

Technological Article

# Open Data Standards for Public Procurement and Contracting: A Collaborative Construction



Padrão de Dados Abertos em Compras e Contratações Públicas: Uma Construção Colaborativa

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## ABSTRACT

**Objective:** this research examines the collaborative development of a standard for publishing open data in public procurement and contracting, drawing on regional and international initiatives. The study posits that disseminating such a standard can potentially enhance the municipalities' ability to disclose data for citizens and control agencies, complying with open data principles. **Method:** the study started with an examination of a specific issue encountered within a municipality, engaging a network of stakeholders possessing diverse perspectives and insights into the problem and potential solutions. A proposal to resolve the issue was formulated and subjected to a pilot test in a municipality, evaluating its capacity for interoperability and scalability to other municipalities and public agencies. **Result:** alongside the proposal for an open data standard comprising three classes of data — public notice, adjudication, and contracting —, the study yielded two additional outcomes: the development and systematization of a co-production methodology to address public issues, and the initiation of a project to establish a statewide network for open data standardization. **Conclusion:** the development of the open data standard involved the integration of diverse knowledge, resources, and stakeholders. In addition, it encountered challenges, underwent iterations, and imparted valuable lessons. The emphasis on problem-solving and collaborative engagement among municipalities, academia, civil society, and government agencies was an aspect that stood out. Constructed collaboratively, the open data standard demonstrated potential for replication and is recommended for adoption by other organizations seeking to promote open data initiatives. The technopolitical and ontological aspects of the process, along with the perspectives and challenges for its sustainability, contribute to advancing knowledge and enhancing the practice of collaborative governance.

**Keywords:** collaborative construction; standard; open data; public procurement and contracting; municipalities.

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## RESUMO

**Objetivo:** o artigo analisa a construção colaborativa da proposta de um padrão para publicação de dados abertos em compras e contratações públicas, baseado na composição de iniciativas regionais e internacionais. Pressupõe-se que tal padrão, uma vez difundido, pode otimizar a disponibilização de dados por municípios para cidadãos e órgãos de controle, em conformidade com os princípios de dados abertos. **Método:** partiu-se de um problema concreto vivenciado em um município, envolvendo uma rede de atores com perspectivas e conhecimentos diversos em relação ao problema e sua solução, para desenvolver uma proposta de solução, testar em um município piloto e gerar potencial para interoperabilidade e escalabilidade para outros municípios e órgãos públicos. **Resultado:** além do padrão em si, contemplando três classes de dados (edital, adjudicação e contrato), houve outros dois produtos: o desenvolvimento e sistematização da metodologia de coprodução em resposta a um problema público e o projeto de constituição de uma rede estadual para a padronização de dados abertos. **Conclusão:** a construção do padrão envolveu vários conhecimentos, recursos e atores. O processo incluiu desafios, mudanças e aprendizagens. Um dos destaques é o foco na resolução de problemas, a construção colaborativa a partir dos municípios, com academia, sociedade civil e órgãos de governo. Construído de forma colaborativa, o padrão tem potencial de replicabilidade, sendo recomendado para outras organizações que desejem utilizá-lo para gerar dados abertos. As características do processo, de natureza tecnopolítica e ontológica, bem como as perspectivas e os desafios para sua continuidade, contribuem para o conhecimento e a prática da governança colaborativa.

**Palavras-chave:** construção colaborativa; padrão; dados abertos; compras e contratações públicas; municípios.

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## INTRODUCTION

Open government, open data, and open contracting have been extensively debated and approached in practices to enhance transparency and accountability in public administration and the quality of public services. International organizations such as the Open Government Partnership (OGP, 2017), the Open Contracting Partnership (OCP, 2019; 2022), the Organisation for Economic Co-operation and Development (OCDE, 2013; 2022) and the World Bank (Fagan et al., 2022; World Bank Institute [WBI], 2012) have been pivotal in urging governments, corporations, and other stakeholders in public management to embrace greater openness. These entities advocate for the dissemination of information and active engagement of citizens and service users in collaboration with governments to enhance public services.

In Brazil, endeavors fostering transparency and citizen-government interaction through open data have gained momentum. One example is the initiative *Operação Serenata de Amor* (2023), which uses openly accessible data provided by the National Congress on daily allowances to scrutinize spending trends. Another example is the practices of the state of Espírito Santo (*Dados abertos do Espírito Santo*, 2023) which has stood out in transparency rankings (*Transparência Internacional Brasil*, 2023). Finally, the project *Querido Diário* (Open Knowledge Brasil, 2023), champions open data availability and employs artificial intelligence to analyze data from official gazettes. Concurrently, scholars delve into the subject, exploring the ontological and techno-political processes of open data and their influencing factors (Distinto et al., 2016; Muñoz-Soro et al., 2016; Schommer et al., 2022; Soylu et al., 2019), as well as the utilization and practical applications of data (Angélico, 2023).

Brazilian legislation addresses this issue through various decrees and laws (Decree n. 7,724, 2012; Decree n. 8,777, 2016; Decree n. 10,332, 2020; Law n. 12,527, 2011), aiming to foster a culture of transparency and open data, and encouraging governments to engage more openly with society. However, the legal framework is not always explicit, as evidenced in the country's freedom of information law, Law n. 12,527 (2011) known as LAI. While the law mandates that government websites must facilitate automated access by external systems in open, structured, and machine-readable formats (Article 8, § 3, III), it lacks specific standards for implementation. Furthermore, the General Personal Data Protection Law - Law n. 13,709 (2018) regulates procedures for processing personal data by both public and private entities. In the realm of public procurement, for instance, Article 5 of the new law on tendering and contracts - Law n. 14,133

(2021b) underscores transparency as a guiding principle. Yet, despite the array of laws and initiatives, Brazil still lacks a defined standard for generating data on public purchases and contracts that aligns with open data criteria.

In addition to fulfilling legal obligations, the act of opening data can be viewed as a fundamental democratic principle and a catalyst for enhancing governance and public services (Schommer et al., 2022). However, resistance to this practice often stems from a combination of structural, cultural, and organizational factors (Meijer, 2015; Ritter et al., 2017). Several hurdles impede the opening of public data, including financial constraints, an imbalance between collaborative processes and efficient decision-making, and challenges in demonstrating tangible impact (Bartolomucci, 2023).

The disclosure of open data in procurement and contracting not only fosters increased competition by mitigating risks and corruption (Bahur et al., 2020) but also enhances cost management, internal controls, and compliance with oversight agencies' requirements. Public procurement and contracting constitute a substantial portion, approximately 12%, of a country's GDP (Bosio & Djankov, 2020). According to the Open Contracting Partnership, the global market for public contracting is valued at USD 13 trillion. Governments allocate USD 1.00 for every USD 3.00 spent through contracts with companies (OCP, 2023). Consequently, enhancements in public procurement can significantly impact fiscal equilibrium, bolster resource availability, generate public value, and advance objectives such as socio-environmental sustainability. Moreover, they can foster the emergence of new businesses and safeguard vulnerable segments of society (Fagan et al., 2022).

From an academic standpoint, significant aspects remain awaiting exploration regarding the training and professionalization of technicians operating in this domain. There are many opportunities for research into public procurement strategies and legislation, along with the challenges in public management regarding transparency, innovation, co-production, and co-creation (Silva et al., 2023).

In this context, Brazilian municipalities allocate a significant portion of their administrative capacity to managing procurement and contracting procedures while ensuring compliance with reporting obligations to control agencies and other stakeholders. The focus on meeting these legal requirements and demands, which often rely on management software provided by suppliers, such as purchasing and bidding systems, accounting software, and materials/warehouse management systems, tends to overshadow strategic planning and innovation in areas like transparency, social accountability, and open data.

Consequently, municipalities frequently limit data disclosure to the bare minimum necessary to fulfill formal mandates, rarely making it available in an accessible, open format. This lack of transparency hampers stakeholders' ability to thoroughly analyze and evaluate administrative processes. Furthermore, although control agencies such as the Courts of Auditors require and receive data from municipalities, they often fail to make this information accessible to the public in an open format.

But where should one begin? How can a municipality produce open data when there is no established standard to adhere to? Experience gained from specific initiatives can provide valuable insights that can be applied in other contexts. Therefore, this article examines the collaborative construction of a standard for publishing open data in public procurement and contracting based on the integration of regional and international initiatives. The methodology, elaborated below, entailed addressing a specific issue within a municipality, engaging a network of stakeholders to tackle this common challenge, and devising and testing a solution while assessing its interoperability and scalability to other municipalities and public agencies. The research evaluates the potential impact of the solution from two perspectives: collaborative development and integration of regional and international initiatives.

This proposal holds significant relevance and presents an opportunity, particularly considering the impracticality of each municipality independently publishing data in an open format according to its own criteria, which would undermine comparability and impede various analyses. Therefore, there exists an opportunity for a network to collaboratively develop these standards, drawing from regional and international initiatives, with the potential for future evolution. Two pivotal aspects serve as guiding principles throughout this process: the active involvement of municipalities and the collaborative engagement with academia and various stakeholders through a methodology centered on addressing a tangible problem. It is envisaged that such a standard could streamline data accessibility for citizens and external oversight bodies, aligning with open data principles.

## CONTEXT AND BASIC CONCEPTS

### Context

The context of this research refers to the movement of public managers in a medium-sized Brazilian municipality that struggled to address the social, legal, and bureaucratic demands for transparency and open data, consequently enhancing the efficacy of public procurement and contracting. They sought support from a public university

and established a partnership to overcome this challenge, also involving the state government and a civil society organization (CSO) in a collaborative effort. Unlike many other Brazilian municipalities, the one studied in this case had a department dedicated to developing and managing data systems and invested in innovation and transparency initiatives. However, despite the presence of such infrastructure, the municipality faced an unexpected setback in 2020 when it became the subject of a class action lawsuit for non-compliance with requirements of the freedom of information law (in Brazil, LAI), notably Article 8, § 3, III, which stipulates the necessity to “enable automated access by external systems in open, structured, and machine-readable formats.” Strikingly, the municipality's technical team encountered a dearth of references or consensus among control agencies regarding a standardized data structure. Consequently, while the team recognized the need to adhere to the minimum requirements outlined by these agencies, they found themselves lacking the confidence to define a suitable structure. In response to this challenge, the partnership with the university led to an applied research project that started in 2021 and included gathering a community around the issue and a standardization network. This network has since expanded, encompassing other municipalities and numerous partners ([Universidade do Estado de Santa Catarina \[UDESC\], 2021](#)).

The local government has garnered attention for its commitment to transparency and enhancing service quality through the strategic integration of information technology and active engagement with citizens, civil society organizations (CSOs), academia, and private entities to address collective challenges ([Rocha et al., 2019](#)). Notably, the municipality's efforts have been acknowledged and celebrated by recognizing and receiving awards in two editions of the Good Practices in Public Management Award. This event, held periodically since 2016, has drawn upon a wide-ranging network of partners, with a primary focus on promoting transparency alongside citizen participation ([UDESC, 2020](#)).

In the same Brazilian state, academia has played a pivotal role, with professors, researchers, and master's and doctoral students actively conducting research and engaging in projects centered on themes such as transparency, accountability, open government, public finances, and open contracting ([Bayestorff Duarte, 2019](#), [Raupp, 2016](#); [Raupp & Pinho, 2013](#); [Rocha et al., 2019](#); [Schommer et al., 2015](#)). One noteworthy initiative was their involvement as supporters and partners of the state government in the 2020/2022 edition of the Open Government Partnership (OGP) Local program ([OGP, 2023](#)). Under the auspices of the OGP Local initiative, the state embarked on the development of its inaugural Open Government Action Plan, which encompassed commitments related to

procurement and contracting, as well as the formulation of municipal open government plans. Leveraging its track record in transparency and open government, the municipality under examination in this study emerges as a trailblazer in fostering municipal engagement, collaborating closely with associations of municipalities and local civil society organizations.

The highlighted initiatives align with common objectives and hold the potential to enhance public services and democratize public administration. However, the absence of coordinated and coherent implementation of legal provisions and diverse initiatives often leads to uncertainties and overlapping demands on municipalities. In response to this challenge, a solution derived from the context of one municipality could offer scalability for others, with backing from state and federal governments, regulatory bodies, and national and international partners.

Before delving into the diagnosis of the prevailing issue, it is pertinent to introduce some relevant concepts that inform the process.

## Basic concepts

Essential concepts underpinning this work include open government, governance, collaborative governance, network governance, open contracting, open data, public transparency, and standards community.

An open government can be guided by principles, such as those outlined by the Open Government Partnership [OGP \(2017\)](#), to enhance governance and address public challenges. These principles include public access to government information, encompassing open data dissemination, proactive or reactive disclosure of information, and legal mechanisms that reinforce the right to information; citizen participation, which involves mobilizing citizens to engage in debates, collaborate, and propose contributions through various dialogue channels, ultimately fostering more effective and responsive governance; accountability, which entails a continuous process of holding government officials accountable for their actions and decisions, ensuring transparency, justification, and responsibility; and technology and innovation, which leverage technological advancements to facilitate information exchange, citizen participation, and collaboration, thereby enhancing government processes and services.

According to [Ansell and Torfing \(2016\)](#), the concept of governance encompasses a suite of analytical tools to reflect on and construct rules that organize our increasingly complex, fragmented, and dynamic society. Their perspective on governance acknowledges the interconnected and interdependent nature of many contemporary challenges, requiring collaborative and coordinated responses. Central

to this approach is recognizing the state's pivotal role as a facilitator of collaboration among diverse stakeholders. Unlike the traditional command-and-control model, the public sector is viewed as a facilitator tasked with creating conducive conditions for cooperation between governments, civil society organizations (CSOs), and businesses ([Torfing et al., 2019](#)).

Collaborative governance may also manifest through networks. [Emerson et al. \(2012\)](#) define collaborative governance as “the processes and structures of public policy decision-making and management that engage people constructively across the boundaries of public agencies, levels of government, and/or the public, private and civic spheres in order to carry out a public purpose that could not otherwise be accomplished” (p. 2). For [Schommer and Guertzovich \(2023\)](#), collaborative governance is “a process through which multiple stakeholders mutually engage and negotiate values, meanings and resources to address problems or carry out a public purpose that could not be achieved by individual actors alone” (p. 1).

Network governance refers to how a network is structured and organized, i.e., its regulatory and decision-making mechanisms to safeguard the interests of members and ensure that established norms are defined and followed by both coordinators and participants ([Roth et al., 2010](#)). According to [Roth et al. \(2010\)](#), three key aspects characterize network governance: (a) transient nature and/or reversibility, (b) absence of central authority, and (c) bargaining and consensus. The transient nature denotes the option for participants to exit the network when deemed necessary. The absence of central authority signifies preserving participants' general autonomy, with no submission to a centralized authority within the network. Lastly, decision-making within the network is driven by negotiation and the pursuit of consensus among participating organizations.

Public procurement and contracting are areas where open data and processes can significantly reduce corruption and enhance management and public services. Known as “open contracting,” this approach involves disclosing and using open, accessible, and valuable information regarding public contracts to engage citizens and businesses in addressing challenges and achieving improved outcomes ([OCP, 2024](#)). Among the core principles of open contracting are proactive disclosure and maximum transparency of information (open data) concerning the entire process's functioning. This encompasses offering a comprehensive view of public contracting — from initial planning to the delivery of goods or services and subsequent auditing — through the structured disclosure of procurement activities ([OCP, 2019](#)).

Open data refers to information accessible to the public, presented in digital formats, structured in an open

manner, machine-readable, accessible via the internet, and distributed under an open license permitting free use, consumption, or processing by individuals or organizations (Law n. 14,129, 2021a). Additionally, open data can be understood as data generated by governmental entities and made accessible to the public in a format that not only allows reading and monitoring but also enables its reuse in new projects, websites, and applications. This includes the ability to merge data from various sources and present it in engaging and informative visualizations (World Wide Web [W3C], 2011, p. 4). Thus, when this research refers to open data, it adheres to the eight internationally recognized open data principles: complete, primary, timely, accessible, machine processable, non-discriminatory, non-proprietary, and license-free (OKBR, 2015).

These themes are closely intertwined with public transparency. As per the Brazilian Freedom of Information Law (LAI), “Public agencies and entities are mandated to proactively disclose, irrespective of requests, information of collective or general interest they produce or possess, in an easily accessible location within their competencies” (Law n. 12,527, 2011, art. 8, Caput). Similarly, in the regulations governing the Good Practices in Public Management of Santa Catarina Award (Article 2, § 2), transparency with citizenship, the central tenet of the award, is defined as “practices that foster the engagement of governments and citizens in bolstering public transparency, thereby facilitating processes, optimizing resources, enhancing performance, and democratizing oversight of public administration” (UDESC, 2020).

Given that the objective and practices of the community under examination in this research revolve around the standardization of data structure and semantics, the study adopts the concept proposed by Springer and Cooper (2019), who define a ‘data community’ as a collective of experts, often unrelated, collaborating within a specific data context. These individuals are typically linked by professional relationships spanning various degrees of separation and share a common interest in utilizing and exchanging each other’s data. Furthermore, the study acknowledges the diverse practices supported by members of the standardization community, all aimed at enhancing the quality of data representation and structuring while prioritizing interoperability. Achieving interoperability requires establishing appropriate standards that facilitate content sharing while adhering to legal, security, and privacy conditions.

## DIAGNOSIS OF THE PROBLEM SITUATION

The initial phase of the applied research project involved identifying both national and international

initiatives at the intersection of open data and public procurement and contracting. The objective was to pinpoint elements that could potentially contribute to resolving the existing problem. Table 1 provides a summary of the key focus areas of each identified initiative, as well as the aspects they fail to address.

A literature review was conducted, focused on identifying ontologies related to public procurement and contracting that could offer insights into the project’s goals. A significant gap was identified when examining all initiatives: the absence of consensus regarding the structure and semantics of public procurement and contracting data to be generated and disclosed in an open format. This data is crucial for control agencies, local and state executive entities, and stakeholders such as citizens, businesses, academia, and CSOs. To address this challenge, the proposed solution must streamline the process and establish mechanisms for fostering consensus building. This involves leveraging collaborative governance approaches and engaging with regional and international initiatives to facilitate the harmonization of standards and practices.

The necessity for a consensus strategy regarding the descriptors of the data slated for publication is acknowledged. These descriptors enable both data depositors and consumers — whether for analysis or other purposes — to comprehend the data’s structure and domains. In this context, the challenges associated with standardizing data descriptors stem from several factors, including (1) linguistic vocabulary, (2) social influences, and (3) standard requirements and protocols. It is crucial to grasp the impact of these factors on the standardization of these descriptors, particularly given that this process involves consensus-building steps.

The proposed solution was designed to encompass various paradigmatic perspectives: that of the entity responsible for data provision — in this instance, municipalities; audit and/or control agencies (internal or external) — including municipal controllers, Courts of Auditors, the General Comptroller’s Office (CGU), and the Public Prosecutor’s Office; and stakeholders such as citizens, businesses, and civil society organizations (CSOs), including social observatories and other entities. Additionally, standardization offers advantages extending beyond municipalities, enabling data comparison across all subnational entities. Table 2 outlines the potential benefits of standardizing open data related to procurement and contracting, taking into account diverse users or stakeholders.

After identifying existing initiatives, recognizing the persistent gap, and assessing the potential application of the forthcoming solution, the collaborative construction process is outlined below.

**Table 1.** Identified initiatives at the intersection of open data and public procurement and contracting.

Initiative	Focus	Gap (does not approach/define/have the potential of)
<b>International initiatives</b>		
OCDS, Open Contracting Partnership (OCP, 2022)	The Open Contracting Data Standard (OCDS) is a free, non-proprietary open data standard for public contracting. It was created to support organizations in increasing hiring transparency and enabling deeper analysis of hiring data by a wide range of users.	It does not approach aspects of the Brazilian contracting system. The OCDS is not widely known or frequently employed in Brazil.
Public Procurement Ontology (PPROC) (Muñoz-Soro et al., 2014)	The PPROC ontology was developed within the scope of the public procurement optimization through the semantic technologies (CONTSEM) project. This project has the participation of the company iASoft (OESIA), the University of Zaragoza, ARAID (agency created by the Government of Aragon to promote research, development, and innovation in Aragon), and, as public entities, the Government of Aragon, the Provincial Council of Huesca, and the Municipal Councils of Huesca and Zaragoza.	It does not approach aspects of the Brazilian contracting system.
World Bank (WBI, 2012)	Provides a toolkit for government open data consisting of seven topics: open data fundamentals; starting an open data initiative; demand and engagement; data supply and quality; readiness assessment tool; technical assistance and financing.	It does not offer a standardization model for open data about public procurement and contracting.
<b>Regional initiatives</b>		
e-Sfinge, an initiative from the Court of Auditors of the state of Santa Catarina (TCE/SC, 2023)	The initiative requires and gathers data from public procurement and contracting of all municipalities of the Brazilian state of Santa Catarina.	It does not offer the data in an open format for public access.
Compras.gov.br, a platform for procurement managed by the Brazilian federal government (Portal de Compras do Governo Brasileiro, 2024)	Offers a complete overview of public spending within the scope of direct, autonomous, and foundational federal public administration. The initiative also presents statistical data from municipalities that use the federal government procurement system.	In 2021, there was no data on municipal purchases. Currently (2024), there is data from municipalities, but they are not available in an open format.
São Paulo Electronic Procurement Marketplace (BCE/SP, 2022)	The initiative offers detailed information in an open format of negotiations conducted in the marketplace BEC/SP.	Open data, non-standardized.
Dear Diary (OKBR, 2023)	It promotes the availability of open data and uses artificial intelligence to analyze data from official gazettes, some related to public purchases and contracting.	It does not cover all phases of the procurement and contracting processes.
<b>Brazilian legislation</b>		
Law n. 12,527 (2011) (LAI)	It provides that governmental websites must offer automated access to data through external systems in an open, structured, and machine-readable format.	It does not offer a standard for data generation and disclosure.
Law n. 14,133 (2021b) (new legislation on procurement)	The law provides that the Brazilian National Portal of Public Procurement must adopt an open data format and follow the requirements of LAI.	It does not offer a standard for data generation and disclosure.

Note. Source: Research data.

**Table 2.** Potential benefits of the standardizing open data on public procurement and contracting.

Users or stakeholders	Use/Potential interest
State and municipal administration	Improving the management and performance of procurement and contracting, with more understanding and attractiveness for bid participants and less risk and chance of corruption; Increased government transparency and openness to collaboration with citizens and other organizations; Responding to demands from control agencies; Streamlining and cost savings can be achieved by establishing standards and structuring the process of sharing extraction, transformation, and load (ETL). This approach ensures that outputs (data delivery), ontology, and synonyms are predefined by default.
Internal and external control agencies	Sharing data and knowledge between control agencies reduces disparities. For example, in the 27 states, there are different levels of inspection and data requests. Some state external control agencies require sophisticated, detailed files, with thorough, detailed reporting at short and determined intervals; others require simple files with little structure; Possible unified processing on a centralized basis, generating a careful report to be forwarded to the competent agencies for action; Improved control, comparability, and other analyses that can be carried out.
Businesses bidding in procurement processes	Security and trust in the process encourages the participation of a greater number of companies in bidding, including small companies; The availability of standardized information about processes can help the supplier to better map the market by object; It can create an effective communication channel between the government and the market.
Academia, journalists, CSOs, and citizens	Use of data in different analyses; Demystifying and popularizing terminology and language use facilitates access to information and social accountability.

Note. Source: Research data and OCP (2024).

## METHOD

The project's methodology entails the collaborative construction of a standard for generating data from public procurement and contracting processes to maximize the municipalities' ability to disclose data for citizens and external control agencies in alignment with open data principles. It encompasses techno-political and ontological considerations, with some aspects anticipated from the outset and others emerging organically through problem-solving interactions and relationships forged during the process.

The proposed standard entails establishing a cohesive framework and shared structure, drawing from legislation, best administrative practices, and existing data ontologies in public procurement and contracting. This alignment involves the integration of expertise from various sources, including (1) managers and technicians engaged in procurement and contracting processes and information technology within the local government, (2) academic researchers with relevant experience, (3) partners from the state government specialized in procurement processes and contract management, as well as control agencies such as the OGP Local, the Prosecutor's Office, the Federal General Comptroller's Office (CGU), the Court of Auditors, local and international CSOs, and (4) potential users of open data, comprising diverse profiles such as members of CSOs, researchers, and citizens utilizing public services. By leveraging this multidisciplinary collaboration, the standard aims to ensure comprehensive coverage and effectiveness in addressing the needs of various stakeholders involved in public procurement and contracting processes.

Drawing from prior initiatives, literature, and discussions among its members, the standardization community adhered to the following principles: (1) openness, (2) inclusivity, (3) consensus-building, (4) balance, (5) harmony, (6) community-driven, (7) non-profit, and (8) simplicity.

This initiative was inspired by a preceding effort (Salm, 2020) to establish a national network for information exchange in graduate studies, known as RICAPG or the Network for the Integration of the Graduate Academic-Scientific Community (RICAPG, 2024). Comprising representatives from Brazilian higher education institutions (HEIs), including federal and state public HEIs, as well as private HEIs, the network also included key entities such as the Oswaldo Cruz Foundation (Fiocruz) and the Coordination for the Improvement of Higher Education Personnel (Capes), a department under the Ministry of Education (MEC). The network's endeavors focused on delineating semantic standards through an ongoing consensus-building process among its members, facilitated by

a governance model, regulations, and the active involvement of advisory institutions within the RICAPG community. The principles upheld by the network played a pivotal role in shaping Capes's collaborative governance program of information (GoPG Program) and fostering discussions on data infrastructure maturity and support mechanisms for HEIs in data governance within the network.

The common challenge faced by members of the community outlined in this project was the impetus for devising a solution. This community comprises a network of stakeholders with diverse perspectives and expertise regarding the problem and its potential remedies. These stakeholders are poised to test the proposed solution through a pilot case, paving the way for interoperability and scalability across other municipalities and public agencies. The applied research project orchestrated expertise across various domains, including public administration (encompassing open government processes, public procurement and contracting, public governance, and user-centered service design), information technology, and, finally, accounting, public finances, and legislation on procurement and contracting processes. The following phases were undertaken:

Phase 1 — Mapping and analysis of existing alternatives for opening data in public procurement and contracting, alongside a bibliographic review of ontologies (Ontology T) as conceptual frameworks for representing concepts and their interrelationships.

Phase 2 — Identifying and engaging stakeholders interested in integrating the community and standardization network.

Phase 3 — Establishment of the community, including defining its guiding principles, procedures, participation rules, and consensus-building mechanisms.

Phase 4 — Determination of conceptual alignment structures and markers community members use to highlight differences, inconsistencies, and proposals for change. These structures and markers facilitated discussions during standard proposal review meetings, pinpointing key discussion points in the consensus-building process.

Phase 5 — Community consensus meetings and discussions on proposed change markers and the semantic interoperability standard involving experts from control agencies and civil society organizations.

Phase 6 — Consolidation and transcription of the open data publishing standard prototype into a unified language (JSON-LD), chosen by community representatives for data serialization, in line with standardization community processes.

Phase 7 — Application of the proposed standards as a pilot test in one of the municipalities participating in the community to validate them in open data extraction routines and guide potential adjustments. Concurrently,

Phase 8 — Discussions among a group of supporters on strategies for disseminating the standard and ensuring the sustainability of the standardization network, including the formulation of a project aimed at establishing the Santa Catarina Open Data Standardization Network emphasizing local governments and their interactions.

Phase 9 — Final compilation of results shared with partners, followed by a joint definition of the subsequent steps.

In addition to the standard proposal and its implementation in the municipality participating in the pilot test, two other outcomes emerged from the research project: the development and systematization of a co-production methodology to address public issues and the start of the Santa Catarina Open Data Network project.

## ANALYSIS OF THE PROBLEM SITUATION AND PROPOSALS TO INTEGRATE INITIATIVES

### Network governance

The actors forming the standardization network include representatives from the executive branches of local, state, and federal governments, alongside representatives from control agencies, civil society organizations (CSOs), academia, and international organizations. These stakeholders actively participated in discussions and activities aimed at defining standards. The network governance was organized into three groups: coordinators, advisors, and supporters.

The coordinators were representatives of the group established at the outset of the project, consisting of the public university, the municipality that initially sought support from the university to address open data and transparency issues, an executive agency of the state government, and a civil society organization (CSO). Their role involved organizing and ensuring the advancement of collectively defined activity streams, coordinating the efforts of the advisors with the input of supporters, and fostering the development of the network.

A standardization community has been established within the network. The community is a group of experts gathered to design and co-create a semantic representation capable of facilitating the disclosure of open data on public procurement and contracting. With this goal in mind, the community aims to contribute to developing a semantic interoperability framework for use in the exchange of open data between state control agencies and agencies

of the local executive branch. Among the responsibilities assigned to representatives from participating organizations are (1) discussing common problems and their contexts, (2) evaluating international and national frameworks and standards, and (3) utilizing a conceptual alignment framework, among other tools.

Each organization within the community designated two representatives, known as advisors, possessing complementary expertise in open data and public procurement and contracting processes. These advisors are tasked with actively participating in and overseeing standard-setting procedures. Following individual analyses, collaborative working meetings were convened with all community members to collectively define the standard.

The supporters played a crucial role in aiding the development of the standards and strategizing the standardization network's sustainability. They were consulted throughout the project coordination and the workflow of the standardization community, contributing to the discussion of diffusion and sustainability strategies. Figure 1 provides a concise representation of the network's governance structure.



**Figure 1.** Standardization network governance structure.

Source: Elaborated by the authors.

In this structure, network members share common goals but present different roles, sizes, and power.

### Community procedures to integrate regional and international initiatives

With the aim of streamlining and organizing the work and proposals put forth by the community, a set of procedures was established, which were thoroughly discussed and approved by the representatives. These procedures served to structure work agendas, optimize



the utilization of representatives' time (where each advisor voluntarily contributed their time), resolve any discrepancies in conceptual structures, and facilitate the reuse of international and national frameworks.

The process commenced with discussions and semantic alignment regarding the vocabularies pertinent to public procurement and contracting processes. This involved referencing vocabularies such as the Public Procurement Ontology (PPROC) and the Open Contracting Data Standard (OCDS) (OCP, 2022), as well as the Integrated Management Inspection System (e-Sfinge) (TCESC, 2023), to propose a customized ontology tailored to the realities of municipalities, encompassing their diverse profiles.

The construction of the spreadsheet involved utilizing entities and attributes from the OCDS (OCP, 2022), considering their applicability to the Brazilian context while excluding internal identifiers. Subsequently, tables from e-Sfinge, a system utilized by the Court of Auditors of Santa Catarina, were integrated. This system's data structure sees widespread use, as public managers are mandated to furnish information pertaining to local and state management via e-Sfinge. Furthermore, the model is shared across Brazilian states. Certain attributes from e-Sfinge were incorporated into the proposed standard as a reference, aiming to prevent conflicts with existing concepts and frameworks already adopted by public agents. This strategic approach mitigates the implementation's impact on stakeholders and ensures a more seamless data extraction process. Another measure involved adopting an international reference to align the structure, deemed necessary to supplement concepts related to public contracting. The reference chosen was the PPROC, which integrates semantic technologies into software used by public authorities during bidding procedures (Muñoz-Soro et al., 2014).

During this project phase, three data classes were prioritized to establish a standardized prototype for procurement and public contracting processes: notice, adjudication, and contract (UDESC, 2021).

The process of vocabulary creation comprised a series of discussions among advisors, guided by a conceptual alignment structure and signaling mechanisms established by the coordination team. Attributes for the data classes were selected through a collaborative effort, drawing from the OCDS reference standards, e-Sfinge, and PPROC.

With the conceptual alignment structure established, a workflow comprising five primary steps was outlined: (1) joint definition of each data class in a meeting involving all members, (2) survey of the

attributes pertaining to the selected data class by the coordination team, (3) individual analysis and review of attributes by each organization, (4) consolidation of attribute discussions facilitated by the coordination team, and (5) joint definition of the standard in a meeting involving all members.

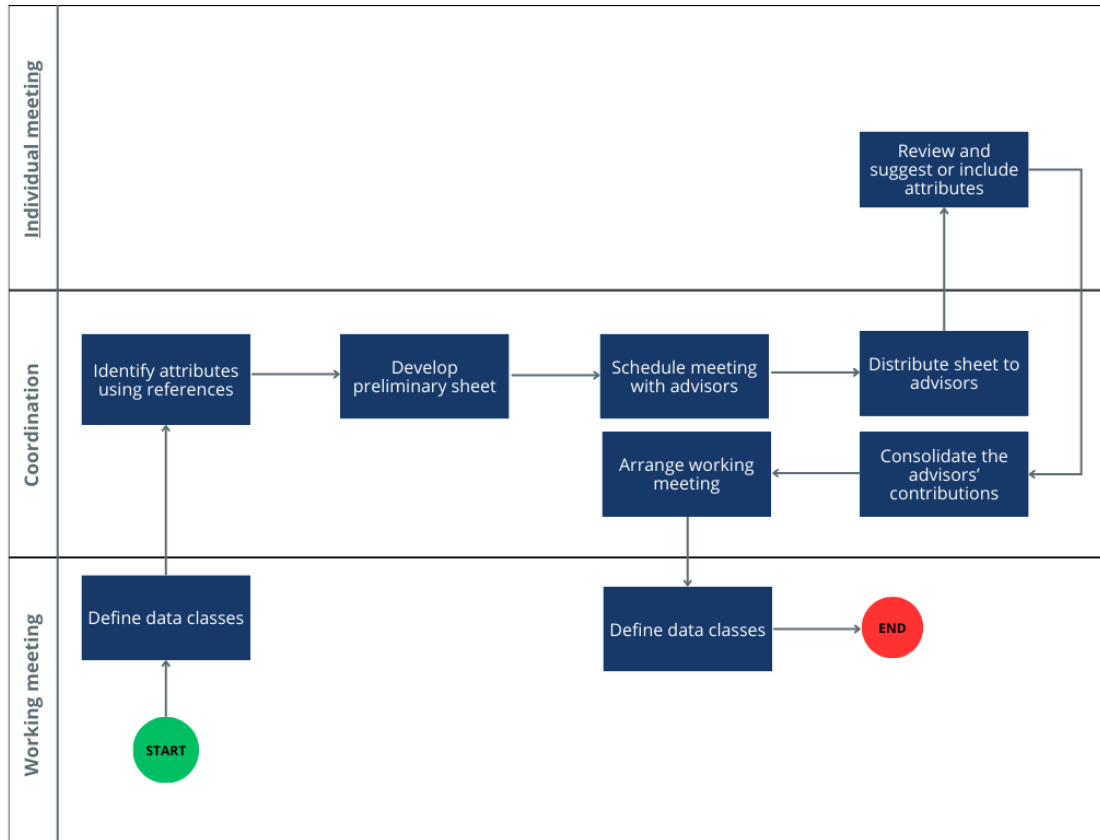
Working meetings, attended by all members, serve as the primary forum for deliberation, where key decisions are made. Before these meetings, the coordination team gathers input and requests to address the delineation of data classes. Each meeting follows a predetermined and agreed-upon agenda, commencing with an overview of activities, presentation of compiled analyses, subdivision into smaller groups for entity and attribute evaluations, and culminating in a collective discussion among all members. To streamline the final analysis, only points of divergence are included on the main agenda, fostering focused debate among advisors and expediting the consensus process.

Throughout these activities, representatives critically scrutinize attributes and their definitions, with the flexibility to modify texts and adjust attribute inclusion. This approach ensures the resulting list aligns closely with each institution's realities and fulfills its specific requirements. Figure 2 is a flowchart illustrating the activity workflow visually.

Moreover, to enhance the collaborative framework, a dedicated space was incorporated into the structure to document the viewpoint of each community member, ensuring a record of individual contributions and providing a means to document analyses, thereby ensuring the compatibility of results. Table 3 outlines a method for categorizing proposed changes.

During group sessions, advisors had the opportunity to share their insights, meticulously analyze spreadsheet fields, and engage in discussions to reach agreements defining the group's analysis.

Following meetings where the conceptual alignment of entities and their attributes was established, the proposed standard was transcribed into a language (JSON-LD) suitable for guiding data extraction structuring. The subsequent phase involved applying the proposed standard by extracting data from the municipality and assessing its validity. A developer was enlisted to translate vocabulary structures capable of extracting instances in a format that adhered to the community's expectations. This process was piloted in the municipality's operational environment to verify attribute availability at the source and assess the feasibility of the standard. The standard is currently available for unrestricted use and is being disseminated to other municipalities.



**Figure 2.** Flowchart of the community activities.  
Source: Elaborated by the authors.

**Table 3.** Form of classification of the change propositions.

Control of change by COLOR	Key
Fields must be colored according to the change proposition or maintenance of the original proposition.	GREEN (Maintain the attribute proposed as the original and its domain)
	BLUE (Maintain the attribute proposed as the original, but change the domain)
	YELLOW (Change the proposed attribute's name but maintain the concept and domain as the original)
The change proposition is the content of the field.	RED (Withdrawal of the concept)
	PURPLE (Inclusion of the concept. It was not covered by the original proposition, that is why there was an addition)

**Note.** Source: Elaborated by the authors.

### Outcomes and lessons learned

The development of the proposed standard, the procedures of the standardization community, and the establishment of the standardization network required a diverse array of expertise and resources. This process relied on the contributions of volunteers and was marked by numerous challenges, adaptations, flexibility, and continuous learning (Schommer et al., 2023).

The formation of the network and its operational procedures are perceived as instrumental in solidifying the

proposal, with the model holding significant potential for replication. It stands as a beacon for organizations seeking to spearhead strategies for open data publication with semantic interoperability. A key highlight of this initiative was its proactive approach to problem solving, underscored by a collaborative ethos shared among municipalities, academia, state executive bodies, control agencies, and civil society.

In addition to the outcomes directly related to the project's final deliverables (i.e., the process model, alignment structure, and proposed semantic standard), the applied research project facilitated learning about the methodology

for co-producing a standard. It underscored the importance of cultivating a leadership profile conducive to systems convening (*Systems Convening, 2023*) — one capable of rallying and maintaining the engagement of diverse stakeholders around a common purpose for the long term, with flexibility and a commitment to integrating newfound insights into the process.

The techno-political and ontological dimensions inherent in data-opening processes were brought to the forefront (*Schommer et al., 2022*), emphasizing the intricate interplay of technical, financial, and institutional resources and knowledge. This highlighted the necessity of developing collaborative governance structures to sustain stakeholder engagement and deliver tangible, valuable outcomes appreciated by all involved parties (*Schommer et al., 2023*).

The proposal to institutionalize the Santa Catarina Open Data Standardization Network, focusing on local governments and their relationships, aims to ensure the ongoing operation of the network established in the project in August 2023. This endeavor will be led by the organization Consórcio Ciga (*Ciga, 2023*) and the Association of Municipalities, with active involvement from various stakeholders. The network will collaboratively develop standards for generating open data, extending beyond public procurement and contracting to areas such as education, health, and social assistance. Several potential partners have expressed interest in supporting the initiative, including the OCP, the CGU, the Public Prosecutor's Office of Santa Catarina, and the school of the state legislative branch (*Escola do Legislativo — ALESC*). Their participation will be instrumental in disseminating the standard, providing training, and promoting its adoption across different contexts.

## CONCLUSIONS AND TECHNOLOGICAL CONTRIBUTION

The article examined the collaborative construction of a proposal for a standard aimed at disclosing open data in public procurement and contracting, drawing insights from regional and international initiatives. At the heart of the project lay the identification of a critical gap: the absence of consensus regarding the structure and semantics of public procurement and contracting data slated for generation and dissemination in an open format. This gap impeded the effective utilization of such data by control agencies, local and state executive branches, and stakeholders, including citizens, companies, academia, and civil society organizations. In response, the devised solution sought to streamline the process and engender consensus-building mechanisms through collaborative governance and integration of regional and international initiatives.

The methodology outlined in this research detailed the construction of the proposed standard and scrutinized the process and its implications across two dimensions: collaborative construction and integration of regional and international initiatives. In addition to the standard itself, which encompasses three data classes — notice, adjudication, and contract —, two other outcomes emerged: the development and systematization of a co-production methodology tailored to address public issues and the initiation of a project aimed at establishing an open data standardization network at the state level.

The construction of the standard entailed leveraging various knowledge domains, resources, and stakeholders, navigating through challenges, adaptations, and a continuous learning curve. Notably, the focus remained steadfast on resolving tangible challenges faced by municipalities, fostering a collaborative ethos among municipal entities, academia, civil society, and other governmental agencies. By virtue of being collaboratively crafted by representatives from diverse organizations, the proposed standard exhibits potential for replication and dissemination, making it a recommended resource for other entities seeking to generate open data. Furthermore, the proposition to establish a Santa Catarina Open Data Standardization Network with a focus on municipal governments and their interrelations holds promise for advancement, provided that lessons learned and mobilized resources are effectively incorporated, partnerships expanded, and the techno-political and ontological dimensions of the process are duly addressed. The outlook and challenges surrounding its continuity contribute to advancing knowledge and practices in collaborative governance.

From a technological standpoint, this study offers insights into the formulation of a standardized structure to facilitate the extraction and publication of data concerning contracts and public procurement. This achievement stemmed from an alignment and reengineering process of non-ontological resources, drawing upon both international and regional references. The development of data extraction and structuring routines in alignment with the community-created standard can serve as a supportive resource for members aiming to integrate these arrangements into their operational workflows.

Proposals for future research include the formulation of a sustainability model for the standardization community in the domain of public procurement and contracting, the evolution of the proposed standard, and the enhancement of governance and sustainability measures for the network, possibly extending its scope to encompass other data types and administrative spheres. Additionally, there is room for studies analyzing data-opening processes from a techno-political and ontological perspective..

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## Authors' Contributions

**1<sup>st</sup> author:** conceptualization (equal), data curation (equal), formal analysis (equal), funding acquisition (equal), investigation (equal), methodology (equal), writing – review & editing (equal).

**2<sup>nd</sup> author:** conceptualization (equal), data curation (equal), formal analysis (equal), funding acquisition (equal), investigation (equal), methodology (equal), project administration (equal), writing – original draft (equal).

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**4<sup>th</sup> author:** conceptualization (equal), formal analysis (equal), supervision (equal), validation (equal), visualization (equal), writing – review & editing (equal).

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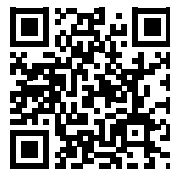
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The authors claim that all data used in the research have been made publicly available, and can be accessed via the Harvard Dataverse platform:



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