associated with their relatively limited capabilities [66]. Overall, while scholarly evidence indicates potential benefits of chatbot deployment in public services, challenges such as high initial costs, limited conversational skills, and over-automation must be judiciously considered.

It should be noted that the extent of these limitations often depends on the technological sophistication of the chatbot and the quality of its training for query resolution. The landscape of this technology has been profoundly influenced by the advent of LLMs [67]. These advanced technologies can generate free-form text, allowing virtual agents to manage complex, open-ended inquiries more effectively than their rule-based or basic natural language processing counterparts [68]. This sophistication in conversational skills potentially reduces the likelihood of user dissatisfaction commonly associated with more rudimentary chatbots [69]. Moreover, the pre-trained nature of these models may save on development expenses by diminishing the need for extensive, task-specific training data [70].

**Box 1: Glossary of Technical Concepts**

- **Large Language Models (LLMs):** LLMs are advanced machine learning algorithms trained on massive datasets that can generate coherent and contextually relevant text across a multitude of tasks. LLMs are to textual data what advanced statistical models are to numerical data: tools for generating insights, making predictions, and facilitating complex tasks [71].
- **Generative Pre-trained Transformer (GPT) and Claude Anthropic:** These are specific types of LLMs, developed by OpenAI [72] and Anthropic [73], respectively. Both serve as pinnacle examples of machine learning algorithms for natural language processing. These models function like advanced digital libraries that not only understand but also generate coherent and contextually relevant text.
- **Chatbots Powered by LLMs:** These are specialised conversational agents that leverage the capabilities of LLMs to facilitate more dynamic and contextually sensitive interactions. While traditional chatbots could be likened to automated FAQs, chatbots powered by LLMs are akin to virtual consultants, capable of navigating complex inquiries and providing more nuanced responses [74].

As we navigate the intricacies of chatbot applications in public administration, one example can illuminate the theoretical discussions. A recent pilot programme in the state of Espírito Santo in Brazil, the *Transparenc.IA chatbot* is aimed at facilitating citizen queries concerning fiscal expenditures by utilising LLMs. Figure 5 shows the Application Front-end, while Figure 6 presents the system architecture. Despite the inherent technical complexity, the point to underscore is that Artificial Intelligence is employed to translate general user queries into filters. Once these filters are applied to government data spreadsheets, they return the desired information in a language comprehensible to the user [75].

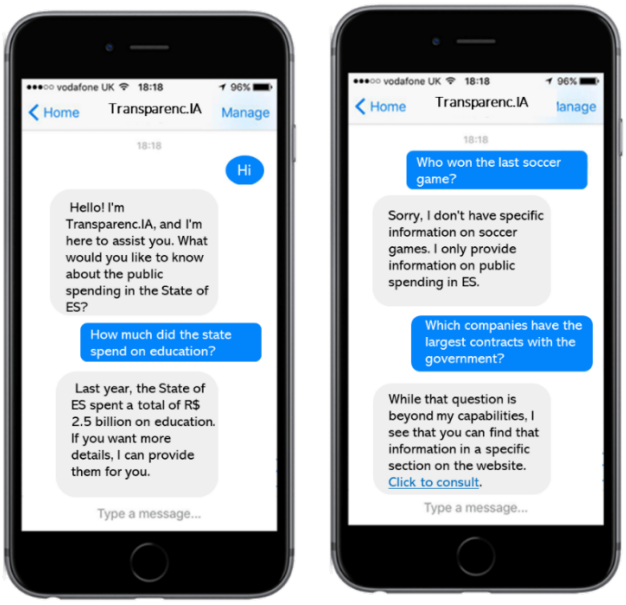


Figure 5. Front-end of Transparenc.IA Chatbot

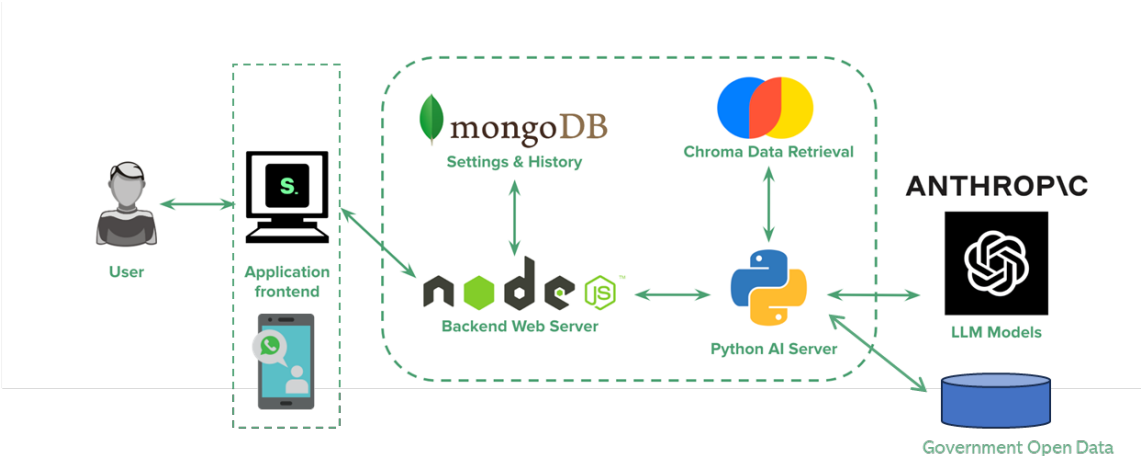


Figure 6. Architecture of Transparenc.IA Chatbot

Considering the challenges of high cost and technical complexity, the government of Espírito Santo sought out a readily available technological solution in the market and assessed the efficiency of using commercially available LLMs. In the process of evaluating the Proof of Concept (PoC),, the state government employed a methodology that included a set of 50 questions to assess the capability of the LLM models to apply the correct filters to retrieve accurate information from the complex government spending records.

Table 1 indicates that GPT 3.5 emerged as the most cost-efficient of the models evaluated. While its accuracy rate was 75%, lower than its competitors, it had the advantage of initiating responses in fewer than 5 seconds and incurred a modest monthly cost of 2,000 USD. Consequently, it was deemed the optimal selection for a project expected to cater to 20,000 users per month [76].

**Table 5. Comparative Analysis of Large Language Models for Transparenc.IA Chatbot**

| Large Language Model (LLM) | Monthly Operational Cost (USD) | Accuracy in Fiscal Queries (%) | Time to Initiate Response (seconds) |
|---|---|---|---|
| **GPT 3.5** | 2,000 | 75 | <5 |
| **GPT 4** | 21,000 | 90 | >20 |
| **Claude 2.0** | 13,000 | 83 | <10 |

Source: Espírito Santo Government & Superdash Software (2023)

The selection of GPT 3.5 for this project pilot underscores the promise of employing AI Chatbots for civic engagement in fiscal matters. The efficiency of this model in initiating quick responses, coupled with its cost-effectiveness, positions it as a feasible tool for bridging the informational gap between government and citizens. Nonetheless, while the case study offers technical promise, detailed evaluation data is needed to determine its real-world effectiveness, involving risks such as data bias, ethical safety, and model transparency, which loom large as potential roadblocks to widespread adoption.

As policymakers contemplate scaling these technologies, a nuanced understanding of these concerns becomes imperative. In the next section, this policy brief delves into some implementation issues and offers a set of recommendations for implementing AI Chatbots in the context of Brazilian governance.

## 7. POLICY RECCOMENDATIONS

The recommendations outlined in this policy brief stem from a detailed investigation conducted from July to October 2023 which included monitoring initial steps in the design of a chatbot for the state of Espírito Santo as well as interviews with experts from academia and government, and AI specialists.

Key participants involved representatives from local audit courts, the president of the Federal Audit Court, heads of federal transparency portals, and professionals working in AI transparency initiatives in Brazil and Europe. This diversity of perspectives greatly informed the comprehensive guidance offered by this brief.

### 7.1 ESTABLISHING AN INTERNAL PILOT FOR CHATBOT

The integration of a chatbot for fiscal transparency commences with an internal pilot project. This initial phase, distinct from the formal bidding processes described in subsequent recommendations, serves primarily as an exploratory research initiative. Its purpose is to internally ascertain the feasibility and potential effectiveness of the chatbot in a controlled environment before the allocation of substantial public resources. Furthermore, it serves to demonstrate the practicality of the chatbot and to secure support from internal stakeholders. If similar successful implementations were to be identified in other governments, this phase could potentially be streamlined [77].

This stage requires the strategic involvement of professionals with expertise spanning AI, finance, and public policy. The recruitment for this phase diverges from standard procurement procedures, favouring a more direct, personalised approach. This method, involving targeted outreach and comprehensive discussions with potential participants, allows for a thorough assessment of each candidate's skills and their commitment to contributing to a Proof of Concept (PoC) [78].

A unique aspect of this phase is the potential for a cost neutral PoC, achieved through a symbiotic partnership between the government and AI service providers. The government offers its expertise in public finance, providing a real-world testing environment, while the AI service provider gains a valuable opportunity to refine their solutions in a practical context. This mutually beneficial arrangement is particularly advantageous considering Brazil's extensive network of over 11,000 transparency portals, as presented in section 4, representing a substantial future market for successful AI solutions.

The primary objective here is to develop a PoC to showcase the potential of the chatbot without incurring substantial initial costs. The PoC should utilise a detailed dataset, derived from prevalent inquiries on the transparency portal. While this data is publicly available, the integration of technical glossaries and additional explanatory materials is crucial for the preliminary training of the chatbot. Collaboration with academia and industry experts at this juncture can amplify the chatbot's foundational knowledge and enhance the project's overall credibility.

The chatbot's performance evaluation requires a meticulous methodology. The PoC's duration is typically short, ranging from a few days to a couple of weeks, providing a rapid assessment. A set of diverse questions, representative of public interest, should be compiled and used to assess the chatbot's

responses, with an expectation of high accuracy. The indicative accuracy rate of 95-100% serves as a guideline, with the understanding that specific figures may be adapted based on the project's unique needs and findings from the pilot tests. This iterative process of testing and refinement is essential to fine-tuning the chatbot's accuracy and relevance [79].

Advancing from this internal pilot to expansive community testing is contingent upon the achievement of predetermined success criteria, established during the PoC. These criteria, which mainly include accuracy and cost-effectiveness, must be explicit, measurable, and in harmony with the project's long-term objectives. Upon meeting these standards, the project can progress to the community testing phase, as elaborated in the following recommendation. This stage not only demonstrates AI's potential but also critically evaluates its practicality and value in real-world applications, serving as a "trial run" before any large-scale implementation.

### 7.2 EXPANDING CHATBOT TESTING TO THE COMMUNITY

The transition from internal pilot testing to broader community engagement is a critical step in the chatbot implementation process. This expansion can be carried out with the use of a recent legal framework, specifically the "Public Contract for Innovative Solution" (CPSI), part of the Legal Framework for Startups and Innovative Entrepreneurship (Complementary Law 182/2021). This framework encourages technological innovation in the public sector by providing financial support to participating companies during the testing phase, thereby promoting stability and growth in this sector [80].

The process begins with the government agency issuing a public call for innovative technological solutions, with a clear emphasis on the chatbot project's goals. This call invites startups to propose how AI chatbots can enhance fiscal transparency. The selection process is then streamlined, with a focus on choosing proposals that offer the most value. This assessment goes beyond cost and includes factors such as technical excellence, feasibility, and potential benefits to the public.

The law allows for flexibility in the selection process, with the possibility of choosing more than one proposal for further development. This approach is designed to spur a range of innovative solutions. Once selected, these proposals enter a contractual phase, known as the CPSI, which defines the project's goals, evaluation methods, and financial aspects. The contract includes a clear financial ceiling and allows for different forms of remuneration, which can cover various operational costs, including those specific to AI services.

Community involvement is central to this phase. The public's feedback, gathered through surveys or interactive sessions, provides valuable insights into the chatbot's performance and user satisfaction, thereby building public trust. To ensure a wide range of feedback, users might be randomly assigned to interact with different chatbots.

However, this phase requires careful consideration of several key factors:

- Scalability: The chatbot should be able to expand its capabilities to accommodate increased user traffic or more complex queries.
- Usability: The chatbot needs to be user-friendly across various platforms, including mobile apps and official websites.
- Evaluation of Proposals: Proposals should be assessed transparently, with a committee of experts evaluating each chatbot based on predefined criteria, including user feedback and accuracy of responses.

Successful community testing paves the way for the next phase, moving the project closer to full-scale implementation. The agency will have valuable data on user preferences, technical performance, and cost, ready to proceed to the formal contractual stage, detailed in the next subsection. This progression is crucial, but it's also vital to avoid investing in a solution that fails to maintain public interest over time. Past instances have shown that even promising projects can falter if they don't engage users effectively, highlighting the importance of this community testing phase. The subsequent recommendation will explore how to transition from a successful pilot to a sustainable, full-scale program.

### 7.3 ADVANCING IN THE PROCUREMENT STAGE AND ENSURING CHATBOT MAINTENANCE

The transition from community testing to definitive adoption is key for the sustainable implementation of chatbot technology, and requires a strategy tailored to the unique operational needs and transparency obligations of each public administration body. Smaller entities with limited resources and less stringent transparency requirements might licensing for the use of software, with a pay-per-use model, more economical and manageable, reducing the need for significant initial investments and simplifying system maintenance, especially when specialised expertise may not be readily available. In contrast, larger public bodies could benefit from a comprehensive solution, potentially shared among several agencies, to optimise cost-efficiency and resource utilisation.

Upon concluding the initial bidding process and fulfilling the Contract for Innovative Public Solution (CPSI) conditions outlined in Article 14 of Complementary Law 182/2021, the administration can proceed with the procurement stage under Article 15. This stage allows for a supply contract with the initial contractor without a new bidding process, contingent upon the CPSI's successful outcome. The supply contract's duration is capped at 24 months, extendable by another 24 months. The contract value cannot exceed five times the CPSI's maximum value, ensuring fiscal prudence while accommodating necessary adjustments for price changes or unforeseen needs.

Navigating the procurement process involves addressing complexities, especially regarding legal compliance and information accuracy. A comprehensive risk management strategy is essential, pinpointing potential operational, security, and legal challenges, and formulating preemptive solutions. The system must also ensure information accuracy, incorporating a disclaimer feature to help users understand the data's source and context, thereby minimising misinformation risks.

Integrating a back-office system is crucial for continuous improvement and maintenance. This system facilitates real-time monitoring of user interactions and chatbot responses, providing valuable insights for iterative refinements. Establishing a dedicated curation team, which includes staff from departments accustomed to handling public inquiries, is recommended. This team will regularly review interactions, making necessary adjustments to preserve response relevance and accuracy.

Extending the chatbot's reach beyond the government portal is critical. Integration with popular social platforms like WhatsApp can increase accessibility and user familiarity with fiscal data, encouraging more interaction. However, such expansion requires strategic promotion. Evidence from the Federal Audit Court (TCU) underscores the effectiveness of promotional campaigns in enhancing user engagement, necessitating sustained marketing efforts. The risk of project discontinuation due to low user engagement is significant, highlighting the need to keep users interested.

In summary, this phase requires a comprehensive approach that integrates formal procurement procedures, rigorous system maintenance, broad accessibility, and dynamic promotion. Continuous engagement with key stakeholders, including government agencies, technology partners, and user representatives, is crucial for maintaining the chatbot's relevance and credibility. Regular assessments, key for guiding decisions on contract renewals and adjustments, ensure the chatbot consistently promotes informed public participation and enhances fiscal transparency [81].

It's important to acknowledge that, in addition to these operational strategies, safeguarding user privacy and ensuring system security is fundamental to the chatbot's functionality. The subsequent section explores the complexities of addressing these risks.

### 7.4. SAFEGUARDING PRIVACY AND ENSURING SECURITY IN AI CHATBOT DEPLOYMENT

In the wake of the preceding recommendations focusing on the implementation and expansion of AI chatbots for fiscal transparency, it becomes imperative to address privacy and security considerations. The utilisation of AI chatbots, while a transformative approach to democratising access to fiscal data, brings to the fore significant privacy and security challenges that necessitate strategic management.

The concern of paramount importance is the potential disclosure of sensitive information through the analysis of accumulated user queries. Such a scenario could inadvertently unveil societal trends or localised anxieties, particularly if inquiries about certain fiscal matters are recurrent within a specific demographic or region. Mitigating this risk calls for the implementation of measures like the anonymisation of user data and stringent controls on data retention periods.

Moreover, the susceptibility of chatbots to cybersecurity threats, common to all online platforms, underscores the necessity for robust protective protocols. These digital systems, accessible to the public, are potential targets for cyber-attacks, unauthorised access, and other forms of digital disruption. Engaging cybersecurity experts from the initial stages of development is crucial to embed resilient security safeguards, thereby preserving system integrity and maintaining public confidence.

Additionally, the possibility of chatbots providing erroneous or incomplete information poses a risk of fiscal data misrepresentation. While the complete eradication of inaccuracies is unfeasible, the transparency and reliability of the system can be bolstered by incorporating features such as citations for data sources and explicit disclaimers regarding the chatbot's limitations. These elements aid users in correctly interpreting the responses, fostering an informed citizenry.

Furthermore, the interaction dynamics between users and chatbots could lead to unintentional sharing of personal information, thus raising privacy concerns. It is essential to establish clear guidelines within the chatbot's operational framework to prevent unauthorised data collection or misuse. Adherence to existing data protection legislation and standards of digital governance is crucial in this regard, ensuring compliance and safeguarding data integrity [82].

In conclusion, while the current legal frameworks provide a substantial basis for navigating these challenges, the integration of AI chatbots in the public sector mandates continuous dialogue to ensure that technological advancements align with civic values. A commitment to purpose-driven design, coupled with prudent data management practices, is essential in maintaining public trust and maximising the benefits of AI chatbots in fiscal transparency. This commitment guarantees that the deployment of AI chatbots adheres to the highest standards of data privacy and system security, thereby enhancing the public's confidence in these digital initiatives.

# 8. CONCLUSION

This policy brief has illuminated the profound challenges hindering fiscal transparency and active citizen engagement in Brazil, notably the intricate nature of budgetary data and the public's detachment from fiscal governance. Despite Brazil's significant progress in digital transparency, the brief underscores a critical disconnect: the expansion of information availability has not translated into genuine public comprehension or engagement. Herein lies the potential of AI-powered chatbots. By demystifying complex fiscal terminology and facilitating real-time interactions, chatbots stand poised to bridge this divide, transforming passive data into an active dialogue with the citizenry.

However, the deployment of such technology is not without its intricacies. This brief recommends a cautious, phased introduction of AI chatbots, emphasising the need for exploratory pilots, extensive community testing, and context-sensitive implementation strategies. These strategies must be meticulously crafted to navigate the nuanced terrain of legal compliance, data security, and user privacy. Furthermore, they should promote inclusivity and continuous stakeholder engagement, ensuring the technology remains accessible and relevant to all sectors of society.

In conclusion, while AI chatbots are not a universal remedy, they herald a significant shift towards more transparent, accountable, and participatory fiscal governance in Brazil. This policy brief serves as a compass for policymakers, offering evidence-based guidance for harnessing AI to empower citizens, thereby nurturing a more informed public sphere. The conscientious integration of AI chatbots could mark a pivotal moment in Brazil's democratic journey, turning the ideals of participatory democracy into tangible realities and positioning citizens as informed overseers in the public finance landscape.

# 9. REFERENCES


[1] Brasil (2009). Lei da Transparência. Lei Complementar n° 131, de 27 de maio de 2009. https://tinyurl.com/yu66yn7y

[2] Brasil (2011). Lei de Acesso a Informação. Lei nº. 12.527, de 18 de novembro de 2011. https://tinyurl.com/y9nr2yum

[3] Controladoria-Geral da União. (2013). Brasil transparente: Guia de implantação de Portal da Transparência (1st ed.). Secretaria de Prevenção da Corrupção e Informações Estratégicas. https://tinyurl.com/yhppryn7.

[4] Associação dos Membros dos Tribunais de Contas do Brasil (Atricon). (2022). Relatório do Levantamento dos Portais PNTP - Ciclo 2022. https://atricon.org.br/transparenciapublica/

[5] International Budget Partnership (2021). Open Budget Survey. Washington/DC. Available at http://www.internationalbudget.org/open-budget-survey

[6] Freire, F. R., & Batista, C. M. (2016). How does the citizen evaluate the Portal? A study with users of the Federal Government Transparency Portal. Revista da CGU - Controladoria Geral da União, 8(13), 373-403 https://repositorio.cgu.gov.br/bitstream/1/34412/5/V8.n13_Cidadao.pdf

[7] Gigler, B., & Bailur, S. (Eds.). (2014). Closing the feedback loop: Can technology bridge the accountability gap? World Bank Publications. https://tinyurl.com/5fcartnt

[8] Viana, Giovanni Bogea, & De Toledo, Maria Beatriz Felgar. (2011). An evaluation of Brazilian Transparency Portal and how to improve it. International Conference on Information Society (i-Society 2011), 366-372. https://doi.org/10.1109/i-Society18435.2011.5978471

[9] Costa, A. de J. B., Leite, D. B. A., & Campos, E. S. (2015). Portais de transparência fiscal: uma crítica aos municípios com população entre 50 e 100 mil habitantes. Revista Da FAE, 17(1), 24–61. Available at https://revistafae.fae.edu/revistafae/article/view/3

[10] Langella, C., Anessi-Pessina, E., Botica Redmayne, N., & Sicilia, M. (2023). Financial reporting transparency, citizens' understanding, and public participation: A survey experiment study. Public Administration, 101( 2), 584– 603. https://doi.org/10.1111/padm.12804

[11] Porreca, S., Leotta, F., Mecella, M., Vassos, S., & Catarci, T. (2018). Accessing government open data through chatbots. In E. Blomqvist, P. Ciancarini, F. Poggi, & F. Vitali (Eds.), Knowledge Engineering and Knowledge Management: 20th International Conference, EKAW 2016, Bologna, Italy, November 19-23, 2016, Proceedings (pp. 114–128). Springer International Publishing. https://doi.org/10.1007/978-3-319-58694-6_8

[12] Barcellos, R., Bernardini, F., Viterbo, J., & Zuiderwijk, A. (2023). Hippolyta: A framework to enhance open data interpretability and empower citizens. In Proceedings of the 24th Annual International Conference on Digital Government Research (pp. 191–198). ACM. https://doi.org/10.1145/3598469.3598559

[13] Cantador, I., Viejo-Tardío, J., Cortés-Cediel, M. E., & Rodríguez Bolívar, M. P. (2021). A chatbot for searching and exploring open data: Implementation and evaluation in e-government. In DGO2021: The 22nd Annual International Conference on Digital Government Research (pp. 168–179). ACM. https://doi.org/10.1145/3463677.3463681

[14] Gomez, M., Cabot, J., & Clarisó, R. (2023). Towards the automatic generation of conversational interfaces to facilitate the exploration of tabular data. arXiv. http://arxiv.org/abs/2305.11326

[15] Wu, S., Irsoy, O., Lu, S., Dabravolski, V., Dredze, M., Gehrmann, S., Kambadur, P., Rosenberg, D., & Mann, G. (2023). BloombergGPT: A Large Language Model for Finance. arXiv. Retrieved from http://arxiv.org/abs/2303.17564v2

[16] Dan, Y., Lei, Z., Gu, Y., Li, Y., Yin, J., Lin, J., et al. (2023). EduChat: A Large-Scale Language Model-based Chatbot System for Intelligent Education. arXiv. http://arxiv.org/abs/2308.02773

[17] Michener, Gregory and Ritter, Otavio, Comparing Resistance to Open Data Performance Measurement: Public Education in Brazil and the UK (2017). Public Administration, Volume 95, Issue 1. http://dx.doi.org/10.2139/ssrn.3290604

[18] Barreiro, G. S. S., & Furtado, R. P. M. (2015). Inserting the judicialization on the public policy cycle. Rev. Adm. Pública, 49(2). https://doi.org/10.1590/0034-7612126144

[19] Premchand, A. (1993). Public expenditure management. International Monetary Fund. https://tinyurl.com/yj8fvahk

[20] Kolstad, I., & Wiig, A. (2009). Is transparency the key to reducing corruption in resource-rich countries? World Development, 37(3), 521-532. https://tinyurl.com/3k87jb2z

[21] Von Hagen, J., & Harden, I. J. (1995). Budget processes and commitment to fiscal discipline. European Economic Review, 39(3-4), 771-779.

[22] Alt, J. E., & Lassen, D. D. (2006). Fiscal transparency, political parties, and debt in OECD countries. European Economic Review, 50(6), 1403-1439.

[23] Arbatli, E., & Escolano, J. (2015). Fiscal transparency, fiscal performance and credit ratings. Fiscal Studies, 36(2), 237-270.

[24] Von Hagen, J. (1992). Budgeting procedures and fiscal performance in the European Communities. Commission of the European Communities.

[25] Ríos, A. M., Bastida, F., & Benito, B. (2016). Budget transparency and legislative budgetary oversight: An international approach. The American Review of Public Administration, 46(5), 546-568.

[26] de Renzio, P., & Wehner, J. (2017). The Impacts of Fiscal Openness. The World Bank Research Observer, 32(185-210). https://doi.org/10.1093/wbro/lkx004

[27] Jung, H. (2022). Online open budget: The effects of budget transparency on budget efficiency. Public Finance Review, 50(1), 91-119. https://doi.org/10.1177/10911421221093412

[28] Khagram, S., de Renzio, P., & Fung, A. (2013). Overview and synthesis: The political economy of fiscal transparency, participation, and accountability around the world. In S. Khagram, P. de Renzio, & A. Fung (Eds.), The political economy of fiscal transparency, participation, and accountability around the world (pp. 1–45). Brookings Institution Press. https://www.brookings.edu/wp-content/uploads/2016/07/openbudgets_chapter.pdf

[29] Touchton, M., & Wampler, B. (2020). Public engagement for public health: Participatory budgeting, targeted social programmes, and infant mortality in Brazil. Development in Practice, 30(5), 681–686. https://doi.org/10.1080/09614524.2020.1742662

[30] Touchton, M., Wampler, B., & Peixoto, T. (2021). Of democratic governance and revenue: Participatory institutions and tax generation in Brazil. Governance, 34(4), 1193–1212. https://doi.org/10.1111/gove.12552

[31] Jung, H. (2022). Online open budget: The effects of budget transparency on budget efficiency. Public Finance Review, 50(1), 91-119. https://doi.org/10.1177/10911421221093412

[32] Peixoto, T., & Fox, J. (2016). When does ICT-enabled citizen voice lead to government responsiveness? IDS Bulletin, 47(1), 23-40. https://bulletin.ids.ac.uk/index.php/idsbo/article/view/34/html

[33] Joshi, A. (2013). Do they work? Assessing the impact of transparency and accountability initiatives in service delivery. Development Policy Review, 31(1), S29-S48.

[34] Carlitz, R. (2013). Improving transparency and accountability in the budget process: An assessment of recent initiatives. Development Policy Review, 31(1), S49-S67. https://doi.org/10.1111/dpr.12019

[35] Bräutigam, D. (2004). The people's budget? Politics, participation and pro-poor policy. Development Policy Review, 22(6), 653-668. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-7679.2004.00270.x

[36] OECD (2017), OECD Budget Transparency Toolkit: Practical Steps for Supporting Openness, Integrity and Accountability in Public Financial Management, OECD Publishing, Paris, https://doi.org/10.1787/9789264282070-en

[37] International Monetary Fund. Fiscal Affairs Department. (2018). Fiscal transparency handbook. Washington, DC: International Monetary Fund. ISBN 9781484331859. https://tinyurl.com/thp8rsr7

[38] International Budget Partnership. (2010). Guide to Transparency in Government Budget Reports: Why are Budget Reports Important, and What Should They Include? Edited by V. Ramkumar & I. Shapiro. https://tinyurl.com/338vwwk9

[39] UK Government. Government Open Data Portal: Data.gov.uk. (n.d.). https://www.data.gov.uk/

[40] Brazil. Controladoria-Geral da União, Brazil Transparency Portal (n.d.). https://portaldatransparencia.gov.br/despesas

[41] Espírito Santo Government, Executive Transparency Portal (n.d). https://transparencia.es.gov.br/Despesa#

[42] São Paulo Government, Executive Transparency Portal (n.d). https://www.transparencia.sp.gov.br/Home/Investimentos

[43] Lämmerhirt, D., Rubinstein, M., & Montiel, O. (2017). The state of open government data in 2017. Open Knowledge International. https://tinyurl.com/24bd6a2x

[44] Srimarga, I.C. (2010). Open data initiative of Ministry of Finance on national budget transparency in Indonesia. Web Foundation. https://tinyurl.com/2j7zv738

[45] Davies, T., & Fumega, S. (2014). Mixed incentives: Adopting ICT innovations for transparency, accountability, and anti-corruption. Chr. Michelsen Institute. https://tinyurl.com/mrxs2f5n

[46] Bauhr, M., & Grimes, M. (2014). Indignation or resignation: The implications of transparency for societal accountability. Governance, 27(2), 291-320 https://doi.org/10.1111/gove.12033

[47] National Association of Members of Audit Courts (Atricon). (2022). Report on the Survey of Portals. National Public Transparency Program. https://tinyurl.com/2rmrajf6

[48] Regly, T., & Fernandez de Souza, R. (2022). Data availability and democratization of access to public information: An analysis of Portal da Transparência do Governo Federal. Encontros Bibli: Revista Eletrônica de Biblioteconomia e Ciência da Informação, 27, 01-16. Universidade Federal de Santa Catarina. https://doi.org/10.5007/1518-2924.2022.e87855

[49] Rauppi, F. M., & Pinho, J. A. G. de. (2022). Avaliação da transparência e dados sobre a pandemia do Covid-19: uma análise dos portais eletrônicos das capitais dos estados brasileiros. Revista Meta. https://doi.org/10.22347/2175-2753v14i42.3629

[50] Reis, R. N. C. dos, Alcantara, K. F., & Lucena, B. R. D. (2023). Avaliação da transparência ativa nos portais eletrônicos estaduais no contexto da pandemia da COVID-19. Revista Valore, 8, e-8007. https://doi.org/10.22408/reva8020231063e-8007

[51] Brazil. National Treasury Secretariat. (2023). National Public Sector Balance 2023. https://tinyurl.com/mudkzskk

[52] Freire, F. R., & Batista, C. M. (2016). How does the citizen evaluate the Portal? A study with users of the Federal Government Transparency Portal. Revista da CGU - Controladoria Geral da União, 8(13), 373-403 https://repositorio.cgu.gov.br/bitstream/1/34412/5/V8.n13_Cidadao.pdf

[53] A. Cairo (2016). The Truthful Art: Data, Charts, and Maps for Communication, New Riders. https://tinyurl.com/yfseft2j

[54] Amagir, A., Groot, W., Maassen van den Brink, H., & Wilschut, A. (2018). A review of financial-literacy education programs for children and adolescents. Citizenship, Social and Economics Education, 17(1), 56–80. https://doi.org/10.1177/2047173417719555

[55] Ebdon, C., & Franklin, A. L. (2006). Citizen participation in budgeting theory. Public Administration Review, 66(3), 437-447. https://www.jstor.org/stable/3843923

[56] Ackerman, J. (2004). Co-governance for accountability: Beyond "exit" and "voice". World Development, 32(3), 447-463. https://doi.org/10.1016/j.worlddev.2003.06.015

[57] McTear, M., Callejas, Z., & Griol, D. (2016). The conversational interface: Talking to smart devices. Springer. https://link.springer.com/book/10.1007/978-3-319-32967-3

[58] Shawar, B. A., & Atwell, E. (2007). Chatbots: Are they Really Useful? LDV Forum, 22(1), 29-49. https://doi.org/10.21248/jlcl.22.2007.88

[59] Kusal, S., Patil, S., Choudrie, J., Kotecha, K., Mishra, S., & Abraham, A. (2022). AI-Based Conversational Agents: A Scoping Review From Technologies to Future Directions. IEEE Access https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9864589

[60] Adiwardana, D., Luong, M. T., So, D. R., Hall, J., Fiedel, N., Thoppilan, R., ... & Kulikov, I. (2020). Towards a human-like open-domain chatbot. arXiv preprint arXiv:2001.09977 https://doi.org/10.48550/arXiv.2001.09977

[61] Gnewuch, U., Morana, S., Adam, M., & Maedche, A. (2018). Faster Is Not Always Better: Understanding the Effect of Dynamic Response Delays in Human-Chatbot Interaction. In ECIS (p. 125). https://www.researchgate.net/publication/324949980_Faster_Is_Not_Always_Better_Understanding_the_Effect_of_Dynamic_Response_Delays_in_Human-Chatbot_Interaction

[62] Androutsopoulou, A., Karacapilidis, N., Loukis, E., & Charalabidis, Y. (2019). Transforming the communication between citizens and government through AI-guided chatbots. Government Information Quarterly, 36(2), 358-367. (p.601) https://doi.org/10.1016/j.giq.2018.10.001

[63] Schuetzler, R. M., Grimes, G. M., Giboney, J. S., & Nunamaker, J. (2021). The influence of conversational agent embodiment and conversational relevance on socially desirable responding. Decision Support Systems, 149, 113542. https://doi.org/10.1016/j.dss.2018.08.011

[64] Luger, E., & Sellen, A. (2016, May). Like having a really bad PA: the gulf between user expectation and experience of conversational agents. In Proceedings of the 2016 CHI conference on human factors in computing systems (pp. 5286-5297). https://doi.org/10.1145/2858036.2858288

[65] Adam, M., Wessel, M., & Benlian, A. (2020). AI-based chatbots in customer service and their effects on user compliance. Electronic Markets, 1-19. https://link.springer.com/article/10.1007/s12525-020-00414-7

[66] Venkatesh, V. (2020). Impacts of COVID-19: A research agenda to support people in their fight. International Journal of Information Management, 55, 102197. (p.4). https://doi.org/10.1016/j.ijinfomgt.2020.102197

[67] Adiwardana, D., Luong, M. T., So, D. R., Hall, J., Fiedel, N., Thoppilan, R., ... & Kulikov, I. (2020). Towards a human-like open-domain chatbot. arXiv preprint arXiv:2001.09977. (p.2) https://research.google/pubs/pub51348/

[68] Adamopoulou, E., & Moussiades, L. (2020). An Overview of Chatbot Technology. In K. Rannenberg (Ed.), IFIP Advances in Information and Communication Technology, Vol. 584 (Part II, pp. 378-379). Springer. Proceedings of the 16th IFIP WG 12.5 International Conference, AIAI 2020, June 5-7, Neos Marmaras, Greece

[69] Caldarini, G., Jaf, S., & McGarry, K. (2022). A Literature Survey of Recent Advances in Chatbots. Information, 13(1), 41. https://doi.org/10.3390/info13010041

[70] Liu, L., Jiang, H., He, P., Chen, W., Liu, X., Gao, J., & Han, J. (2020). On the variance of the adaptive learning rate and beyond. arXiv preprint arXiv:1908.03265. (p. 2) https://doi.org/10.48550/arXiv.1908.03265

[71] Bommasani, R., Hudson, D. A., Adeli, E., Altman, R., Arora, S., von Arx, S., ... & Bosma, M. (2021). On the opportunities and risks of foundation models. arXiv preprint arXiv:2108.07258. https://arxiv.org/abs/2108.07258

[72] Brown, T., Mann, B., Ryder, N., Subbiah, M., Kaplan, J. D., Dhariwal, P., ... & Amodei, D. (2020). Language models are few-shot learners. Advances in neural information processing systems, 33, 1877-1901. https://arxiv.org/abs/2005.14165

[73] Anthropic. (2022). Introducing Claude. https://www.anthropic.com

[74] Min, S., Wallace, E., Singh, S., Singh, S., Gardner, M., Hajishirzi, H., & Zettlemoyer, L. (2022). Photorealistic conversational agents need capabilities beyond speech recognition. arXiv preprint arXiv:2203.15710. (p.1)

[75] Superdash Software Architecture. (2023). [System architecture diagram of LLM-based chatbot for Espírito Santo Government]. Unpublished illustration.

[76] Espirito Santo Government & Superdash Software. (2023). [Internal communication on LLM performance metrics]. Unpublished raw data.

[77] Borsci, S., Malizia, A., Schmettow, M., van der Velde, F., Tariverdiyeva, G., & Balaji, D. (2022). The Chatbot Usability Scale: the Design and Pilot of a Usability Scale for Interaction with AI-Based Conversational Agents. Personal and Ubiquitous Computing, 26(1), 95-119. https://link.springer.com/article/10.1007/s00779-021-01582-9

[78] Intel Corporation. (2017). 5 steps to an AI proof of concept: A five-step approach to success with proof of concepts (PoC) for image recognition, natural language processing, and predictive maintenance https://www.intel.com/content/dam/www/public/us/en/documents/white-papers/five-steps-ai-proof-of-concept-whitepaper.pdf

[79] Łach, M. (2022). AI Proof of Concept: The Benefits of Kickstarting an AI Software Development Project With AI PoC. https://nexocode.com/blog/posts/ai-proof-of-concept-benefits-of-ai-poc/

[80] Brazil. (2021). Complementary Law No. 182 of June 1, 2021. Presidency of the Republic, Civil House, Subchefia for Legal Affairs. https://www.in.gov.br/en/web/dou/-/lei-complementar-n-182-de-1-de-junho-de-2021-323558527

[81] Wari Maroengsit, Thanarath Piyakulpinyo, Korawat Phonyiam, Suporn Pongnumkul, Pimwadee Chaovalit, & Thanaruk Theeramunkong. (2019). A Survey on Evaluation Methods for Chatbots. Proceedings of the 2019 7th International Conference on Information and Education Technology (ICIET 2019). Association for Computing Machinery. https://doi.org/10.1145/3323771.3323824

[82] Brazil. (2020). General Data Protection Law (LGPD): Best Practice Guide for Implementation in the Federal Public Administration https://www.gov.br/governodigital/pt-br/seguranca-e-protecao-de-dados/guias/guia_lgpd.pdf