Towards Transparent Governance: Unifying City Councils Decision-Making Data Processing and Visualization

Kristýna Zaklová[0009−0009−5716−7446], Jiří Hynek[0000−0002−7292−6094], and Tomáš Hruška[0000−0001−5454−6592]

Faculty of Information Technology, Brno University of Technology, Božetěchova 1/2, 612 66 Brno, Czech Republic
{zaklova,hynek,hruska}@fit.vut.cz

Abstract. The local open government data holds undiscovered potential for wider application. Municipal policies and representatives' decisions have a direct impact on citizens' daily lives and the public should be aware of them. Nevertheless, the data related to city council activities may not always be easily searchable, and if available, the varying formats complicate further extraction and processing. This paper contributes to the academic discourse by proposing a unified approach to processing and storing the data from the council's decision-making. The paper outlines a generic data model designed for broad application across municipalities. A data set within this model can be automatically processed and stored in the database. The solution presents an information system with an user-friendly interface that visualize the data in the form of dashboards, enhancing accessibility for the general public. This paper contains practical example of how the data model can be applied to real votes of the council in the City of Brno, which is the second largest city in the Czech Republic.

Keywords: City Council · Decision-making · Local Politics · Open Government Data · Data Visualization.

1 Introduction

Interest in open government data (OGD) has been growing significantly in recent years [4, 20, 22]. OGD originated as a combination of open data and government data. It has to meet the requirements of free access, use, modification and further sharing [18]; and it must be produced or commissioned from the public bodies. Enacting OGD can be undertaken through various approaches, such as utilizing the five institutional dimensions [21] or employing alternative methodologies [11].

It should also be considered that publishing OGD can bring both benefits and risks [10]. It appears that the adoption of OGD has a positive impact on transparency, economy, and the development of innovation [21]. Furthermore, governments need to ensure that OGD is published in a way that facilitates the creation of both free and commercial products [23]. Examples of civic engagement

projects are given in the study [8]. Other factors in OGD involve the assessment of data quality [9] and the level of openness, typically evaluated through the 5 Star Open Data[1] scale.

There is considerably less information on OGD initiatives at the local level (e.g. the US city of Chicago [8] or two Swedish municipalities [12]). Studies on municipalities show that the pace of data opening is lower than for larger initiatives such as national-level platforms. This paper focuses on city councils, whose authority varies based on country-specific legislation. Usually, a city council consists of representatives periodically elected by the citizens, significantly impacting daily lives of the residents through their decision-making. Municipalities have an interest in transparency and providing public access to their data, even though it is not legally mandated for all of them.

The technical challenges faced by OGD at local and higher levels involve custom datasets, formats and standards [22]. Regarding formats for policy-related data, the Open Knowledge Foundation has launched its initiative to create an infrastructure for the electoral process [17]. However, the data from representative decision-making still needs to be taken into consideration at national and transnational levels.

In the Czech Republic, there are 14 regions and over 6,200 municipalities [5]. According to acts No. 128/2000 and 129/2000 of the Czech Collection of Laws, each must have its own municipal council, but there is not yet a legal obligation to publish meeting minutes or voting records. The Czech OGD standards are available on the Portal for Providers[2]. In the Czech Republic, open formal standards (originally *otevřené formální normy*)[3] are used to unify formats and support data interoperability. So far they only cover some of the datasets.

We aim to design a versatile data model applicable to any municipality. Considering the number of existing municipalities, our initial phase will produce results applicable to the Czech Republic. The expected outputs are the unified model for the city council decision-making data and the information system for the presentation of this dataset with emphasis on the semantics of the data. The results will be practically tested on the City of Brno.

2 Current Form of Available Data and Its Visualizations

Data availability varies significantly based on local legislation and the technical sophistication of the country or region. The authors [3] dealt with OGD at the local level and confirmed the prevalence of semi-structured or non-structured formats (mainly HTML and PDF), suggesting that municipalities perceive this form of publication as open, even though it contradicts OGD principles. Individual municipalities typically have data about their council presented on their official websites. The relevant subsection of the website usually contains a list of council members, meeting minutes and voting records (sometimes directly in the

[1] https://5stardata.info/en/
[2] https://data.gov.cz/english/
[3] https://data.gov.cz/ofn/

minutes). No summary statistics are available, items cannot be filtered by advanced criteria, voting records cannot be sorted by category, etc. Only a minority of municipalities have own dashboards (e.g. Victoria City Council[4]).

The voting records, which are included in a dataset, are commonly located in municipal data portals or national open data catalogs. This pattern is also noticeable in the Czech Republic, where a few municipalities publish their datasets related to council decision-making on the National Open Data Catalog[5]. The dominant formats are JSON, CSV or XML, with scheme and attributes varying by author definition. A single record in the dataset usually represents either a single voting topic (also referred to as a motion or issue in the terminology; e.g. dataset from Cambridge City Council[6]) or a single roll call by a councilor referring to the voting topic (e. g. dataset from Dallas City Council[7]). In the second case, redundant information can be noticed.

Previous research in the field of visualizing voting records usually centers around the data sourced from high-level institutions governing the entire country, as these institutions commonly provide available data. The subsequent projects were chosen due to their close thematic alignment:

- *CivisAnalysis* [2] uses open data from the Brazilian Chamber of Deputies and in the form of the web-based system provides e. g. a visualization of roll call results as n-dimensional space.
- Open-source project *LegisLatio* tool [16] was created with the objectives of visualization of legislative roll call vote data from Ecuadorian parliament and offering better understanding of the voting of multi-party legislative bodies.
- As the new *Voteview.com* [1] was created a new online open-source platform that brings together roll call voting in the United States Congress. Project founder K. Poole also proposed a simple geometric model of voting in which points represent individual legislators and pairs of points represent roll calls [19].
- As a part of the project *Paralemeter.org*, an analysis of the linguistic production paired with the metadata from the perspective of communication and political studies was carried out [13]. The initiative focuses on the Slovene, Croatian and Bosnian parliaments. However, the project currently includes visualization of several municipalities (e.g., the capital city Ljubljana). The general concept of the project is the closest to this work.

Another possible use of voting data is demonstrated by a study [6] that linked information from voting advice applications to votes in parliament. The expected voting results were compared with the actual results of roll calls. With the proposed technique, it is possible to detect legislators who vote differently

[4] https://opendata.victoria.ca/pages/mayor-and-council
[5] https://data.gov.cz/datasets
[6] https://data.cambridgema.gov/General-Government/City-Council-Roll-Call-Votes-2018-2019/3g59-fvq4
[7] https://www.dallasopendata.com/Services/Dallas-City-Council-Voting-Record/ts5d-gdq6

than they promised before the election. Such visualizations have great potential as it provides a tool for overseeing the institutions, increasing their transparency and bringing information closer to the general public.

Shortcomings in these projects often stem from inadequate targeting of users, with a tendency to favor experts over the general public. The use of OGD primarily for academic purposes is confirmed by the authors [14], who also identified a lack of educational events and activities to promote interest in OGD among young people. Furthermore, the practical deployment of these projects is frequently hindered by challenges such as a lack of data availability over an extended period and the absence of mechanisms for adding new records.

3 Solution Requirements

An analysis was conducted, including own research into the issue, an evaluation of the current situation, and the examination of data provided by selected municipalities. Additional information on the practical functioning of the municipality was provided by the staff of the Brno City Municipality[8]. Based on the analysis, the requirements for public deployment of the developed solution and the future operation of the application were gathered. It includes the addition of new records and a longer-term vision of the project. The tool also aims to educate the general public and increase their interest in local politics. To achieve this, three main objectives have been identified.

The first objective is the unification of the data model. Standardization of the same or similar datasets across public sector entities is one of the OGD challenges, according to the source [4]. The model should include as little redundancy as possible and contain mandatory basic and optional additional attributes. Further, it should be generic enough to be applicable to any municipality. Thus, iterative adjustments can be expected. All processed datasets will be published as OGD under the model with the possibility of their further use.

The second objective focuses on the cooperation with specific municipalities. In order to understand political engagement of citizens at the local policy level, it is necessary to understand their motivations. The authors of [15] conclude that institutional rules and levels of citizen engagement are related, with greater participation when citizen engagement is supported. If a municipality makes its data available, it is expected to do so as their own decision, and they are willing to support further processing and an interest in increasing citizen engagement.

The third objective emphasizes the cooperation with the general public. As described by [7], it is important to discuss the challenges of citizen participation and whether investment in the open government movement will increase citizen participation. The emphasis needs to shift to supporting public reflection on pressing issues. It is also necessary to interact with the target users and to regularly evaluate how they perceive the tool, its user-friendliness, clarity of the visualizations and the added value.

[8] Its Data department, respectively Data.Brno team, which publishes the city's data on the municipal data portal—https://datahub.brno.cz/

4 Data Processing and Proposed Data Model

From the design perspective, it was important to understand how the process of collecting and processing data from the decision-making of the representatives is carried out. According to the diagram (Fig. 1), the life cycle of data processing has four phases that correspond to the Ubaldi's OGD value chain [22]:

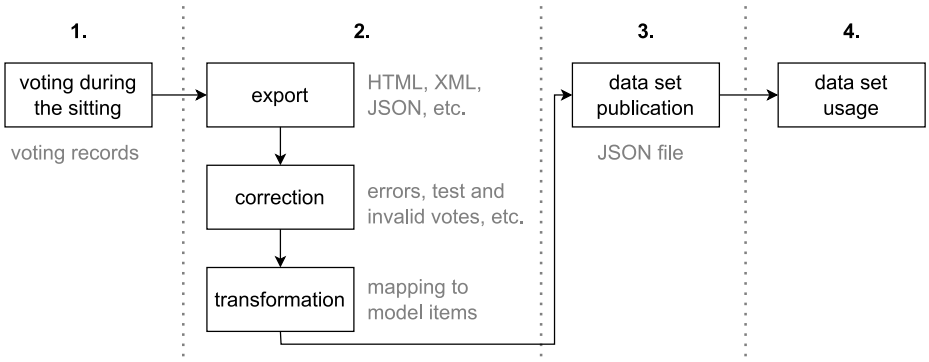

Fig. 1. Data processing flowchart. The individual phases correspond to: data generation (1.); data collection, aggregation and processing (2.); data distribution and delivery (3.); and final data use (4.).

1. **Data Generation**: the council members meet regularly, discussing voting topics according to a previously known agenda. Voting takes place on individual issues, and a voting record is taken from each vote. Larger cities usually have a voting system and voting machines. The systems can have various parameters to a certain extent, so their data outputs typically do not have the same format.
2. **Data Collection, Aggregation and Processing**: the first two phases are provided by the voting system in larger municipalities. Then, the export of the voting records is carried out, usually as a set of records (e. g. HTML files) or as a single dataset (e. g. XML file). This is followed by data processing, which ideally involves validation of the records (removal of errors, test and invalid votes, etc.), and transformation of the data into a generic model, which will be described below.
3. **Data Distribution and Delivery**: the dataset is published within the application itself to transparently provide a source of visualizations and enable further use. It can also be published in a data portal at the municipal or state level.
4. **Final Data Use**: the data can be used in academic, government or commercial sphere. One possible further use of the dataset will be demonstrated in Section 5, which introduces the developed information system.

The generic data model was designed as a JSON schema. It is available under CC BY 4.0 DEED license[9]. It has four separate sub-parts: basic data on municipal self-government; political entities (parties or their coalitions); representatives (members of the council); and councils, i. e. information about the councils for terms, including individual meetings and voting topic with votes.

The individual voting records contain either the summary numbers of the individual voting options (thus the votes of the representatives are anonymous), or the roll call votes of all representatives. Sometimes both options can occur within the same council—in a "secret vote" the votes of councilors are anonymous. The proposed data model takes into account all these variants.

5 Results

The designed system has a client-server architecture which is shown in more detail in Fig 2. The data model described in Section 4 defines the structure of the JSON file that serves as input data for the system. The data is processed automatically and stored in a MySQL relational database. During the dataset transformation, new information is derived (e. g. voting statistics stored for better system performance).

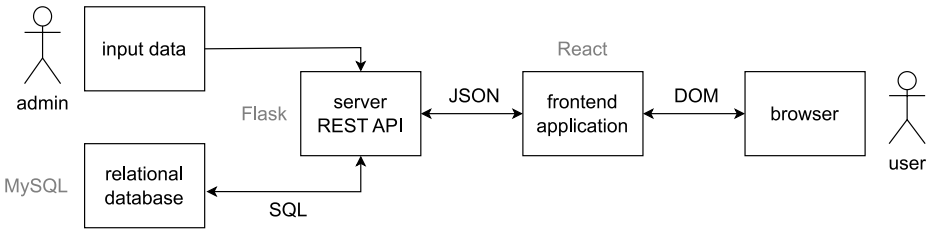

Fig. 2. A diagram of the system architecture including the technologies used and the target users.

The front-end is divided into several views (Fig. 3). It allows displaying basic information about the elected term, political entities, representatives, meetings and votes. For all of the above, it is always possible to display a detail with one specific item. The UI elements vary depending on the type of item selected, but they all have interactivity in common—either allowing to view more detailed information or quickly navigate between views. The dominant chart type is the horizontal stacked bar chart, because of its clarity and size.

More detailed analysis is also available. Councilor's attendance is monitored and it is measured as the ratio of valid votes in which the councilor participated to all valid votes, considering the duration of their mandate. Comparison of two councilors allows to determine the percentage of agreement between them.

[9] https://github.com/zastupko/data-model

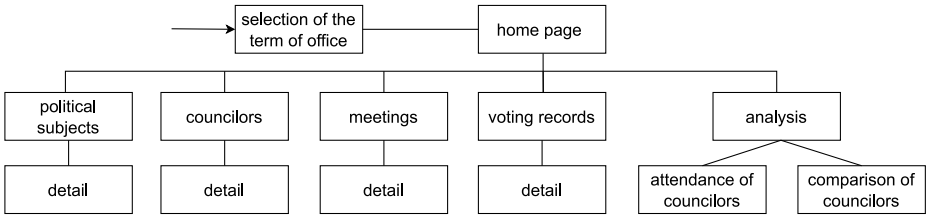

Fig. 3. Hierarchy between views in the client part of the application. For clarity some connections between sub-pages have been omitted in the diagram.

The view enables to browse individual meetings and displays matching and non-matching voting records. When comparing members of one party, it is possible to see if any of them deviate from the behavior of the others; when comparing members of different parties, it is possible to see how they agree or not.

6 Application of Results: the City of Brno

The second largest city in the Czech Republic, with a population of less than half a million, the City of Brno, was the first partner of the project. It provides data from its City Council (originally *Zastupitelstvo města Brna*) with 55 councilors as a further step in its effort to introduce more transparency and share the data from its activities. The created dataset includes the last two terms of the office (2018–2022 and 2022–2026), currently 51 meetings and 4,962 voting topics. The correctness of the created dataset was verified against the meeting minutes.

The created system was deployed within the data portal of the City of Brno[10]. Its first version was released before the municipal elections in autumn 2022 and brought the citizens an overview of the activities of their 8th City Council (Fig 4). The developed solution has demonstrated its usability in more than a year of operation. Now, it includes a new 9th City Council and new records are added periodically.

Cooperation with Brno helped to treat edge cases, which included, for example, replacements of councilors during the term of office, changing the names of councilors, withdrawing from a political subject or introducing secret votes. To evaluate the satisfaction of Brno citizens, a questionnaire survey was used in which 43 men and 45 women participated. More than half of the respondents rated the tool positively—83 % said they understood what the tool does; 76 % rated the orientation on the website as easy; and 80 % rated the website as clear. In addition, suggestions were provided for further enhancements and improvements that we plan to address. Through this collaboration, the citizens of Brno have gained the tool for overseeing their representatives. They have embraced this positively and expressed interest in its continued utilization.

[10] https://www.brno.cz/zastupitelstvo-analyza

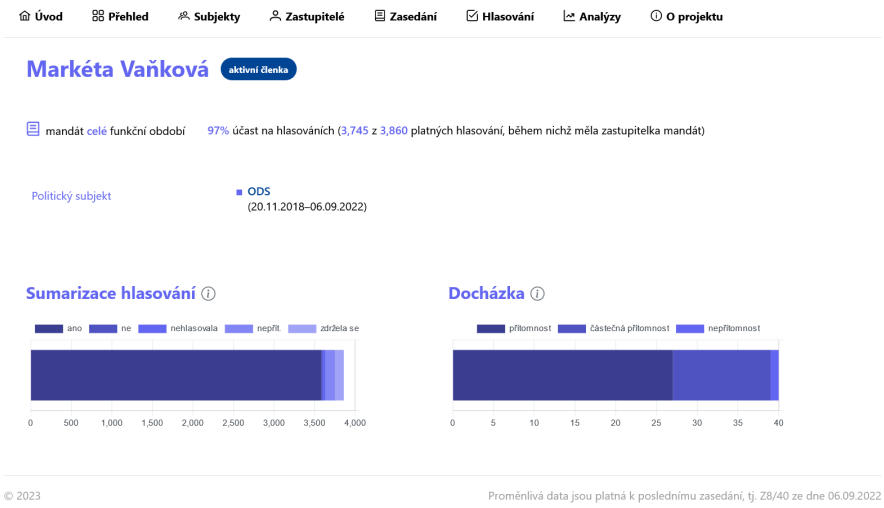

Fig. 4. Statistics of the mayoress of the City of Brno in the previous term of office. The view shows the length of the mandate, the percentage of voting participation, her political affiliation, summary of voting and attendance. Interactive graphs allow more detailed information to be displayed.

7 Discussion

The main advantage of this work is its uniqueness—an effort to increase transparency of city councils and centralize its data in one place, offer open datasets from different municipalities in the same format, and provide unified visualizations for the general public. The usage scenario has only been conducted on one municipality, but the created results should be generic enough to be applicable to different municipalities, which is currently tested with cooperation to other Czech partner cities. It is necessary to verify the suitability of the proposed data processing scheme and the data model for these municipalities. The aim is to establish a standard that would be applicable in the Czech Republic and could be gradually extended in single municipalities. It would also be advantageous to include foreign city councils.

We are aware that the expansion of the project depends on municipalities' willingness to cooperate. But we believe in an upward trend, as can be observed in OGD in general, and we are ready for negotiations to establish new partnerships. Transforming data into the created data model remains a challenge, as pre-processing must accommodate the diverse data formats from each municipality. Nevertheless, there is potential to develop a universal tool capable at least partially automate this part of the process. The use of AI is suggested, namely for automatic vote records classification, knowledge mining, pattern searching, etc. This would contribute not only to a greater understanding of the source data, but also to deeper insights for finding appropriate approaches and solutions.

8 Conclusion

This paper described the problem of availability of OGD from city councils and the research works focused on visualization of such data. In the effort for enhanced accessibility of such information, this work introduces two key concepts: the generic model for city council decision-making data and the information system providing clear visualizations for the general public. The model is included in the process of collecting and processing data from the decision-making of the representatives, which was also presented. The application of results was conducted in the city of Brno, and the insights and experiences gathered thus far have proven advantageous for collaboration with other Czech cities. The attained results showcase the feasibility of implementing this concept, with upcoming steps encompassing its expansion throughout the Czech Republic.

Acknowledgments This work was supported by project Smart information technology for a resilient society, FIT-S-23-8209, funded by Brno University of Technology.

References

1. Boche, A., Lewis, J.B., Rudkin, A., Sonnet, L.: The new Voteview.com: preserving and continuing Keith Poole's infrastructure for scholars, students and observers of Congress. In: Public Choice, vol. 176, pp. 17-–32. Springer (2018). https://doi.org/10.1007/s11127-018-0546-0
2. Borja, F. G., Freitas, C. M. D. S.: CivisAnalysis: Interactive Visualization for Exploring Roll Call Data and Representatives' Voting Behaviour. In: 28th SIBGRAPI Conference on Graphics, Patterns and Images, pp. 257–264. IEEE, Brazil (2015). https://doi.org/10.1109/SIBGRAPI.2015.34
3. Corrêa, A. S., Paula, E. C., Corrêa, P. L. P., Silva, F. S. C.: Transparency and open government data: a wide national assessment of data openness in Brazilian local governments. In: Transforming Government: People, Process and Policy, vol. 11, pp. 58–78. Emerald (2017). https://doi.org/10.1108/TG-12-2015-0052
4. Chlapek, D., Kučera, J., Nečaský, M., Kubáň, M.: Open data and PSI in the Czech Republic. In: ePSIplatform Topic Report No. 2014/03 (2014).
5. Czech Statistical Office—Small Lexicon of Municipalities of the Czech Republic—2021, https://www.czso.cz/csu/czso/maly-lexikon-obci-ceske-republiky-2021. Last accessed 25 Oct 2023
6. Etter, V., Herzen, J., Grossglauser, M., Thiran, P.: Mining democracy. In: Proceedings of the second ACM conference on Online social networks, pp. 1–12. ACM, New York (2014). https://doi.org/10.1145/2660460.2660476
7. Evans, A. M., Campos, A.: Open government initiatives: Challenges of citizen participation. Journal of Policy Analysis and Management **32**(1), 172–185 (2013).
8. Kassen, M.: A promising phenomenon of open data: A case study of the Chicago open data project. In: Government Information Quarterly, vol. 30, pp. 508–513. Elsevier BV (2013). https://doi.org/10.1016/j.giq.2013.05.012
9. Kučera, J., Chlapek, D., Nečaský, M.: Open Government Data Catalogs: Current Approaches and Quality Perspective. In: Lecture Notes in Computer Science,

pp. 152–166. Springer, Heidelberg (2013). https://doi.org/10.1007/978-3-642-40160-2_13
10. Kučera, J., Chlapek, D.: Benefits and Risks of Open Government Data. In: Journal of Systems Integration, vol. 5, pp. 30–41. Czech Society for Systems Integration (2014). https://doi.org/10.20470/jsi.v5i1.185
11. Kučera, J., Chlapek, D., Klímek, J., Nečaský, M.: Methodologies and Best Practices for Open Data Publication. In: DATESO, pp. 52–64. CEUR workshop proceedings (2015).
12. Lassinantti, J., Bergvall-Kareborn, B., Stahlbrost, A.: Shaping local open data initiatives: Politics and implications. In: Journal of theoretical and applied electronic commerce research, vol. 9, pp. 17–33. MDPI AG (2014). https://doi.org/10.4067/S0718-18762014000200003
13. Ljubešić, N., Fišer, D., Erjavec, T., Dobranić, F.: The Parlameter corpus of contemporary Slovene parliamentary proceedings. In: Language Technologies & Digital Humanities, pp. 162–167. Ljubljana (2018).
14. Lněnička, M., Nikiforova, A., Saxena, S., Singh, P.: Investigation into the adoption of open government data among students: The behavioural intention-based comparative analysis of three countries. In: Aslib Journal of Information Management, vol. 74, pp. 549–567. Emerald (2022). https://doi.org/10.1108/ajim-08-2021-0249
15. Lowndes, V., Pratchett, L., Stoker, G.: Local political participation: The impact of rules-in-use. In: Public administration, vol. 84, pp. 539–561. Wiley (2006). https://doi.org/10.1111/j.1467-9299.2006.00601.x
16. Méndez, G. G., Moreno, O., Mendoza, P.: LegisLatio: A visualization Tool for Legislative Roll-call Vote Data. In: Proceedings of the 15th International Symposium on Visual Information Communication and Interaction, pp. 1-–8. ACM, New York (2022). https://doi.org/10.1145/3554944.3554957
17. Open Knowledge Foundation—Digital Public Infrastructure for Electoral Processes, https://okfn.org/en/projects/digital-public-infrastructure-for-electoral-processes/. Last accessed 8 Nov 2023
18. Open Knowledge Foundation—Open Definition, https://opendefinition.org/okd. Last accessed 4 Nov 2023
19. Poole, K. T.: Spatial models of parliamentary voting. 1st edn. Cambridge University Press, New York, USA (2005)
20. Ren, G. J., Glissmann, S.: Identifying Information Assets for Open Data: The Role of Business Architecture and Information Quality. 2012 In: 14th International Conference on Commerce and Enterprise Computing, pp. 94–100. IEEE, Hangzhou (2012). https://doi.org/10.1109/CEC.2012.23
21. Safarov, I.: Institutional dimensions of open government data implementation: Evidence from the Netherlands, Sweden, and the UK. In: Public Performance & Management Review, vol. 42, pp. 305–328. Informa UK Limited (2019). https://doi.org/10.1080/15309576.2018.1438296
22. Ubaldi, B.: Open government data: Towards empirical analysis of open government data initiatives. OECD Working Papers on Public Governance (2013). https://doi.org/10.1787/5k46bj4f03s7-en
23. Zeleti, F. A., Ojo, A., Curry, E.: Exploring the economic value of open government data. In: Government Information Quarterly, vol. 33, pp. 535–551. Elsevier BV (2016). https://doi.org/10.1016/j.giq.2016.01.008