Open Source Software Adoption and Reuse in European Local Governments

A Multiple-Case Study

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Abstract

By 2030, the EU Digital Decade calls for all key public digital services within the EU are to be available online. The Interoperable Europe Act further promotes cross-border sharing and collaboration on interoperable digital solutions and assets among public organisations at local, regional, national, and EU levels. Open source software is central to these goals and ambitions. However, uneven capabilities across the public sector, especially at the local level, require targeted investments and support. This study explores five mature case studies of local governments adopting open source solutions, highlighting their roles alongside community actors and service suppliers. It identifies common challenges, governance models, and success factors, offering detailed recommendations to scale and sustain these initiatives. Archetypes are defined for local governments, communities, and suppliers to clarify roles and support collaboration. Key themes include designing for reuse, fostering agile development, ensuring diverse funding, and promoting inclusive governance. Recommendations focus on removing barriers, aligning policy goals with open source strategies, and enabling a robust service supplier ecosystem. Ultimately, the report makes the case that sustainable cross-border sharing and interoperability relies on coordinated efforts among all actors to grow capabilities and steward open source solutions effectively.

Keywords

Open Source, Open Source Software, Government, Municipalities, Local Government, Regional Government, Public Sector, Public Sector Organisation(s), Government, Adoption, Collaboration, Cross-Border, Sharing, Reuse, Interoperability.

Executive summary

By 2030, the EU Digital Decade calls for all key public digital services in EU Member States to be available online. The Interoperable Europe Act aims to ensure seamless access to cross-border public services and promote cross-border collaboration as well as sharing and reusing of interoperable digital solutions and assets. Open source software is a key tool and lever for achieving the ambitious yet critical goals. Extensive investments will be required to support the different parts of the European public sector sphere in their work towards achieving these goals and leveraging open source accordingly, as some are more capable than others, where local governments constitute a significant category of the latter.

To support and provide guidance for local governments in their digital transformations, as required by the Interoperable Europe Act, this study provides an in-depth investigation of five mature case studies of how local governments have adopted, developed, and collaborated on joint open source software solutions. The study specifically highlights the three perspectives of i) local governments and Public Sector Organisations (PSOs) constituting the driver and user of an open source solution, ii) the community actors supporting their collaboration, and iii) service suppliers (public, private, civil society) that provide technical capabilities necessary for the technical planning, development, maintenance, and operation of the solutions.

The outputs are threefold. First, the extensive and in-depth case studies provide diverse and detailed contextual information on how local government open source projects have evolved through various stages, what challenges they have experienced, how these have been managed, and how sustainability is planned. Second, a set of archetypes is defined for each of the three groups to support actors in identifying their own role and those of others in the open source ecosystem or what roles are missing in order to support successful open source collaboration in a specific context. Third, specific recommendations are provided aimed at supporting local governments, community actors, and service suppliers to come together in developing and supporting open source solutions with the potential to scale cross-border collaboration.

Below, the investigated case studies, recommendations, and archetypes are expanded, along with concluding remarks and paths forward for policy and practice.

Case Studies

The cases were sampled based on an extensive mapping of open source projects actively developed and governed by local governments across Europe. Each case represents mature examples with diverse characteristics and

elements of how collaboration, and sharing and reuse on open source can take its form.

Consul Democracy, developed by the City of Madrid in 2015 amidst political changes driven by anti-austerity protests, is a robust and scalable open source citizen participation platform that supports participatory democracy initiatives by enabling direct citizen engagement. Consul has been adopted globally by various governments and organisations, including cities like Buenos Aires, Paris, and New York. Lessons from the Consul case study emphasise the importance of diverse funding and support to improve project resilience, scalable governance to enable sub-communities, open knowledge sharing, and defined exit strategies to ensure resilience and flexibility in the community it supports.

OS2borgerPC and MedborgarPC provide an example of an open source operating system solution used in public spaces like libraries and citizen service centres, developed through collaborations between Danish and Swedish local government associations (OS2[1] and Sambruk[2]) and Magenta, a Danish open source IT supplier. The two solutions share a common codebase and are maintained by the same service supplier, showcasing the potential and challenges of cross-border open source collaboration in the public sector. Despite successful collaboration, organisational and governance challenges persist, particularly around service supplier relationships and development models. Continuous checks and reviews are essential to ensure adherence to open source principles and avoid lock-in effects. Effective coordination, clear communication channels, and a coordinated co-funding model are critical for responsible governance and broader adoption. Including suppliers in governance from the beginning promotes collaboration and transparency.

Golemio is an open source smart city data platform developed by Operator ICT[3], owned by the City of Prague, to integrate, manage, and analyse data from various urban systems, particularly in public transit and waste management. The platform's primary use case is public transit, managing data for Prague and Central Bohemia's integrated transit system, with additional applications in waste management, energy monitoring, and environmental sensing. The platform has thus far received no reuse outside this context, as the focus of Operator ICT is exclusively on the City of Prague and not on growing a larger community of users. The case illustrates the power and potential of public sector agile development and how it requires cross-departmental collaboration and continuous stakeholder engagement. Using a publicly owned service supplier like Operator ICT can more easily adopt agile processes, allowing for flexible, responsive development.

[1] OS2 – Offentligt Digitaliseringsfællesskab. (s.d.). OS2 – Public Digitalization Network in Denmark. Available: https://www.os2.eu/
[2] Sambruk – Ideella föreningen Sambruk. (s.d.). Sambruk – Kommunal verksamhetsutveckling. Available: https://sambruk.se/
[3] Operátor ICT, a.s. (s.d.). Operator ICT – We are creating a new Prague. Available: https://operatorict.cz/en

Parlameter, developed by the Slovenian non-profit Danes je nov dan[4] (DJND), is an open source platform that tracks and compares parliamentary work, providing detailed analytics of activities. Initially volunteer-driven, it expanded from Slovenia to other countries, though efforts in Poland and Ukraine were discontinued due to local challenges. The case illustrates the risks of local governments becoming passive users without effective capacity-building, stressing the importance of collaboration and customisation to local needs. Smaller local governments in Slovenia struggle with resources and rely on larger ones, lacking a collective procurement model, which limits innovation.

Digitransit is an open source journey planner platform that integrates multiple transit modes and provides info screen services and third-party APIs for developers. The solution is utilised by local governments across Finland and other Finnish PSOs, and has been developed since 2014 by Fintraffic[5], HSL (Helsingin Seudun Liikenne - eng. Helsinki Region Traffic)[6], and Waltti Solutions Oy[7]. The project builds on OpenTripPlanner[8] (OTP), open source route planning engine, and uses OpenStreetMap[9] data for its mapping functionality. International adoption spans Estonia, Germany, and the U.S., which also demonstrates challenges in maintaining responsiveness across different contexts. The need for being responsive and providing active support, along with developing documentation and onboarding processes that lower barriers for newcomers are vital for adoption. Availability of service suppliers is limited but promoted as potential enablers for increased adoption and sustainability of the open source project, but still lack in presence. A potential reason includes the dominance of HSL in the governance and development of the open source project.

Collaboration Archetypes

These archetypes provide the descriptive roles and capabilities needed for local governments to create and maintain sustainable open source solutions. They help actors within these communities to understand their own roles, their relationships to each other, and how the aforementioned recommendations should be considered.

Local government-based archetypes

Growing the capabilities necessary to leverage open source to its fullest potential, while also managing the many risks, is a challenge in itself. The case studies, however, demonstrated how local governments can approach this challenge, either by growing external, internal, or quasi-internal capabilities.

[4] Danes je nov dan – Inštitut za druga vprašanja. (2013). Danes je nov dan. Available: https://danesjenovdan.si/
[5] Fintraffic Ltd. (s.d.). Fintraffic – We control traffic on land, at sea and in the air. Available: https://www.fintraffic.fi/en
[6] Helsinki Region Transport (HSL). (s.d.). HSL – Helsinki Region Transport. Available: https://www.hsl.fi/en
[7] Waltti Solutions Ltd. (s.d.). Waltti – Public Transport Services. Available: https://waltti.fi/en/
[8] OpenTripPlanner Project. (s.d.). OpenTripPlanner. Available: https://www.opentripplanner.org/
[9] OpenStreetMap contributors. (s.d.). OpenStreetMap. Available: https://www.openstreetmap.org/

External capabilities can be acquired by leveraging external proxy and umbrella organisations such as international foundations (for example, Consul Democracy Foundation) or national local government associations (for example, OS2 or Sambruk) where local governments and other actors come together and pool their resources. External service suppliers can also be leveraged with the caveat that any relationship is based on trust, control, and transparency to ensure the freedom and flexibility of the local governments.

Internal capabilities, provided directly by the local government, require substantial and long-term investment but can provide greater control and opportunity to leverage open source based on the local needs. The City of Madrid's Consul project and Barcelona's Decidim illustrate how resourceful local governments can build and scale open source solutions when underpinned by political will. The City of Munich exemplifies how a local government Open Source Program Office (OSPO[10]) can help support a large city and provide an interface towards the open source ecosystem.

Quasi-internal capabilities involve cooperation with quasi-public organisations, such as joint stock companies or entities owned or subsidised by local governments, blurring the lines between internal and external resources. For example, the City of Prague grows its technical capabilities through Operator ICT, a fully-owned service supplier, enabling agile and open working methods between the supplier and the different parts of the city. Similarly, Digitransit demonstrates how HSL along with Fintraffic and Waltti enables cross-local government collaboration on a national scale in Finland.

Community-based archetypes

Through the case studies, three forms of organisational structures emerged among community actors that can support local governments based on their needs and contextual settings, and take on the role of an open source steward[11] for joint open source projects.

International foundations play a crucial role in the international growth of open source projects by providing sustainable governance and collaborative development. They enable economies of scale and ensure resources are directed back to support the codebases. The Consul Democracy Foundation, for example, took over the Consul project from the City of Madrid in 2019, securing funding and maintaining collaboration across over 100 PSOs globally.

National provider-oriented associations are crucial for local governments interested in reusing existing open source solutions rather than developing new ones. These associations, like Sambruk in Sweden, pool resources and coordinate efforts, serving as an interface between local governments and

[10] The OSPO is an organisational construct and best practice transferred from Industry that provides a centre of competency and support for its organisation in adopting and collaborating on open source.
[11] The term Open Source Steward was introduced by article 18 in the Cyber Resilience Act, and is adopted in this report to refer to organisations that provide hosting of open source projects on behalf of its owners, or members, and caring for the projects' long-term sustainability.

service suppliers. They improve bargaining power, align requirements engineering, and ensure the continued maintenance and quality of open source.

National development-oriented associations play a crucial role in developing new open source solutions by pooling resources and capabilities to address common needs. OS2, for example, enables its members to collaborate on open source projects, avoiding lock-in effects and stewarding over 25 projects. Similarly, VNG, the Dutch Association of local governments, supports the Signalen open source project from Amsterdam, providing a long-term home for its development and sustainability.

Supplier-based archetypes

Through the case studies, three types of service suppliers emerged, providing suitable alternatives varying on the context and needs of the local governments.

Civil society service suppliers play a crucial role in supporting local governments with limited resources and capabilities, offering non-profit development services driven by public interest. Code for Romania exemplifies this by adopting and customising Consul for smaller local governments, providing necessary support and training, and eventually transferring the operation to the local governments. This approach encourages knowledge transfer and reduces dependency on commercial service suppliers as service suppliers.

Local government-owned service suppliers enable local governments to develop open source solutions tailored to their needs, either through internal departments or co-owned entities. The City of Prague's Operator ICT exemplifies this by attracting talented engineers with competitive salaries and agile development practices, enhancing solution customisation and collaboration. Similarly, HSL, co-owned by Helsinki region local governments, develops Digitransit, fostering national and international collaboration.

Private service suppliers are a traditional source of technical capabilities for PSOs and play a crucial role in open source projects. In the Consul project, these suppliers support local governments both nationally and internationally, especially after the City of Madrid reduced its support in 2019. Similarly, in the OS2borgerPC project, the service supplier Magenta facilitated adoption beyond Denmark, providing critical technical resources and fostering productive relationships with local governments.

Recommendations

A set of high-level recommendations are extracted based on the lessons learnt from the case studies, and overall cross-case synthesis. Further context per recommendation is provided in the report.

Recommendation #1: Open source as a multipurpose tool for achieving a diverse set of policy goals.

Local governments should first define policy goals, and then consider open source as one of the tools that can be used for achieving their policy goals.

Recommendation #2: Culture, competence, and resources limiting open source adoption.

Local governments should self-assess and explicitly map out barriers and challenges, both perceived and experienced, that in any way inhibit the adoption, development and collaboration on open source solutions.

Recommendation #3: Capabilities needed to communicate and interact - internally and externally.

Local governments should inventory what capabilities are needed, both to address identified challenges, and to achieve the defined goals, and determine how these can be acquired either internally or externally.

Recommendation #4: Designing for reuse from day one requires consideration and funding.

Local governments should design their solutions with interoperability and reuse in mind from day one, for example, by implementing a modular and flexible design, standardised interfaces and formats (considering open standards first), and the ability to localise solutions.

National and local governments should dedicate central funds that can support development and maintenance activities required to promote and enable local governments to create interoperable solutions with the potential for cross-border reuse.

Recommendation #5: Enabling an open and agile collaboration across the community.

Local governments should strive towards adopting an agile and open culture and practice in their procurement and development of new software solutions. When internal capabilities are not available, local governments should identify or establish potential conveners of such activities (for example, stewards or suppliers).

Recommendation #6: Limiting the dependence of open source projects on any single actor or source of funding is key to sustainability

Local governments should actively consider how they can support both the development and maintenance of key open source projects, for example, through procurement of service suppliers, and direct sponsorships.

Recommendation #7: Promoting a sustainable service supplier ecosystem in procurement.

While procuring open source solutions and related services, local governments should ensure that the defined conditions for service suppliers enable

sustainable business models, and by extension, sustainable maintenance of the open source solutions.

Recommendation #8: Local government associations enable co-funding, coordination and stewardship of open source projects.

Local governments should consider what role existing associations can play in supporting open source adoption, development, and collaboration, or if new organisational structures are required to steward current and future open source solutions.

Recommendation #9: Open Source Stewardship needed for projects scalability and sustainability.

Local governments should consider early on who will steward open source solutions in the long term, in order to scale adoption and create a sustainable funding for their continued development and maintenance.

Recommendation #10: Including suppliers in governance, while maintaining control and transparency.

Local governments should from the start actively involve relevant service suppliers in the technical governance and coordination of the planning, development, maintenance, and day-to-day operations of the open source solution.

Final thoughts

Open source software has significant potential for local governments in supporting interoperability while also providing control, transparency, and flexibility of their solutions. However, barriers, such as conservative cultures and procurement practices, often hinder its adoption. Achieving the benefits of open source requires substantial resources, skills, and know-how, which local governments typically lack. The study identifies various ways to acquire and grow these capabilities, both from the perspective of the local governments, community actors, and service suppliers. All three are more or less needed to allow for an open source solution to stay sustainable and deliver on its underpinning expectations. The intent of this study is to provide guidance for these actors in how they relate, complement, and depend on each other for mutual success.

Contents

1. Introduction

Open source software code is integral to the functionality of virtually all digital software, including the critical infrastructure and software stacks that governments depend on for key societal functions and the delivery of public services. This is not just theoretical, as studies have repeatedly shown the reach and value of open source. Industry surveys[12] estimate that a majority of any given software codebase – including those with huge societal applications, like the International Space Station[13] – is made up of open source components. Without open source technologies and networks of open source developers collaborating on those technologies, firms would reportedly pay an estimated three and a half times more to build the software and platforms that power their operations, equating to approximately €8.8 trillion[14].

This value extends to the public sector. For example, in the case of EU governments, open source is not just a technological asset, it is an essential pillar of the European economy, including its digital sovereignty, cybersecurity/cyber resilience competitiveness, and innovation[15]. Opportunities are iteratively stressed[16] for achieving Europe's Digital Decade[17] 2030 targets, enabling long-term interoperability as envisaged by the European Interoperability Framework (EIF). The latter emphasises how '*Public administrations should not only use open source software, but whenever possible contribute to the pertinent developer communities*'[18]. The Interoperable Europe Act further aims to ensure seamless access to cross-border public services, and promote cross-border collaboration, and the sharing and reuse of interoperable digital solutions and assets, where open source software is a key tool and lever for achieving these ambitious yet critical goals.

The use of open source is also increasingly being mandated or promoted in national-level policies[19], with Switzerland being one of the latter examples[20]. Still, much of the potential is forsaken as the necessary support structures are missing, providing guidance for how open source policies can be interpreted and implemented in practice[21]. Public sector organisations (PSOs) are typically challenged by lack of internal technical resources and capabilities, conservative procurement culture and practice, risk-aversion, and a siloed and self-centric focus. These challenges are particularly pronounced for local governments,

[12] Perlow, 2022
[13] Free Software Foundation. (2013). GNU/Linux chosen as operating system of the International Space Station. Available: https://www.fsf.org/blogs/community/gnu-linux-chosen-as-operating-system-of-the-international-space-station
[14] Hoffman et. al, 2024
[15] Blind et al. 2022
[16] European Commission, 2017a; 2020a; 2022
[17] European Commission. (2021)
[18] European Commission, 2017b
[19] Linåker & Muto, 2024; Blind et. al, 2022
[20] Interoperable Europe Portal. (2024). New Open Source law in Switzerland. Available: https://interoperable-europe.ec.europa.eu/collection/open-source-observatory-osor/news/new-open-source-law-switzerland
[21] Linåker & Muto, 2024

which benefit the most from adoption and reuse of common software stacks as most tasks and obligations are similar across local government borders.

Research on open source adoption and reuse in local governments has mainly focused on providing case reports[22],highlighting benefits and opportunities[23], and how open source technologies can be used to restructure the public sector[24] and to develop new e-government services[25]. Studies have also been reported on the risks and critical factors related to the adoption as well as the release of open source[26].

Practitioners in PSOs, on the other hand, have developed several guidelines, catalogues, and various types of resources to support both the adoption, development, and collaboration of open source for PSOs[27]. Many examples have been collected through the European Commission's Open Source Observatory (OSOR)[28], now hosted under the Interoperable Europe portal[29]. OSOR has sought to address some of the surfeit of knowledge on adoption and use of open source at the local level. It does so by specifically aggregating policies, case studies and articles about how even the smallest PSOs are learning about, adopting, contributing to and supporting open source and other open technologies in diverse jurisdictions across the EU, and even in other parts of the globe.

Nevertheless, in the available academic and policy literature, the analytical rigour given to understanding local government adoption – including the elements of development, maintenance and collaboration – remains relatively geographically bound to national-level jurisdictions, with local governments receiving only secondary considerations, if any. While there are some notable exceptions to this general trend, this study attempts to fill that gap. It aims to explore best practices for structuring and executing collaborative open source development and maintenance that enable the creation and reuse of sustainable projects within local governments, emphasising the dynamics of collaborations between local governments and questions related to interoperability.

The study aims to explore practice through an in-depth multi-case study of open source projects with a significant involvement of local governments. Using an iterative design science research process, an extensive mapping of over 1,000 local government open source projects was initially performed with a higher level of metadata extracted. The sample of five case studies was selected through a categorisation and synthesis of the collected metadata. Semi-structured interviews with key stakeholders and review of online material were performed for each of the case studies, iteratively synthesised through dedicated case study briefs. Findings were cross-analysed, synthesised and

[22] Hollmann et. al, 2013; Ven et. al, 2006; Fitzgerald and Kenny, 2004
[23] Kovács et. al, 2004; Huysmans et. al, 2008
[24] Hautamäki and Oksanen, 2018
[25] Kalja et. al, 2007
[26] Kuechler et. al, 2013; Scanlon, 2019; Linåker and Regnell, 2020
[27] Linåker & Muto, 2024
[28] Interoperable Europe. (s.d.). Open Source Observatory (OSOR). Available: https://interoperable-europe.ec.europa.eu/collection/open-source-observatory-osor
[29] Interoperable Europe. (s.d.). Interoperable Europe Portal. Available: https://interoperable-europe.ec.europa.eu/

validated through two consecutive focus groups with interviewees and external experts.

This study presents the synthesis of the findings, while more detailed reports on the individual case studies can be found in the appendices. The contributions of the study to the literature on open source software's adoption and reuse in a local government context are threefold. First, the extensive and in-depth case studies provide diverse and detailed contextual information for how local government open source projects have evolved through various stages and what challenges they have experienced, as well as how these have been managed and how sustainability is planned for. Second, a set of archetypes is defined for each of the three groups to support actors to identify their own role, and those of others in the open source ecosystem, or what roles that are missing, in order to support a successful open source collaboration in a specific context. Third, specific recommendations are provided to support local governments, community actors, and service suppliers to come together in developing and supporting open source solutions with the potential to share, collaborate on and scale those solutions cross-border.

Section 2 of this report begins by surveying the relevant literature on open source adoption in local governments, using it to make a more comprehensive and detailed case for the observations highlighted above. Section 3 then makes the case for the research design which was used to help address this gap, as well as the approach taken for scoping and identifying selected case studies of open source projects in a European context. Section 4 presents these case studies at the project level, providing an overview, key findings, and lessons learnt for each. Then in Section 5, we generalise the key findings and lessons learnt up to a higher level using perspectives and archetypes, and then extract a new evaluative framework for understanding findings on open source adoption based on key categories of evaluation (see Section 6). Our Recommendations (Section 7) considers the perspectives of the adopters (for example, PSOs), communities (for example, foundations), and service suppliers in light of the findings, critically discussing them and using them to draw final recommendations. The conclusion is then reached in Section 8.

2. Background and related work

2.1. An introduction to open source

Compared to open source, Commercial-Off-The-Shelf (COTS) software is defined by being sold or licensed to the public by a seller aiming to generate revenue while keeping a hold of intellectual property rights. The software is utilised without changes to the source code and is available in several uniform copies[30]. Open source, on the other hand, provides 'the freedom to use, change, sell or give away the software, the availability of the source code and the protection of the authors' intellectual property rights'[31]. As such, software created and distributed under an open source licence permits users not only to scrutinise the source code but also to alter the software from the ground up[32].

Today, software applications are commonly ceasing to be considered as stand-alone products and instead more and more interact with other applications or components of the IT architecture. As such, the selection of COTS components influences the wider IT architecture, which in turn increases the significance of service supplier relationships[33]. The avoidance of lock-in effects – referring to customers being so closely tied to a company or service that switching provider would require substantial cost and effort – is a key strength of open source. Avoiding lock-in effects is of special importance in the time of widespread adoption of proprietary licensed Software as a Service (SaaS) solutions, as in to prevent agreeing to unfavourable terms with a service supplier due to dependence on that provider[34]. In particular, utilising or even contributing towards open source hinders organisations from being tied to proprietary software and promotes those organisations' sovereignty[35]. The threat of losing critical knowledge when key individuals leave their organisations without sharing that information is a consistent issue[36]. This challenge can be worsened in open source projects for many reasons[37]. The primary causes for this include the high likelihood of code being abandoned during development, the unreliability of having long-term contributors sticking with open source projects and the potential for community related problems[38]. In this sense, open source development lives and dies with its community. The departure of community members not only reduces the know-how of the team but also discontinues their relationship with the rest of the community[39]. This break of connections damages knowledge building activities and potentially diminishes the health of the overall community[40].

[30] Larsen, Holck & Pedersen, 2004
[31] Feller and Fitzgerald, 2002
[32] Crowston et. al, 2004
[33] Ibid.
[34] Lundell et. al, 2021
[35] Blind and Böhm, 2019
[36] Jennex and Durcikova, 2013
[37] Rigby et. al, 2016
[38] Rashid et. al, 2019
[39] Wang and Lantzy, 2011
[40] Rashid et. al, 2019

As part of a survey investigating the adoption of open source in the local government of Lombardy (in Italy), researchers identified both positive and negative results when adopting open source. On the one hand, the researchers saw as key strengths of open source the potential to save money, the customisability of open source compared to proprietary software, and the ease of integrating open source with proprietary software. On the other hand, finding support from specialised organisations to aid the migration to open source, the long training times for the employees and the associated costs, as well as a perceived lower level of user-friendliness, security, and stability of open source applications when compared to proprietary software were key weaknesses[41].

A case study on the uptake of open source in Greek local governments determined similar findings, in terms of perceived strengths and weaknesses. The identified major advantages of using open source were its lower cost, the prevalence of active communities supporting and progressing the software and the ease of expanding functionalities. Perceived disadvantages lay in the inability of open source to consistently cover all desired functionalities, inadequate training possibilities and a lack of such certifications, and insufficient support offerings, as well as instances of user communities delivering lower levels of security compared to commercial companies[42].

2.2. Barriers of and challenges for open source adoption

The adoption of open source can be hindered for manifold reasons. Table 1 in Annex B summarises the results of the literature review on the barriers and challenges for open source adoption.

When discussing the barriers of initiating open source projects and acquiring open source solutions, a lack of interest from the involved parties presents a major challenge from the start. Reasons for this are various, like the low interest in open source and risk-averse behaviour due to satisfaction with the existing systems[43] or the lack of prior exposure to open source or of perceived need of using open source products[44]. The disinterest may also be the result of an absence of open source advocates in the organisation[45], due to copying the behaviour of competitors[46] or because of the perception of requiring substantial efforts needed to deploy open source products[47].

Linked to the lack of interest is an internal resistance against adopting open source[48]. Besides general resistance from the parties involved, cultural

[41] Tosi et. al, 2015
[42] Koloniaris et. al, 2018
[43] Glynn et. al, 2005; Larsen et. al, 2004; Magnusson, 2011; Mergel, 2021; Petrov & Obwegeser, 2018; Silic & Back, 2017
[44] Deller & Guilloux, 2008; Gurusamy & Campbell, 2011; Petrov & Obwegeser, 2018
[45] Magnusson, 2011; Petrov & Obwegeser, 2018
[46] Glynn et. al, 2005; Petrov & Obwegeser, 2018
[47] Magnusson, 2011
[48] Glynn et. al, 2005, Gurusamy & Campbell, 2011; Koloniaris et. al, 2018; Mergel, 2021; Petrov & Obwegeser, 2018; Silic & Back, 2017; Tosi et. al, 2015; Yaseen et. al, 2020

resistance factors[49] or opposition from the management[50] can increase the friction in adopting open source. Even when all participants are willing to adopt open source technologies, a major inhibiting factor to doing so lies commonly in the personnel's limited open source understanding, competence or capabilities[51]. Open source is still deployed a lot less than proprietary software and thus, staff is used to those products and often unfamiliar with open source software. To overcome this, extensive open source training is required[52], making it a key barrier for adopting open source. Finding skilled personnel can also be challenging or too costly for some organisations[53].

Additionally, the maturity of open source products is often recognised as lesser than those products of commercial companies. This increases the perceived risks of utilising open source products[54], in particular in regard to the level of security management[55]. Worsening this perception is the limited availability of documentation or low levels of documentation quality[56], and the view of inferior levels of user-friendliness regarding open source products[57].

This lower level of maturity brings forth additional issues related to the comparability of open source products, both to one another and to proprietary or commercial options. On the one hand, there is an absence of open source standards and standardisation[58]. On the other hand, there exists a lack of open source product certifications[59]. This creates further difficulties when choosing between open source solutions and providers. Moreover, finding external support was the single most commonly reported individual barrier in successfully adopting open source products[60]. Worse yet, the costs of receiving external support, maintenance and training are often hidden or disregarded by the involved parties, leading to planning and budgeting issues[61].

Among the most difficult barriers to overcome regards the topics of integration and migration. Problems with integrating open source with existing systems and guaranteeing interoperability between them is often cited[62]. Migration towards open source components can happen for many reasons as well, like technical complications or issues related to commercial service supplier lock-in and pre-existing contracts, which are commonplace as well[63].

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[49] Deller & Guilloux, 2008; Mergel, 2021; Petrov & Obwegeser, 2018
[50] Bouras et. al, 2013; Larsen et. al, 2004
[51] Deller & Guilloux; 2008, Gurusamy & Campbell, 2011; Magnusson, 2011; Petrov & Obwegeser, 2018; Ven & Verelst, 2009; Yaseen et. al, 2020
[52] Koloniaris et. al, 2018; Robles et. al, 2019; Tosi et. al, 2015
[53] Bouras et. al, 2013, Gurusamy & Campbell; 2011, Magnusson, 2011; Petrov & Obwegeser, 2018; Silic & Back, 2017
[54] Bouras et. al, 2013, Glynn et al. 2005, Magnusson 2011, Mergel 2021, Petrov & Obwegeser 2018
[55] Bouras et. al, 2013, Koloniaris et. al, 2018, Petrov & Obwegeser, 2018, Yaseen et. al, 2020
[56] Gurusamy & Campbell 2011, Shaikh, 2016
[57] Bouras et. al, 2013; Tosi et. al, 2015
[58] Magnusson, 2011; Silic & Back, 2017
[59] Shaikh, 2016
[60] Bouras et. al, 2013; Glynn et. al, 2005; Gurusamy & Campbell, 2011; Koloniaris et. al, 2018; Larsen et. al, 2004; Petrov & Obwegeser, 2018; Tosi et. al, 2015; Ven & Verelst, 2009; Yaseen et. al, 2020
[61] Bouras et. al, 2013; Gurusamy & Campbell, 2011; Magnusson, 2011; Silic & Back, 2017; Tosi et. al, 2015; Ven & Verelst, 2012
[62] Bouras et. al, 2013; Deller & Guilloux, 2008; Gurusamy & Campbell, 2011; Magnusson, 2011; Mergel, 2021; Petrov & Obwegeser, 2018; Silic & Back, 2017; Tosi et al, 2015
[63] Glynn et. al, 2005; Gurusamy & Campbell, 2011; Holck et. al, 2005; Mergel, 2021; Silic & Back, 2017; Yaseen et. al, 2020

Linked to the above-mentioned challenges with pre-existing contracts are legal issues, ranging from concerns regarding licensing and intellectual property rights[64] to compliance related legal hurdles[65]. Lastly, applicable to open source adoption in PSOs, are political obstacles. The absence of laws supporting open source adoption in PSOs[66], difficulties maintaining political support in favour of open source[67] and potential biases of government procurement policies towards COTS[68] can be highlighted in particular.

2.3. Incentives for open source adoption

The most common advantage of open source lies in the technical opportunities open source brings, like the flexibility and customisability of open source products. Table 2 in Annex B summarises the results of the literature review on the drivers and incentives for open source adoption.

Being able to adapt the code to the particular needs and environment of the organisation instead of relying on Commercial-Off-The-Shelf (COTS) software is a key strength of open source[69]. One major strength is security. Due to the open access to the source code, open source products tend to be more secure than proprietary software[70]. Allen (2010) illustrates that mature open source solutions have a high level of perceived effectiveness from its users. Outside the technical aspects of open source, the most important singular driver for adopting open source regards the saving of costs relating to the low acquisition costs and maintenance of the software[71].

Finally, the potential for collaboration, be it in the form of participation in an open source community[72], the reuse of open source solutions and working in tandem with other organisations[73] or collaborating through joint associations[74] is a major incentive for adopting open source. Moreover, Allen (2010) calls attention to the ease of testing open source due to the rather rapid deployment of open source solutions and the low risks and costs linked to open source projects. Lastly, Bouras et al. (2013) mention the beneficial aspects of having control over intellectual property rights.

[64] Gurusamy & Campbell, 2011
[65] Silic & Back, 2017
[66] Tosi et al. 2015
[67] Robles et al. 2019
[68] Petrov & Obwegeser 2018
[69] Allen 2010, Deller & Guilloux 2008, Glynn et al. 2005, Koloniaris et al. 2018, Magnusson 2011, Mergel 2021, Tosi et al. 2015, Yaseen et al. 2020
[70] Tosi et al. 2015, Yaseen et al. 2020
[71] Allen 2011, Bouras et al. 2013, Deller & Guilloux 2008, Koloniaris et al. 2018, Magnusson 2011, Mergel 2021, Tosi et al. 2015, Ven & Verelst 2012, Yaseen et al. 2020
[72] Bouras et al. 2013, Glynn et al. 2005, Mergel 2021
[73] Deller & Guilloux 2008, Glynn et al. 2005
[74] Viseur & Jullien, 2023, Robles et al. 2019

2.4. From open source adoption barriers to success factors

To successfully adopt open source, political will – e.g. finding advocates and developing internal support for adoption – is key, while preparing countermeasures for how to overcome any possible barriers. On the one hand, the presence of a clear authority figure supporting open source, be it on the management level or the head of the IT department, is paramount[75]. On the other hand, the existence of boundary spanners and open source champions is crucial as well[76]. Boundary spanners are individuals who combine their organisational familiarity with knowledge of open source. They can champion the open source adoption and contribute to bridging the contact between the organisation and new innovations[77]. Open source projects in PSOs in particular benefit greatly from the presence of political will and focused mobilisation in favour of open source adoption[78].

Besides finding the centre figures in an organisation, the availability of open source literate personnel is a major success factor[79]. Moreover, the successful implementation of open source projects grows internal IT talent and can lead to an improved relationship between the IT department and its users[80]. This in turn increases the autonomy of the organisation and reduces commercial service supplier lock-in[81]. Outside these aforementioned factors, the literature also showcases some additional, more specific guidelines for adoption.

Lundell et al. (2021) have laid out five recommended requirements for open source procurement undertakings with a particular focus on the avoidance of lock-in effects. The procuring organisation ought to only express requirements for already implemented open source projects and must be aware of a potential exit strategy, ideally on brief notice and with safeguarded data and digital assets. Additionally, the procuring organisation has to articulate requirements for open IT standards and interoperability with those standards, while abstaining from declaring requirements for specific proprietary software applications. Tosi et al. (2015) had noted that a requirement analysis must be performed thoroughly.

Bouras et al. (2013) agree in regard to creating clear definitions of technical areas and of the requirements. Moreover, the organisation should identify and analyse potential software solutions using a combination of techniques and learn from previous evaluations of open source solutions. To further enable these practices, a group of experts consisting of the head of IT and other department heads should be formed.

[75] Glynn et. al, 2005; Mergel, 2021; Van Loon & Toshkov, 2015; Yaseen et. al, 2020
[76] Glynn et. al, 2005; Mergel, 2021; Van Loon & Toshkov, 2015; Ven & Verelst, 2012
[77] Van Loon & Toshkov, 2015
[78] Van Loon & Toshkov, 2015
[79] Glynn et. al, 2005; Mergel, 2016; Yaseen et. al, 2020
[80] Allen, 2010
[81] Bouras et. al, 2013; Deller & Guilloux, 2008; Yaseen et. al, 2020

Besides the technical requirements of open source products, Silic & Back (2017) highlights that rigorous evaluation and testing of open source products needs to be performed, as well as assurance checks to ensure that all open source products are legally compliant. Furthermore, the organisation shall align and coordinate internal and external stakeholder interests while planning a long-term, phased approach for the migration. Lastly, hidden costs for training, external support, etc. must be accounted for. Ven & Verelst (2009) add the need of a balance between external support and internal know-how according to the needs and capabilities of the organisation. Additionally, Hamid et al. (2016) advise to leverage the open source community as much as possible to facilitate knowledge exchange.

While Holck et al. (2005) highlighted the customisability of open source as a key strength, the avoidance of modifications not incorporated into the source by the supplier have to be a prerequisite. The creation of clear accountability between the service supplier and the customer is key. Anticipating sudden changes due to the unpredictable nature of open source products must be accounted for as well.

Allen (2010) also shows how systems stemming from open source platforms can be recognised as being developed and deployed not only rapidly, but also cost-efficiently, which should be emphasised to the stakeholders. Furthermore, IT departments can take inspiration from product developers to server their internal marketplace. This can enhance their relationship with their user base, focusing on aiding instead of controlling user behaviour, potentially strengthening local IT talent. Lastly, he suggests letting open source projects bypass traditional project management processes, allowing for greater flexibility and speed.

Mergel (2016) agrees with the former point of highly advising following agile project development practices and to promote transparency and visibility of the open source project. To acquire the necessary know-how, external IT talent should not only be attracted and also incorporated into the team rapidly. Finally, bringing management on board to safeguard their support is paramount.

3. Research Design

Building on the aforementioned literature, this study attempts to comprehensively and more systematically advance knowledge of open source in a public sector context, but specifically at the local government level. The study adopts a design science research approach[82], wherein knowledge extracted from the problem context is used to design interventions that are applied and evaluated in the problem context. The research cycle is iterative, wherein lessons from one cycle feed into the next investigated.

The problem context is constituted by PSOs in local governments using common open source solutions and collaborating on their development and maintenance. The main research goal is to explore and generate knowledge on how the collaborative development and maintenance can be structured and executed to enable the creation and reuse of sustainable open source projects – specifically in the context of PSOs at the local government level.

The research has been conducted in three cycles. First, an overarching mapping of open source projects with active adoption and collaboration of local level PSOs was performed. Knowledge has been synthesised to create initial understanding of the problem context, complemented by a literature review of relevant scientific and grey literature. In the second research cycle, a multiple-case study[83] was performed with five case studies sampled from the population of case studies identified in the previous research cycle. The unit of analysis consisted of the motivations, processes, tools, and governance structures used within the projects to enable and perform their development, maintenance, and adoption by the local governments. Finally, in the third research cycle, a set of focus groups was conducted to validate and enrich findings from the previous cycles.

Below, we describe the planned research approach in further detail.

3.1. Research Cycle #1: Mapping of open source projects in local PSOs

In the first cycle, open source projects with active adoption and collaboration between local level PSOs were mapped within the 27 EU Member States and Norway, Liechtenstein, and Iceland. Personal contacts, networks and resources were leveraged, including, but not limited to:

- The EU's informal Open Source Programme Office (OSPO) network facilitated by the European Commission OSPO (EC-OSPO);
- OpenForum Europe's community network;
- The Open Source Observatory's online knowledge center; and,
- Publicly available data and repositories.

[82] Runeson et. al, 2020
[83] Runeson & Höst, 2009

This data was compiled in collaboration by four researchers working in parallel. Informative attributes were developed inductively through the analysis of the collected material, and from relevant scientific and grey literature on the topic. The researchers held continuous discussions to validate the inclusion of each case. The mapping is presented as supplementary material to the report. Findings were synthesised and described in an initial theoretical framework providing inputs to next steps in the research process.

3.2. Research Cycle #2: Multiple-Case Study of Local PSO Projects

A purposive sampling approach[84] was used to identify and select cases from the defined population. The objective of sampling was to purposefully collect a diverse set, taking into account geographical coverage, technology, scope, and maturity of the open source projects, their communities, and specifically of the local level PSOs involved. Special consideration was taken to how the development and collaboration was facilitated and organised among PSOs, service suppliers and concerned communities. A subset of high level archetypes were derived with ten candidate case studies from which five were selected in collaboration with the commissioning organisation for this study.

For each case, four to eight interviews were conducted with key individuals (see Annex C). The interviews were semi-structured, allowing for digression in topics as the interviews progressed. This flexibility allowed for the capture of additional nuance, context, and examples that might otherwise be overlooked. The interview questionnaire (see Annex A) was based on the synthesised knowledge described in the initial version of the theoretical framework coming out of the mapping and literature review of Research Cycle #1.

The interviews lasted for approximately one hour and were conducted and recorded online via an online platform (*BigBlueButton*). The interviews were conducted by two to three experienced researchers, with the lead researcher guiding the interviews and a second and/or third researcher taking notes and asking follow-up questions as necessary. The recordings were automatically transcribed in a local offline environment using the open source tool *WhisperX*. These transcriptions were then processed to ensure readability and accuracy.

Interviewees provided with informed consent upfront regarding the background, design and publication process of the study, as well as the data collection and management process used. They were offered the opportunity to ask clarifying questions about the process throughout the study. Each interviewee remained anonymous by name but referred to by a generalisable and appropriate title, and the organisation they support have been attributed by necessity.

Statements in the transcriptions were coded in a sequence of steps during the data analysis phase[85]. Initially, the transcripts were structurally coded based on

[84] Patton, 2014
[85] Saldaña, 2021

an *a priori* codebook derived from the synthesised findings of the previous research cycle. The structured data was then openly coded, with statements being assigned codes or short descriptive phrases characterising the phenomena described. The codes were then rearranged and categorised using axial coding into general themes and common topics among the codes.

The coding process was iteratively performed for each interview and case. Once all cases were coded, a cross-case analysis was performed to further synthesise and differentiate the findings between the characteristics each case represents. The theoretical framework has been revised accordingly.

3.3. Research Cycle #3: Focus Groups of Experts for Feedback

The synthesised findings from previous research cycles were enriched and validated through two focus groups[86]. Interviewees from the case studies were invited, as well as additional external networks. In each focus group, participants were presented with a background on the study, followed by overviews of the findings connected to the different contexts represented by the five case studies. After each overview, an open discussion took place among the participants, facilitated by the research team. Each focus group lasted for 90 minutes and was recorded, transcribed and analysed following a similar process as for the interviews.

3.4. Challenges and Potential Threats to Validity

Since a qualitative research approach was adopted, a set of criteria for naturalistic inquiries has been utilised for discussing and evaluating the threats to validity of the study[87]. These criteria include credibility, transferability, dependability and confirmability.

3.4.1. Credibility

Credibility pertains to the truth value of the presented findings. To enhance this aspect, member checking was conducted, allowing each interviewee to review and provide feedback on the synthesised findings. Additionally, the researchers behind this study engaged in continuous discussions and peer debriefings to maintain situational awareness of their observations and the perceived level of saturation among each of the case studies. The follow-up focus groups further contributed to strengthening this aspect of validity.

[86] Kontio et. al, 2008
[87] Guba, 1981

3.4.2. Transferability

Transferability concerns whether and how the presented findings can be applied to other case studies beyond those studied. Since this is a qualitative and exploratory study, the aim is not to make generalisations about an entire population. Instead, the goal was to develop an understanding of the problem context and generate knowledge that can be valuable for practitioners operating within this context. Consequently, readers must consider the context from which the data was collected to enable any anecdotal generalisations. Quotes from the interviews will be used consciously to provide rich and contextually detailed findings.

Purposeful sampling is another method that was employed to ensure the transferability of the results. The initial mapping yielded a broader sample of the overall population of relevant open source projects. From this sample, five case studies were selected based on criteria aimed at achieving as wide a representation as possible.

3.4.3. Dependability

Dependability refers to the reliability of the results in terms of their replicability and traceability throughout the chain of evidence. To enhance this aspect, an audit trail has been maintained throughout the data analysis and collection process. This documentation covers all stages of the research process, from the initial version of the conceptual framework through the mapping, case studies and focus groups.

3.4.4. Confirmability

Confirmability relates to the extent to which the presented findings were objectively derived. In this regard, investigator triangulation[88] (e.g. the involvement of multiple researchers) has been leveraged throughout the research design and implementation process to ensure neutrality and reduce the risk of introducing researcher bias. This approach includes several steps aimed at maintaining research focus and a clear chain of evidence, from the initial assumptions to the design of the questionnaire and the iterative coding process.

[88] Guba, 1981

4. Case Studies

This section provides a series of five case studies: Consul Democracy, OS2borgerPC and MedborgarPC, Golemio, Parlameter, and Digitransit. The case studies constitute the bulk of the original analysis for this report and are presented in this section in a condensed form. More detailed case studies can be found as supplementary materials to this main report.

The initial phase of this project was focused on data collection and mapping of open source projects, policies, organisations, and news articles across local and regional governments in Europe. Simultaneously, the team conducted an initial literature review and refined the research design. This report analyses key findings according to each of these areas and seeks to identify the selected case studies that will be the focus of the final report's analysis.

As mentioned in the methodology, ten candidate case studies were selected using a purposive sampling approach, in part based on geographic diversity, topical diversity and archetype diversity (according to early version of the archetypes in Section 5, which were drafted in an early form in the mapping phase and refined throughout the analysis). The five selected case studies therefore, while not exhaustive, constitute an interesting but not fully representative picture of open source collaboration within and between local governments in Europe.

(Note: Where possible, interview references have been simplified at the paragraph level for clarity and brevity, as part of their inclusion in this main report. For more detailed references, including pseudonymised sources, affiliations, and quotes – please check the longer, supplementary case studies available on the OSOR website).

4.1. Consul Democracy: Building and sustaining a Pan-European community of PSOs through an open source foundation

Consul Democracy, often referred to simply as 'Consul', is a robust and scalable citizen participation platform that supports participatory democracy initiatives by enabling direct citizen engagement. The platform allows participatory budgeting, collaborative legislation and citizen consultations, fostering transparency and community involvement in governance. Over time, it has been adopted by various international governments and civil society organisations, making it a key tool for civic participation globally[89].

Consul is built using Ruby on Rails as its core framework, utilising PostgreSQL for database management and integrating Elasticsearch for advanced search capabilities for and enhanced user experience. The platform is licensed under the GNU Affero General Public Licence (AGPL), ensuring that any modifications

[89] Consul Democracy Foundation. (s.d.). CONSUL DEMOCRACY. Available: https://consuldemocracy.org/

remain open source. Consul's active community of developers and contributors continuously updates the platform, ensuring security, usability and adaptability to evolving governance needs in different contexts where it is deployed[90].

Consul was originally by the Madrid City Council, in the wake of political change on the back of anti-austerity protests, which had started in 2011 and culminated in the elections of 2015. During those elections, it was the reformist and pro-democracy party *Ahora Madrid* which helped bring Consul into the world. The party swept to power in the Madrid City Council elections, in large part because of a commitment to initiating political change, most notably through bottom-up democracy. At the same time, similar political changes were happening in Barcelona and many other cities across Spain, a result of bottom-up local government initiatives that were tied into the critiques of left-wing parties and coalitions[91].

The new mayor in 2015 was Manuela Carmena, a politician who was influential in launching *Decide Madrid*, the open source platform which would later become Consul. *Decide Madrid* promised to enable individual voices from across the city to be heard and included in local government decision-making processes. In particular, it was designed to facilitate so-called ‘direct democracy’ or ‘participatory democracy’ enabling citizens to engage in bottom-up decision-making processes such as participatory budgeting and policy proposals[92].

Since its inception, Consul has expanded globally, influencing participatory governance in numerous local governments, regions, and organisations in big cities such as Buenos Aires, Paris, and New York[93]. In the period from 2017 to 2019, Consul gained international traction, especially in Latin America and Europe, with an expansion of interest made possible by open community collaboration via the Internet.

While its use declined a little bit after 2019, the last five years have been characterised by increasing pan-European collaboration in the Consul community, with large influence coming from Germany, Scotland and, to a lesser extent, the Netherlands, but also Romania, Slovenia and other places outside of Western Europe. This expansion has forced Consul to evolve into more consolidated modalities for sharing and collaboration, even as the development of formal governance structures to support contribution and maintenance have stagnated. While the Consul Democracy Foundation has focused largely on community-building and collaboration so far, it hopes to improve the governance and financial sustainability of Consul in the year ahead[94].

In spite of these challenges, Consul has proved to be a successful and durable enabler of direct democracy processes, particularly around participatory

[90] Ibid.
[91] Interview with Former City of Madrid Employee
[92] Interview with Consul Democracy Foundation; Interview with Former City of Madrid Employee
[93] Ibid.
[94] Interviews with All Interviewed Stakeholders for Consul

budgeting, and continues to provide local governments and other organisations with essential tools for participatory democracy.

4.1.1. Key Stakeholders in Consul Democracy

Consul Democracy Foundation: The Consul Democracy Foundation was established in 2019 to ensure Consul's continued maintenance as political support from the Madrid City Council declined following elections. Rather than maintaining the codebase with its own developers, the Foundation focuses primarily on community development and expanding the use of Consul[95].

COSLA (Convention of Scottish Local Authorities): COSLA serves as a central facilitator for Consul implementation across Scottish local governments, providing technical management, hosting, deployment, and onboarding support. This centralised approach reduces duplication of effort across 32 councils and leverages shared expertise, though it faces capacity constraints[96].

Decidim: Decidim originated as a fork of Consul when the City of Barcelona sought more flexibility and customisation options for citizen participation. The Decidim Association governs the project through a Coordination Committee elected democratically, ensuring community-driven decision-making[97].

Code for Romania: Code for Romania, now operating under the auspices of Commit Global[98], began working with Consul in 2019 and deployed the first instance in Brașov, a medium-sized city in Romania. That first instance focused on participatory budgeting, aiming to implement end-to-end processes before handing them over to local governments to ensure autonomy[99].

City of Munich: The City of Munich adopted Consul to implement direct democracy digitally, continuing a policy priority from a previous administration. The Open Source Program Office (OSPO)[100] in Munich has become the sole sponsor of the Consul Democracy Foundation, contributing approximately 20.000 euros annually to support the project's sustainability[101].

City of Groningen: The City of Groningen was highly active in the international Consul community early on and played a leadership role in promoting the platform within and beyond the Netherlands. However, their involvement has diminished recently[102].

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[95] Interview with Consul Democracy Foundation; Focus Group Discussions with Consul Democracy Foundation
[96] Interview with Convention of Local Scottish Authorities (COSLA)
[97] Interview with Decidim Association
[98] In 2023, Code for Romania took the step that turned it into the first NGO in our country that became a global organisation. Commit Global became the parent organisation or network that connects and supports civic tech organisations around the world, which had previously been organised informally as Code for All. Code for Romania is the leading member organisation within the Commit Global network, with much of its staff and operations subsumed into Commit Global. Other members include organisations like Code for Pakistan, Code for Japan, and Code for Australia.
[99] Interview with Code for Romania
[100] The OSPO is an organisational construct and best practice transferred from Industry that provides a centre of competency and support for its organisation in adopting and collaborating on open source.
[101] Interview with City of Munich OSPO
[102] Interview with City of Groningen

4.1.2. Key Findings from the Consul Democracy Case

Adoption and Use

Adoption of Consul has grown substantially internationally and fostered vibrant communities, though use of Consul has varied significantly across different countries and their local governments, shaped by local political contexts, resource availability, and strategic goals.

- Initially developed in Madrid to support participatory democracy, Consul rapidly gained traction across Madrid in 2015 and early 2016, continuing to spread around Spain, and international attention came in 2016 and 2017, all the way through 2019[103].
- The platform's adaptability allowed for diverse implementations, with each local government customising features to suit local needs. However, this led to fragmentation and adoption challenges[104], as multiple forks emerged without a streamlined process for reintegration into a core codebase[105].
- The adoption process has also been influenced by organisational models and governance structures[106].
- Some adopting organisations have focused on knowledge transfer to ensure local governments maintained autonomy and did not become dependent on external support, highlighting the importance of strategic exit planning and sustainability considerations[107].
- Challenges in adoption were not limited to technical fragmentation, but also involved cultural, language, and political barriers, such as localising the system to local contexts or addressing a lack of sustained political will over time[108].
- Consul has fostered vibrant international communities, facilitating knowledge exchange through conferences, webinars, and active Slack channels. These communities have been vital for sustaining the project and supporting the diverse needs of global users[109].

Development and Maintenance

Development and maintenance of Consul, initially driven by Madrid City Council, evolved with widespread adoption and contributions from various stakeholders, but faced challenges including political shifts and dependency on a small core of technical providers.

[103] Interview with Consul Democracy Foundation; Interview with Former City of Madrid Employee
[104] Cf. Yaseen et al., 2020.
[105] Interviews with All Interviewed Stakeholders for Consul
[106] Interview with Convention of Scottish Local Authorities (COSLA)
[107] Interview with Commit Global / Code for Romania
[108] Interviews with All Interviewed Stakeholders for Consul
[109] Interview with Consul Democracy Foundation; Interview with Former City of Madrid Employee

- Consul's development was heavily driven by the Madrid City Council, which had initiated its development, largely due to a mandate from the government[110]. Van Loon & Toshkov (2015) and Mergel (20121) show how having people within the organisation who promote, inform about, and politically support the adoption of OSS appears is indispensable for OSS adoption
- After just 6–12 months, Consul spread widely, with active contributions from various stakeholders, including both Spanish cities and actors outside Spain[111].
- In 2016-2017, the City of Barcelona forked Consul and developed its own open source platform, which came to be known as Decidim; this was partially due to a need for greater oversight of the architecture and customisation options[112].
- Political shifts in Madrid, beginning in 2019 when a more conservative and technology-sceptic government was elected, led to reduced official support for the Consul software, which declined further with the onset of the COVID-19 pandemic[113]. As Robles et. al (2019) note, there can be trade-offs for governments in deciding how and when to promote open source projects, especially during crises like these.
- The lack of in-house technical expertise in many local governments led to a form of dependency on providers, of which there is a small core supporting Consul since its early days in Spain[114]. This is common amongst a lot of the literature, which notes challenges related to vendor lock-in.
- The set-up of the Consul Democracy Foundation had begun in 2018, in large part a proactive measure to anticipate risk should the City of Madrid withdraw support. The work was finished in 2019. The role of the Consul Democracy Foundation became focused on community development and expanding use of Consul; they do not have their own developers[115].
- Challenges in development and maintenance persist, including reliance on a small pool of maintainers, securing maintenance funding, and adoption challenges[116]. These challenges seem common in the literature, as noted by Yaseen et al. (2020) and others.
- Political changes affect long-term adoption and funding commitments, and bureaucratic hurdles in integrating open source into government workflows remain as well[117]. This echoes Van Loon & Toshkov (2015), who noted how the degree of OSS adoption crucially depends on the

[110] Ibid.
[111] Interview with Consul Democracy Foundation; Interview with Former City of Madrid Employee; Interview with Decidim Association
[112] Interview with Decidim Association
[113] Interview with Consul Democracy Foundation; Interview with Former City of Madrid Employee
[114] Interviews with All Interviewed Stakeholders for Consul
[115] Interview with Consul Democracy Foundation; Interview with Former City of Madrid Employee
[116] Ibid.
[117] Ibid.

presence of boundary spanners and political commitment within local government.

- Development and planning of the Consul core platform project is performed by a core group of developers, predominantly representing service suppliers with long-standing support in the community. Communication is managed through an international Slack instance[118].

Funding and Sustainability

Consul's funding journey evolved from initial Madrid City Council backing to a more precarious model dependent on external contributions, with inadequate fundraising despite diversification attempts like a certification programme and city sponsorship; though there are some plans to redouble and make these efforts more successful in the future.

- Initially funded by the Madrid City Council, Consul expanded naturally and freely, in the way many open source projects do, in the period between 2016 and 2019[119].
- Further development of Consul – including new features or architecture – is funded largely by participating local governments, though many of these contributions seem not to have made their way back to the core codebase[120].
- Since the emergence of the Consul Democracy Foundation in 2019, Consul has since transitioned to a model reliant on external financial contributions, with attempts at diversified funding through grants and sponsorship. That said, the added total of all this fundraising seems to be insufficient[121].
- There have been attempts at a diversified funding model, which have helped to sustain the platform. Namely, the Consul Democracy Foundation has developed a certification programme with service suppliers. Despite this, and monetary sponsorship from the city government in Munich, long-term financial stability remains a key concern for Consul[122].
- The Consul Democracy Foundation is actively seeking to bring on more local government sponsors while also building out its certification programme for service suppliers, both of which offer potential future sources of sustainable funding[123].

[118] Interview with Former City of Madrid Employee; Interview with Convention of Scottish Local Authorities (COSLA)
[119] Interview with Former City of Madrid Employee
[120] Interviews with All Interviewed Stakeholders for Consul
[121] Interview with Consul Democracy Foundation; Interview with City of Munich OSPO
[122] Ibid.
[123] Interview with Consul Democracy Foundation, as well as Focus Group Discussions and Informal Discussions

Governance and Organisation

Consul's governance evolved from a loosely structured model with fragmented local government contributions to an informal structure under the Consul Democracy Foundation, characterised by service supplier-led development, minimal local government involvement, and insufficient centralised coordination, resulting in some degree of community and codebase fragmentation (though this is beginning to change).

- During the period from 2016 to 2019, governance of Consul was mainly informally structured yet centred around the City of Madrid, with contributions from various local governments coming in a fragmented and ad-hoc way[124].
- There was a lot of collaboration around Consul and sharing of knowledge and information, but it is also true that most cities had their own installations[125].
- Since 2019, when political change happened in the City of Madrid and the Consul Democracy Foundation emerged, governance of Consul has remained informal, and challenges remain in ensuring continuous technical development and coordination[126].
- As noted by Yassen et al. (2020), a lack of a clear governance structure seems to have led to fragmented development wherein cities and service suppliers contribute separately, often without merging features back to the core codebase. It shows how governing open source software is a challenging process that needs a significant shift in the organisational structure[127].
- Today's contributions to Consul come largely from certified service suppliers and/or commercial service suppliers, with fewer contributions from local governments and NGOs, with each group playing a different role in shaping the project's development[128].
- The absence of a strong centralised governance structure has reinforced challenges in governing a unified community – let alone a single codebase – ultimately leading to a degree of fragmentation in the community[129].

4.1.3. Lessons Learnt from the Consul Democracy Case[130]

This section summarises the key insights and takeaways derived from the Consul Democracy case:

1. **Diverse funding and support, for example, in terms of funders and type of funding (e.g. grants, sponsorships and resources),**

[124] Interviews with All Interviewed Stakeholders for Consul
[125] Ibid.
[126] Interview with Consul Democracy Foundation; Interview with City of Munich OSPO.
[127] Interviews with All Interviewed Stakeholders for Consul
[128] Interview with Consul Democracy Foundation, as well as Focus Group Discussions and Informal Discussions.
[129] Interviews with All Interviewed Stakeholders for Consul
[130] All lessons learnt reflect knowledge from across all the interviews for the Consul case study.

improves resilience of the project and reduces overdependence on any single actor, particularly as a project scales internationally. The Consul case study illustrates how insufficient funding diversification can fragment communities and create problematic dependencies on service suppliers (like commercial service suppliers or systems integrators) for both customisation and financial support. While PSOs and local governments in particular can provide valuable support, relying solely on local government or single-source funding can lead to long-term instability, as can a lack of funding diversification once a project goes into a foundation.

2. **For an international project to function freely, collaboration across the overarching (cross-border) community must be maintained.** Structured and inclusive governance is critical as an open source product or collaboration gets used more and more internationally, but it also requires sub-communities to be built up and fed into the larger community that supports the 'core' project, even in case studies where there is no single maintainer. This is particularly relevant in a public sector context as more PSOs, particularly local governments, come onboard. A steering committee model – with clear roles for local government representatives and product development teams – could help coordinate diverse contributions while preventing fragmentation in the codebase, but this has not been part of Consul's case (though there is some evidence this may be changing).

3. **Open knowledge sharing and community interaction with users from similar contexts and with similar requirements for the solutions is critical for sustainability.** Digital communication channels and online communities are crucial for platform growth in open source projects, particularly in their early stages. Consul's success stemmed largely from its diverse user community of local government and other PSOs sharing knowledge and best practices across (city) borders, which happened organically in its early days as a community. Online collaboration modalities supported the expansion and ultimate consolidation of the Consul community, even as formal fundraising stagnated and governance structures weakened. Yet, as communities grow larger, a risk is that diversity and distance grows between the users. If underpinning needs and ways of communicating grow too large, community members may be forced to look to alternative options, as happened with the City of Groeningen.

4. **Without more defined governance structures, service suppliers can begin to play an outsized role in technical decision-making, and cities can become reliant on them over time.** Global open source solutions require technical adaptability through modular development, facilitating updates and customisation while accommodating diverse local government IT environments. Consul's experience demonstrates how

trade-offs in technical choices, for example, a lack of modularity or centralisation in maintenance can lead to service supplier dependence and ad hoc collaboration, with minimal upstream contributions resulting from architectural constraints and a community culture that has been built around that architecture. A platform's continued adoption depends on its flexibility to meet evolving needs across different social and political contexts.

5. **With open source projects steered by a foundation, it is important to balance centralisation of governance with the modularity and adaptability of the project.** Governance structures impact technical decisions, as seen in the challenges Consul faced in maintaining a unified codebase. The lack of a formal governance procedure and the reliance on trust-based collaboration led to fragmented development, with multiple forks adapted to different local needs. It becomes clear that there is a need to adopt more balanced approaches.

6. **Exit strategies should be defined before adopting an open source project.** Practitioners and policymakers need to ensure that the adoption of solutions enables migration (for example, an 'exit strategy') if the project's governance changes, or it is no longer maintainable. Exit strategies can be defined both in terms of getting out of relationships with a service supplier and the ability of an open source project and its data to be taken over by another actor, including a service supplier. Unlike proprietary software, which often comes with contracts ensuring long-term maintenance and accountability, open source relies on community contributions and voluntary maintenance. By proactively planning exit strategies, projects can not only reduce the perceived risks of open source but also enable resilience and flexibility in the community it supports.

4.2. OS2borgerPC/MedborgarPC: Collaboration dynamics for common use of open source across borders in Scandinavia

OS2borgerPC[131] and MedborgarPC[132] are open source operating system solutions primarily used in public spaces like libraries and citizen service centres. They are developed through collaborations between the Danish and Swedish local government associations (OS2[133] and Sambruk[134] respectively) and Magenta[135],a Danish open source IT supplier, which acts as the primary service supplier. The solutions share a common, mostly similar codebase and

[131] OS2 – Offentligt Digitaliseringsfællesskab. (s.d.). OS2borgerPC. Available: https://www.os2.eu/os2borgerpc
[132] Sambruk – Ideella föreningen Sambruk. (s.d.). MedborgarPC. Available: https://sambruk.se/medborgarpc/
[133] OS2 – Offentligt Digitaliseringsfællesskab. (s.d.). In English. Available: https://www.os2.eu/in-english
[134] Sambruk – Ideella föreningen Sambruk. (s.d.). Sambruk – Kommunal verksamhetsutveckling. Available: https://sambruk.se/
[135] Magenta ApS. (s.d.). Magenta – Open Source Supplier in Denmark since 1999. Available: https://www.magenta.dk/en/

are maintained by the same service supplier, demonstrating both the potential and challenges of cross-border open source collaboration in public sector organisations (PSOs), particularly when there is a relationship with a third party involved.

It is, in essence, packaged version of the open source operating system Ubuntu[136], enabling visitors to use public library PCs in a safe yet easy way though a custom and simplified interface. MedborgarPC (the Swedish version) is supported by Sambruk, in more direct collaboration with Magenta. MedborgarPC provides the same core software system[137], with some key operational and organisational differences in how they managed and deployed in Sweden, as well as some necessary localisation efforts[138].

Both solutions provide a secure, managed operating system environment that can be centrally administered and maintained, with features tailored to public access scenarios. In the case of both OS2 and Sambruk, the solution is provided as software-as-a-service (SaaS) where local governments subscribe to have their computers connected to a portal, organised via the associations themselves[139]. Magenta handles security and maintenance aspects for many Danish members of OS2 and all current Swedish local governments participating via Sambruk.

OS2borgerPC originated from a collaboration between City of Aarhus in Denmark and Magenta, and was later turned over to OS2 to be collaborated on and shared between local governments. The former Aarhus CTO had approached Magenta with an idea for an open source operating system. Initially called ‘Library OS’, it was later onboarded into OS2 as OS2borgerPC, with support from Magenta. More broadly, the collaboration between OS2 and Magenta dates back to OS2's founding, as Magenta was part of OS2 on the service supplier side[140].

MedborgarPC came about through collaboration between Sambruk and Magenta, with Sambruk undertaking the Swedish translation and localisation efforts. Magenta contacted Sambruk around 2018-2019. At that time, Magenta had a good relationship with OS2 and saw similarities between the organisations. The actual collaboration didn't start immediately, and it took about two years to successfully find a way in with Sambruk. At that point, Sambruk decided to translate the system to Swedish at their own cost and market it to Swedish local governments[141].

Today, this cross-border expansion represents one of the more successful examples of Nordic local government software collaboration. As of 2025, the OS2borgerPC project is used by mainly public libraries in about 50 Danish local governments. About half of the local governments are organised through OS2.

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[136] OS2 – Offentligt Digitaliseringsfællesskab. (s.d.). OS2borgerPC Server Image Documentation. Available: https://os2borgerpc-server-image.readthedocs.io/en/latest/
[137] Sambruk – Ideella föreningen Sambruk. (s.d.). MedborgarPC. Available: https://sambruk.se/medborgarpc/
[138] Interview with Sambruk
[139] Interview with OS2; Interview with Sambruk
[140] Interview with OS2; Interview with Magenta
[141] Interview with Sambruk; Interview with Magenta

While the project has also recently been introduced in Sweden through Sambruk, a Swedish local government association of about 150 local governments, only two Swedish local governments have recently started to adopt the solution under the label of MedborgarPC, with an increasing number having started showing interest[142].

While the core technology is shared and is a positive example of collaboration between local governments and across borders, the collaboration has faced some organisational and governance challenges, particularly around service supplier relationships and development and maintenance models. Moreover, the association model in both OS2 and Sambruk has consistently demonstrated both strengths and weaknesses in helping local governments to adopt, maintain, and contribute to the solutions, on both the Danish and Swedish sides.

4.2.1. Key Stakeholders in OS2borgerpc and MedborgarPC

OS2: OS2 is a Danish local government association focused on enabling their members to initiate and collaborate on common software solutions, mainly in the form of open source software[143]. The association today manages 28 projects, with a secretariat providing support. They have recently pushed for more service supplier independence and transparency in development processes[144].

Sambruk: Sambruk is a Swedish association of about 150 members, primarily local governments, that co-create and co-maintain digital resources[145]. Similar to OS2, they operate on a membership model where local governments pay fees based on their population size per project that are leveraged. In the MedborgarPC project, they work directly with Magenta as a service supplier[146].

Magenta: Magenta[147] is a commercial service supplier which is the primary service supplier for both OS2borgerPC and MedborgarPC. Magenta was one of the founding members of OS2 on the service supplier side and developed the original system based on a request from the City of Aarhus. They provide the solution as a SaaS offering, handling development, security, and maintenance. They currently serve a large number of Danish local governments and have expanded to serve Swedish local governments through collaboration with Sambruk[148].

Borås Public Library: Borås City Library – located in the City of Borås, Västra Götaland County, Sweden – transitioned to MedborgarPC after years of using 'Netloan', an expensive and outdated computer management system for

[142] Interview with Sambruk
[143] OS2 – Offentligt Digitaliseringsfællesskab. (s.d.). In English. Available: https://www.os2.eu/in-english
[144] Interview with OS2
[145] Sambruk – Ideella föreningen Sambruk. (s.d.). Sambruk – Kommunal verksamhetsutveckling. Available: https://sambruk.se/
[146] Interview with Sambruk
[147] Magenta ApS. (s.d.). Magenta – Open Source Supplier in Denmark since 1999. Available: https://www.magenta.dk/en/
[148] Interview with Magenta

libraries. The library connected with Sambruk through another software project and discovered MedborgarPC as a cost-effective open source alternative[149].

4.2.2. Key Findings from the OS2borgerPC and MedborgarPC Case

Adoption and Use

OS2borgerPC emerged from Aarhus's innovative IT system and has since grown into a collaborative open source local government solution, primarily in Denmark but with recent expansion into Sweden as MedborgarPC, which collaborates informally with the OS2 association.

- Today, in Denmark, approximately 50 local governments are customers of the solution, either by participating through OS2 or operating outside the OS2 framework.
- In Sweden, the adoption is more recent, with two local governments actively using the system and several others showing interest.[150]
- To onboard local governments to the system more quickly, Sambruk worked directly with Magenta, the same service supplier who was working with local governments in Denmark.[151]
- While Denmark has a longer history with open source at the local government level, this was not as true in Sweden. Sambruk was more of a traditional local government association and its engagement with the world of open source IT has been a relatively recent phenomenon[152].

Development and Maintenance

One service supplier, Magenta, dominates the development and maintenance of OS2borgerPC across Denmark and Sweden, operating both in- and outside of the collaborative frameworks like the OS2 and Sambruk associations, despite some underlying tensions around service supplier independence and development transparency.

- Magenta serves as the primary developer and maintainer of the system on behalf of the local governments in Denmark and Sweden, who mostly collaborate through OS2 or Sambruk respectively.
- Some development is also procured directly by local governments from Magenta, which today has two developers more or less dedicated to the project.
- The development model has been a source of tension in Denmark where OS2 has pushed for more service supplier independence and transparency in development processes.

[149] Interview with Borås Public Library
[150] Interview with Sambruk
[151] Ibid.
[152] Interview with Sambruk; Interview with Borås Public Library

- Magenta, on the other hand, disagrees, noting that reuse is possible but that some local governments may not necessarily possess all required technical capabilities. In these cases, suppliers such as Magenta can provide support.
- Recently, there has been a freeze on the main codebase while these issues are being resolved by a second service supplier, with Magenta continuing development in their own fork of the project.
- That said, the development of the Swedish version, MedborgarPC, has contributed new features such as SMS authentication and appointment booking integration.

Funding and Sustainability

The funding for OS2borgerPC and MedborgarPC is decentralised, relying on association membership fees, direct local government procurement, and service supplier relationships, without a centralised funding mechanism due to the limited size of their community of practice.

- Funding for OS2borgerPC or MedborgarPC is to large degrees centralised through OS2 or Sambruk for the Danish and Swedish local governments respectively.
- Local governments can also procure directly from a service supplier like Magenta, which has reportedly become more common since the tensions increased between OS2 and Magenta on the development and maintenance efforts of the project.
- The association model works similarly for OS2 and Sambruk, though there are some small differences. A base membership fee is provided to the respective associations. An additional fee is charged for each solution a member local government chooses to adopt.
- On the OS2 side, the joint funding model for OS2borgerPC is focused on development and maintenance costs, while subscription services are managed directly between the local governments and the preferred service supplier. There is a preference from the association for a transparent pricing structure of how funds are allocated between development, maintenance, and services.
- Sambruk supports local governments working with Magenta on feature development, maintenance, and customisation.
- On the service supplier side, Magenta prefers a funding model from the local governments that incorporates continuous development and maintenance cost with the SaaS subscription. A lag in procurement requests from the local governments on development and maintenance implies a risk of the number of resources being dedicated to the project. The sustainability and quality of the project, by extension, come at risk due to the lack of continuous maintenance and oversight, and competing solutions taking ground.

Governance and Organisation

The governance of OS2borgerPC is complex and fragmented, involving multiple stakeholders like OS2, Sambruk and Magenta, with overlapping and sometimes competing coordination models across different local governments in Denmark and Sweden.

- In Denmark, a de facto dual governance structure is emerging with OS2 and Magenta facilitating and orchestrating two parts of the community of local governments, which overlaps to certain extents.
- From OS2's side, the OS2borgerPC project follows OS2's standardised governance model that they have refined through the years and applies to all of their open source projects.
- A technical steering committee performs and facilitates the collaborative requirements engineering process and procure the development and maintenance activities accordingly from the service suppliers.
- Amounts are generally below thresholds, which is why direct procurement can be applied. From Magenta's side, they serve as a focal point for its customers, coordinating requests and development efforts.
- A transfer of local governments from the auspices of OS2 to Magenta is attributed to a period of inattention from the local governments involved in OS2's governance structure.
- Today, the governance for OS2borgerPC has reportedly been revitalised, including a dedicated project coordinator helping to facilitate the collaboration.
- Between the two factions, differences relate not to just financial matters, but also issues of choice and autonomy in response to the governance of the solution itself.
- Sambruk, by comparison, has a more straightforward yet arms-length relationship with Magenta, operating primarily through a service supplier-client model while ensuring open source principles are maintained.
- The cross-border collaboration between OS2borgerPC and MedborgarPC lacks formal governance structures, relying mainly on service supplier-mediated coordination. The unique tripartite relationship between OS2, Magenta, and Sambruk creates some complicated collaboration dynamics.
- Magenta has become the hub for the development and maintenance of OS2borgerPC, while the governance is managed in clusters of OS2 and Sambruk, as well as directly by local governments through bilateral direct contacts with Magenta. This seems to work for now, but there are questions about the long-term sustainability of the model[153].

[153] Interview with OS2; Interview with Sambruk; Interview with Magenta

4.2.3. Lessons Learnt from the OS2borgerPC and MedborgarPC Case

This section summarises the key insights and takeaways derived from the OS2borgerPC and MedborgarPC case:

1. **Local governments should continuously check and review relevant projects to ensure compliance with open source principles and avoid potential lock-in effects.** In the case of OS2borgerPC, OS2 identified concerns at a late stage, prompting them to contract a second supplier for a code review. This move led to longer-term tensions between Magenta and OS2, the main service supplier, highlighting the importance of transparent and recurring reviews to build mutual trust and prevent misunderstandings. Such practices also support a more balanced competitive landscape by encouraging accountability and ensuring software sustainability, while addressing risks of dependency on a single service supplier. Local governments should generally strive to retain some technical expertise (internally or through collaborations such as OS2 and Sambruk) and introduce regular checks and reviews of open source projects to ensure commitment to open source principles and good practices. Over time, this may help to improve code quality and prevent service supplier lock-in.

2. **Procurement should consider market size and turnover in relation to the number of suppliers and service bundling, enabling sustainable business models and open source project maintenance.** A mutual understanding between local governments and service suppliers is critical to ensure competitive prices and digital sovereignty, while securing profitable business models for service suppliers, and by extension a healthy maintenance of the open source projects. One factor to consider in this balance regards the number of service suppliers that are actively procured from by the local governments, in relation to the market turnover these local governments make up. A second factor to consider is the bundling of services in the procurement from service suppliers. A separation between development and maintenance activities and operation, support and implementation-related services, as in the case of OS2, enables service suppliers to potentially focus on the latter only. A consequence is that development efforts are concentrated to one supplier, Magenta in the case of OS2borgerPC, who will have difficulty in upkeeping their engineers dedicated to the project, when development and maintenance is procured sporadically.

3. **Local governments must decide whether to take an active or passive role in the governance and maintenance of their open source projects and engage service suppliers accordingly.** Robust and active governance and coordination are crucial for the sustainable

management of open source projects. A period of inactivity from OS2's side related to OS2borgerPC led some local governments to engage directly with Magenta, bypassing community structures of the association. This undermined collaborative governance within the association itself and created divisions within the community, which should have been bound together by their participation in a collective. To prevent this, local governments must maintain clear and active communication channels and uphold consistent governance practices. An alternative approach is to outsource maintenance and continuous lower-level governance to suppliers, while still remaining active on high-level roadmap decisions and the strategic matters of the projects. The latter requires extra care in establishing transparent decision-making processes, including recurring reviews, and involving all stakeholders to ensure trust and mitigate the risks of lock-in.

4. **Including suppliers in the governance and planning process from the outset of a project promotes collaboration, awareness, knowledge-sharing, and synergies in development for PSO open source projects.** Irrespective of whether local governments must decide whether to take an active or passive role in the governance and maintenance of their open source projects, involving suppliers from the outset of open source projects has the potential to foster collaboration, awareness, and knowledge-sharing. This leads to more efficient development cycles and better project outcomes. The local governments should still ensure a safe and controlled space where suppliers are not involved. Such a space is needed to discuss procurement and higher level strategies where they as customers can talk freely and without risk of influencing or favouring certain suppliers before others.

5. **Coordinated co-funding and procurement enables a synchronised and consistent communication between users and service suppliers.** Coordinated co-funding and procurement are essential for aligning communication between users and service suppliers in open source projects. In the case of OS2borgerPC and MedborgarPC, OS2 and Sambruk implemented their respective co-funding models where fees are determined by the population size of a local government or the number of instances used. This approach helps distribute costs fairly and encourages broader adoption of both solutions across local governments and libraries. While direct procurements may be necessary to address specific development needs, as some local governments did with Magenta even though they were part of the OS2 association, such arrangements can also cause silos and disrupt community cohesion if not properly synchronised. In any case, what remains clear from the OS2 and Sambruk example is that a coordinated funding approach enables transparent communication and shared development goals, minimising conflicts and ensuring that the different stakeholders involved remain aligned around a common support model.

6. **Local governments should consider generalisability and localisation beyond local use cases early on to enable reuse, but typically require external funding to make this a reality.** While localisation to Swedish from Danish was relatively straightforward for MedborgarPC due to Ubuntu's underlying maturity, other local governments faced challenges with high customisation costs. External funding sources like national or European grants can support developing modular designs with native localisation features. By planning for generalisability early, local governments can enhance the potential scalability and adaptability of their open source projects across different administrative contexts.

4.3. Golemio: Developing and operationalising open source for Service Delivery at the City-Level in Central Europe

Golemio is a smart city data platform developed and maintained by Operator ICT[154], a joint stock organisation fully owned by the City of Prague. The platform integrates, manages, and analyses data from various urban systems, provides a comprehensive data management and analytics platform that enables B2G ('business-to-government') and G2G ('government-to-government') services in Prague and the surrounding Central Bohemia region, particularly in public transit and waste management. While it uses an Open Source Initiative-approved MIT licence[155], Golemio is heavily customised for Prague's specific needs and context. The decision to open source the code of Golemio was done largely for developer satisfaction and transparency (more on this later), and it is governed like a single service supplier open source solution, albeit one owned by a public organisation[156].

Developed with a focus on creating value through data services rather than merely collecting information, the platform functions as an intermediary between local government data sources and citizens. Its modular architecture includes integration engines, input/output gateways, and visualisation capabilities, all designed to handle complex data workflows while maintaining flexibility for evolving city needs. The platform processes both real-time sensor data and static information from various local government data sources, with approximately 70% of its use case studies focused on public transit, alongside energy consumption and waste management applications[157].

The platform emerged from Prague's Smart City Initiative in 2016-2017, when the mayor provided substantial funding for smart city development across multiple domains. Rather than centralising all smart city efforts under a single local government organisation, the city strategically launched several pilot

[154] Operátor ICT, a.s. (s.d.). Operator ICT – We are creating a new Prague. Available: https://operatorict.cz/
[155] Open Source Initiative. (s.d.). Licenses & Standards. Available: https://opensource.org/licenses
[156] Interview with Operátor ICT (Operational)
[157] Ibid.

projects, including initiatives in waste management, ‘smart benches’, and public transit. Initially, the city purchased a Cisco-based solution through a Czech business as a 1.5-year pilot project. After approximately 6-7 months, it became evident that an externally-supplied platform couldn't meet their evolving requirements due to unclear specifications and the need for continuous platform enhancement[158].

This realisation led Operator ICT to make a pivotal decision: develop Golemio entirely in-house using an agile development approach. This transition involved not only organising an internal team using Scrum methodology but also teaching city stakeholders to embrace agile, incremental thinking – moving away from long-term roadmaps toward building team capacity and delivering solutions in short iterations. Since its inception, the development team has grown to approximately 30 people, including developers, data analysts, product managers, and domain experts, working collaboratively to evolve the platform based on the city's emerging needs[159].

The primary use case for Golemio is public transit, where the platform manages data for Prague and the Central Bohemia region's integrated transport system. Operating under a three-sided contract between the City of Prague, Central Bohemia region and Operator ICT, the platform handles data from 2,000-3,000 buses during peak hours, providing real-time vehicle tracking, journey planning and analytics for public transit organisations. Central Bohemia contributes approximately one-quarter of the funding for running the platform, with Prague covering the remainder, reflecting the integrated nature of the regional public transit network[160].

Beyond public transit, Golemio supports various smart city applications including waste management, energy monitoring, and environmental sensing. The platform serves approximately 500 users and Operator ICT provides open APIs that allow external developers and organisations to access and utilise city data. This has enabled various integrations, from Google using the public transit data to students leveraging it for analysis projects. While the platform was designed primarily for Prague's specific context and requirements, Operator ICT offers consulting services to other cities interested in implementing similar data platforms, sharing experiences and approaches rather than expecting direct software reuse[161].

The case of Golemio is hard to generalise to the level of normal open source communities. However, it does demonstrate the advantages of open source software in terms of collaboration and open governance, even in case studies where the code or software is not used widely out of a single jurisdiction. Moreover, its development model offers a positive example of intra-city collaboration. Nevertheless, some challenges remain for Golemio in terms of sharing and reuse, and much of its success remains very limited and context-dependent.

[158] Interview with Operátor ICT (Operational); Operátor ICT (Technical); Interview with City of Prague
[159] Interview with Operátor ICT (Technical)
[160] Interview with Operátor ICT (Operational); Interview with Prague Integrated Transport
[161] Ibid.

4.3.1. Key Stakeholders in Golemio

Operator ICT: Operator ICT is a fully local government-owned IT service supplier responsible for delivering software and products to Prague, with a focus on building smart city platforms. They developed the Golemio data platform internally after an unsuccessful attempt to use an external Cisco solution, employing an agile approach with a team of developers and data analysts. The organisation chose to publish Golemio under an open source licence primarily to attract and retain talent, showcase their work, and create transparency, rather than expecting widespread reuse of the platform[162].

Regional Organizer of Prague Integrated Transport (ROPID): ROPID is a public service organisation (PSO) directed by the City of Prague, responsible for coordinating technical resources and supporting the transport system in Prague and Central Bohemia. They serve as an external product owner for IT systems and public transit networks, helping to set priorities, provide specifications, and validate solutions for the Golemio platform. While not deeply involved in technical development, they play a crucial role in defining requirements and guiding the platform's development from the client perspective[163].

City of Prague: The City of Prague provided the initial mandate and significant funding for the smart city initiative in 2016/2017, tasking Operator ICT with developing innovative solutions across various domains like public transit, waste management, and public services. As the primary funder and owner of Operator ICT, the city played a critical role in supporting the Golemio platform's development, requiring continuous education about the platform's value and potential beyond simple data collection[164].

Central Bohemia Region: The Central Bohemia Region is a peripheral stakeholder in the Golemio project, paying approximately 25% of the platform's operational costs and occasionally providing requirements or feedback. They are closely integrated with Prague's public transit system, with buses crossing between Prague and Central Bohemia, and benefit from the data analytics and backend services provided by the Golemio platform through a three-sided contract with Operator ICT and the City of Prague[165].

4.3.2. Key Findings from the Golemio Case

Adoption and Use

The City of Prague stands out as a proactive open source producer, strategically developing and sharing technological solutions through Golemio while fostering selective external adoption and regional collaboration.

[162] Interview with Operátor ICT (Operational)
[163] Interview with Prague Integrated Transport
[164] Interview with City of Prague
[165] Interview with Operátor ICT (Technical); Interview with Prague Integrated Transport

- The City of Prague is a producer and consumer of open source, rather than purely a consumer, or adopter, of open source – as seen in some other case studies.
- The adoption of Golemio within the City of Prague ecosystem has been driven primarily by practical use case studies, with the team deliberately taking a data-first approach focused on addressing specific local government needs rather than adhering to predetermined standards[166].
- The most substantial adoption of Golemio has occurred in the public transit space, where ROPID (Regional Organiser of Prague Integrated Transport) serves as an engaged external product owner[167].
- When it comes to encouraging other departments to use the platform, there is a necessary element of upskilling which needs to take place[168].
- External adoption beyond Prague's local government boundaries has been selective but significant, particularly with the Central Bohemia region, which contributes approximately one-quarter of the funding for Golemio's operations[169].
- Regional collaboration has been especially fruitful for public transit use case studies, with the platform providing backend services for ticketing systems and facilitating data exchange between Prague and the surrounding communities[170].
- An open API approach has fostered additional external adoption, with entities ranging from Google to local startups and student projects utilising the public transit data feeds[171].
- Despite interest from other Czech cities and regions, none outside Prague have directly adopted Golemio's code due to its customisation for Prague's specific context and the substantial investment required to implement a similar system[172].
- The development team has engaged in approximately ten different conversations with interested local governments, including discussions with German cities and the Government of Slovakia, though most of these engagements resulted in the adoption of principles and approaches rather than the platform itself[173].

Development and Maintenance

While open source by licence, the development of Golemio by Operator ICT is non-traditional from the perspective of the open source community, reflecting a strategic approach to open source in local government. The approach is characterised by internal team collaboration, a focus on code transparency,

[166] Interview with Operátor ICT (Operational); Interview with City of Prague
[167] Interview with Operátor ICT (Operational); Interview with Prague Integrated Transport
[168] Interview with Operátor ICT (Technical)
[169] Interview with Prague Integrated Transport
[170] Interview with Operátor ICT (Technical)
[171] Interview with Prague Integrated Transport
[172] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[173] Interview with Operátor ICT (Operational)

flexible development practices, and interdepartmental cooperation, rather than supporting external contributions or partnerships.

- Since 2017, the development of Golemio has been maintained by Operator ICT, with increasing support and contribution from other city departments, including ROPID[174].
- The platform was released as open source under an MIT licence though not primarily to encourage code reuse or external contributions; rather, the open sourcing decision was driven by several strategic considerations, most notably attracting and retaining talented developers who value transparency and improving code quality[175].
- The platform's open source nature has significantly influenced development practices, with the team maintaining high code quality standards knowing their work is publicly visible[176].
- While the platform is open source, external contributions have been limited, with only about ten merge requests received for minor bug fixes. This reality reflects the highly contextualised nature of the platform – while the code is open, its specific design for Prague's needs has meant that direct code reuse by other cities has been minimal[177, 178].
- The development process follows an agile methodology with sprints and iterative development, which has proven particularly valuable in the local government context, where traditional waterfall methods often struggle to accommodate evolving requirements[179].
- The horizontal cooperation between Operator ICT and other city departments like ROPID enabled collaboration without the constraints typical of public-private contracts, allowing for more flexible requirement definition and adaptation[180].
- Golemio's ongoing development and maintenance is uncommonly well-resourced for a local government open source project, with the project being managed by a dedicated team of around 30 professionals, almost evenly split between developers and data analysts/product managers[181].
- The Golemio team employs consulting external programmers through ‘body shopping’, though these contractors are fully embedded within the team rather than operating as traditional outsourcers. This integrated approach helps maintain consistency in development practices and culture[182].

[174] Ibid.
[175] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[176] Ibid.
[177] Interview with Operátor ICT (Operational)
[178] These challenges echo the work of Tosi et. al, 2015, who had noted issues related to FLOSS migration and contribution.
[179] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[180] Interview with Operátor ICT (Technical); Interview with Prague Integrated Transport
[181] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[182] Interview with Operátor ICT (Technical)

Funding and Sustainability

Golemio, primarily funded by the City of Prague with support from the Central Bohemia region, is operated by Operator ICT as a financially sustainable project that leverages OICT's joint stock company model and strategic talent management to drive sustainability and maintenance, though they sometimes struggle with salaries and communicating the value of the project.

- The financial foundation of Golemio rests primarily on funding from the City of Prague, supplemented by a significant contribution from the Central Bohemia region, which covers approximately 25% of operating costs, whereas Prague spends around 3/4[183].
- The operation of Golemio by Operator ICT is driven by a profit motive, as the company has an incentive to sell the use of the solution to new local government clients. This funding arrangement is formalised through a three-sided contract involving the City of Prague, Central Bohemia Region, and Operator ICT[184].
- Operator ICT also has other sources of revenue and operates under a joint stock company model, which has proved advantageous for them in terms of talent management, including standard business arrangements with various local government companies for specific development work[185].
- A diversified business model creates additional revenue streams to support the growth of Golemio, which is not the only project of Operator ICT, but can be considered their flagship[186].
- Attracting and recruiting high-quality developers has been central to developing and running an open source data platform for Operator ICT[187].
- They have a salary table which makes it easier to provide (better) salaries for developers and give them freedom to work on an open source project; while the salaries are a little better than what is usual for local government, the real advantage is the public interest nature of the work[188].
- One of the ongoing challenges the Operator ICT team has faced in maintaining financial sustainability has been educating city officials about the nature of platform development and maintenance costs[189]. As noted by Petrov & Obwegeser (2018), it is common that many open source companies lack financial and human resources to provide managerial support in this way.

[183] Ibid.
[184] Interview with Operátor ICT (Operational); Interview with Prague Integrated Transport
[185] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical); Interview with City of Prague
[186] Interview with City of Prague
[187] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[188] Interview with Operátor ICT (Technical)
[189] Interview with Operátor ICT (Operational); Interview with City of Prague

- The team has had to develop effective strategies for communicating the platform's value proposition and justifying continued investment, often struggling to bridge the gap between technical realities and administrative expectations in budget discussions, particularly when justifying the support for the platform to be published under and maintained under an open source licence[190].

Governance and Organisation

Operator ICT acts as an intermediary between city departments, coordinating requirements and facilitating collaboration, with a particular focus on public transit services and adaptable engagement approaches.

- Operator ICT has positioned itself as a crucial intermediary between the various parts of the city's departments. It drives and coordinates the roadmap and requirements engineering, while taking input from its various customers, weighting their needs and priorities with the bigger picture.
- The governance setup enables direct dialogues and horizontal collaboration, for example, with ROPID, to be more easily possible[191].
- Horizontal collaboration has been particularly valuable for public transit-related services, where collaboration with ROPID has resulted in an integrated approach for both Prague and the surrounding Central Bohemia region. The approach is supported by a distributed product ownership structure, with dedicated owners for both platform and public transit components, ensuring focused development while maintaining overall system coherence[192].
- The public transit sector has emerged as a particular success story, with strong partnerships enabling sophisticated data integration and service delivery. Other use case studies such as in energy and waste management, some of which are already implemented and others which are in the process of being developed[193].
- The team maintains regular engagement with stakeholders to define requirements and priorities, though the depth of collaboration often depends on the technical sophistication of the partner department and their ability to articulate clear use case studies[194]. This can be seen as a kind of open innovation organisation, as noted by Mergel (2021), wherein there is coordinated engagement with stakeholders to exchange knowledge.
- Variability in user needs within other local government departments has led to the development of different engagement models, from highly

[190] Interview with Operátor ICT (Operational)
[191] Interview with Operátor ICT (Technical); Interview with Prague Integrated Transport
[192] Interview with Prague Integrated Transport
[193] Interview with Operátor ICT (Technical); Interview with City of Prague
[194] Interview with Benedikt Kotmel; Interview with City of Prague

structured collaboration in areas like public transit, to more flexible advisory relationships in less technically mature departments[195].

- Despite some collaboration on public transit networks with the larger Central Bohemia Region that the City of Prague belongs to, actual collaboration outside of Prague and its immediate surroundings is non-existent[196].

4.3.3. Lessons Learnt from the Golemio Case

This section summarises the key insights and takeaways derived from Golemio case:

1. **The lack of an external community could pose a long-term challenge for the sustainability of an open source project.** While Golemio operates under an MIT licence, it has failed to develop a robust collaborative ecosystem beyond Prague due to its city-specific customisation and tightly controlled governance. While this is a conscious decision from Operator ICT and the City of Prague, the limited external engagement creates dependency risks on a narrow team of internal developers and funders, especially vulnerable to organisational changes at Operator ICT or shifts in political priorities. Without a stronger external contributor base, Golemio risks missing opportunities for innovation and shared maintenance burden, potentially undermining its long-term sustainability and resilience.

2. **Agile development, which is vital for development of open source, requires horizontal cross-departmental collaboration and continuous stakeholder engagement and education.** The team had to convince stakeholders to try shorter agile cycles and demonstrate value incrementally to build trust in this approach. This required teaching the city how to have an agile way of thinking rather than focusing on the short-term. The Golemio team had to demonstrate that, although agile development might seem less structured than traditional waterfall approaches, it actually provided better value and more responsive solutions for the city.

3. **Open sourcing can help with developer recruitment and code quality, even if external contributions are limited.** After thorough deliberation, Operator ICT ultimately agreed that the long-term benefits of open sourcing the code outweighed the potential risks. The interviews revealed that while Golemio received minimal external code contributions, the public nature of the code proved valuable for attracting and retaining developers. The ability to showcase their work helped with recruitment, particularly since they often couldn't match private sector salaries.

[195] Interview with Operátor ICT (Operational)
[196] Ibid.

4. **Building trust with political stakeholders takes time, but it is essential for the sustainable operation of open source solutions.** The team had to prove their value over time and build trust through delivering results by learning to communicate technical concepts to non-technical stakeholders. One key way they built trust with city officials was by working to persuade external companies to share their data with Prague. The team found that trust was built incrementally through successful delivery of smaller projects, which then enabled them to take on larger, more complex initiatives.

5. **Publicly owned service suppliers can more easily than external providers adopt an agile collaborative development process with their owners.** Operator ICT began developing a custom solution to meet its specific needs because those were not met by the previous data platform solution. The local government ownership structure allowed them to pivot more easily to an internal development team that could work more flexibly and responsively with city stakeholders. Their status as a local government-owned company provided administrative advantages, including more flexibility in salary structures and the ability to maintain specialised teams.

6. **Standards are vital for facilitating interoperability and real-world applications when using open source technologies, but they demand a nuanced understanding rather than a 'one-size-fits-all' approach.** Operator ICT monitors and adopts standards for data sharing and APIs when it makes sense, such as in public transit data, where established standards exist. In other contexts, like waste management, technologies are outpacing standardisation work, and they haven't seen a need to impose standards. They adopted a pragmatic approach, using standards where they enabled meaningful interoperability, but not letting them constrain their ability to solve local problems effectively.

4.4. Parlameter: Collaborating to adopt and reuse open source through a non-profit, supplier-driven business model in Eastern Europe

Parlameter[197] is an open source platform for parliaments. The project began nearly a decade ago in Slovenia by the non-profit *Danes je nov dan* (DJND) with a simple premise: to provide a more meaningful way of tracking and comparing the work of parliamentarians. The goal of the project was to move beyond traditional political measures which mainly gauge voting intentions and are more useful to political parties than to voters and find innovative ways to evaluate parliamentary performance in a way that directly benefits the public[198].

[197] Danes je nov dan – Inštitut za druga vprašanja. (s.d.). Danes je nov dan. Available: https://danesjenovdan.si/en/
[198] Interview with Danes je nov dan

Parlameter can be likened to the "Google Analytics for the Parliament"[199]. The project digitalises transcripts and voting records for parliaments and has, over the years, evolved into a comprehensive analytics platform for tracking parliamentary performance. The platform provides detailed analytics of parliamentary activities, such as how members vote, their meetings, and overall performance. It handles transcripts and voting records from their collection to visualisation and publishing, providing a complete solution for any organisation aiming for full transparency and digitalisation of sessions[200].

Parlameter is composed of four open source components: Parlacards, Parladata, Parlasite, and Parlassets[201]. Parlacards provide embeddable cards for Parlameter, while Parladata serves as the core data system. Parlasite includes embedded JavaScript (EJS) templates and a server for hosting the Parlameter website, and Parlassets consists of static assets for the frontend. Notably, Parlasite and Parlassets are licenced under '*The Unlicense*' [202], a template that disclaims copyright interests and dedicates the software to the public domain. This licence combines a copyright waiver inspired by the public domain SQLite project with a no-warranty statement from the MIT/X11 licence.

Parlameter initially started as a volunteer-driven initiative focused on monitoring the Slovenian parliament, with the first integration happening in 2016[203]. Over time, it has expanded to several Slovenian local governments. For example, in Ljubljana, it was first adopted at the local government level on January 18, 2022, to monitor the activities of the Ljubljana City Council. It was also adopted in 2022 in Hrastnik, Lendava (in partnership with the local media outlet Lendavainfo)[204] and Ajdovščina. Over time, the platform expanded to include the parliaments of Croatia and Bosnia and Herzegovina as well, in September 2018 and April 2019. (Efforts to implement the system in Poland and Ukraine were also undertaken, but these were eventually discontinued due to challenges in adapting the platform to the local political contexts.)

With venture funding, the project transitioned to full-time work under the non-profit organisation DJND. Translating into Today is a New Day, *Danes je nov dan*, *Inštitut za druga vprašanja* (meaning 'Today Is a New Day, Institute for Other Studies'), is a non-profit and independent private organisation established in 2013[205]. By utilising digital technologies and developing campaigns, it promotes participation in democratic processes and civic action, to foster a more just, open, and inclusive society[206]. As Parlameter was initially developed as a volunteer effort, their first major funding for the organisation itself came from the Google Digital News Initiative. This funding enabled some team

[199] Ibid.
[200] Parlameter. (s.d.). Parlameter – Making Parliaments Understandable. Available: https://parlameter.org/
[201] Danes je nov dan. (s.d.). Parlameter [GitHub repository]. Available: https://github.com/danesjenovdan/parlameter
[202] The Unlicense. (s.d.). The Unlicense. Available: https://unlicense.org/
[203] Danes je nov dan – Inštitut za druga vprašanja. (s.d.). Parlameter. Available: https://danesjenovdan.si/en/projects/?projects=parlameter
[204] Lendavainfo.com – Lendavska informativna stran. (s.d.). Lendavainfo.com. Available: https://lendavainfo.com/
[205] Interview with Danes je nov dan
[206] Danes je nov dan – Inštitut za druga vprašanja. (s.d.). About. Available: https://danesjenovdan.si/en/about/

members to leave their jobs and work full-time on Parlameter and other projects in DJND[207].

Having successfully expanded from Slovenia to other countries, driven in part by the need to secure funding, Parlameter is a successful example of cross-border sharing of open source, mediated by a civil society organisation and across multiple levels of governments. That said, the Polish version of the platform has been offline for several years due to challenges with data reliability and the need for local partners to ensure the accuracy of the data. The project continues to rely heavily on local partners especially in the non-Slovenian cases, and particularly civil society organisations who track the activities of these parliaments and can ensure the access, accuracy and relevance of data. For the local councils, such work is often considered both too expensive, or not possible due to the expertise required[208]. It's clear that for a Parlameter to succeed in any country, local expertise and oversight are essential.

4.4.1. Key Stakeholders in Parlameter

Danes je nov dan: *Danes je nov dan* is a non-profit and independent private organisation, established in 2013, that uses digital technologies and develops innovative campaigns for participation in democratic processes and civic action. The goal of the non-profit is to change society towards more justice, openness, and inclusivity. The organisation is the main service supplier behind Parlameter.

Zašto ne: Citizens' Association (CA) "Zašto ne (Why not)" is an organisation that deals with the creation of a safe, healthy, active, efficient, and responsible society in Bosnia and Herzegovina through promotion and establishment of political accountability mechanisms, civic activism, and the use of new media and technologies. It is partnering with DJND to integrate the Parlameter platform with *Zašto Ne's Javna Rasprava* platform[209]. This platform leverages an established system to improve citizen engagement, streamline access to parliamentary data, and foster greater transparency and interaction between citizens and decision-makers[210].

Ajdovščina Municipality: This Slovenian local government collaborated with DJND to integrate Parlameter as a tool for analysing decision-making data within the local government council, which is the highest governing organisation at the local level. Beyond examining council members' voting records, the system also provided insights into their meeting attendance, submitted questions, adopted legal acts, and other legislative activities[211].

DJND Volunteer Community: Organised and coordinated by DJND, many operations of Parlameter rely on a volunteer-based approach, particularly involving a community of developers and individuals from diverse backgrounds who work in a 'democracy of action' manner. These developers are often

[207] Interview with Danes je nov dan
[208] Ibid.
[209] Interview with Zašto ne
[210] Zašto ne – Citizens' Association. (s.d.). About Us. Available: https://zastone.ba/en/about-us/
[211] Interview with the Ajdovščina Municipality

professionals, sympathetic to the cause of DJND and employed as programmers who occasionally seek opportunities to contribute meaningfully to society. When they identify a long-standing feature that interests them, they request to work on it, and the task is then assigned to them while the team waits for the ticket to be completed[212].

4.4.2. Key Findings from the Parlameter Case

Adoption and Use

The adoption of Parlameter varies by local government context, requiring local civil society partnerships for data collection due to inadequate local government data publishing systems, while political support often wanes over time without clear explanation despite initial enthusiasm.

- The adoption and use of Parlameter varies depending on the specific context, particularly in terms of political perceptions and the level of involvement from the council, which typically centres around data exchange[213].
- In many local governments, local civil society organisations are needed to provide essential data for the solution. Local governments usually cooperate with a local organisation because they do not publish data in a way that would allow DJND to just absorb, transform and display it[214].
- Despite initial enthusiasm and support for the use of Parlameter, the political interest in the solution eventually shifted, with no clear explanation provided for the change in perspective[215].

Development and Maintenance

Parlameter's flexibility enables local customisation, but effectiveness varies with data quality, requiring significant manual processing in areas with poor data where civil society may intervene. Additionally, system improvements develop organically through local government-specific customisations later shared broadly, with development primarily dependent on DJND as the main service supplier supported by a small volunteer community.

- The Parlameter system's flexibility allows it to be tailored to local needs, though the quality of data across local governments varies, with some requiring substantial customisation. These situations frequently require significant manual effort and, in some cases, financial support for data processing, depending on the local organisation (a challenge as noted by Yasseen et al. (2020)).
- Local governments and parliaments working with Parlameter are frequently requesting new features from DJND to help streamline these

[212] Interview with Danes je nov dan; Interview with Volunteer Contributor
[213] Interview with Danes je nov dan
[214] Ibid.
[215] Ibid.

processes, but DJND requires a lot of effort and is heavily dependent on the local context and requirements[216]. Koloniaris et al. (2018) note how there are high rates of failure where this is the belief that support alone is sufficient to aid adoption.

- New features in Parlameter are developed organically through customisations made for individual local governments that are shared with the rest of the local governments afterwards. Local governments usually request updates to their Parlameter after noticing similar updates implemented in neighbouring areas[217].
- The features and the general technical viability of Parlameter relies solely on DJND as the main service supplier. Short-term development tasks are typically handled by paid employees at DJND, while longer-term tasks are handled in collaboration with the community[218].
- The development process is collaborative, with contributions from a small but engaged community. Communication primarily happens through Slack, and long-term development depends on the interest and commitment of contributors[219].
- The local governments take the role of the user, benefitting from the platform's continuous improvement, such as from regular updates and enhancements at no additional cost[220].
- Using the platform provides local governments with better-structured data, and better transparency towards their citizens that they prepare to be shared with Parlameter[221].
- Most developers for the platform come from the tech industry, and they are volunteers, with local governments rarely employing developers themselves. While some IT staff in local governments may have the technical skills to deploy Parlameter with limited support, this is uncommon[222].

Funding and Sustainability

DJND operates as Parlameter's non-profit maintainer with international funding, coordinating volunteer developers and providing local government implementations at costs below tender thresholds, enabling direct collaboration and regional adoption through example.

- DJND operates as a non-profit organisation, following a model where no profits are distributed to members or owners. The organisation currently employs seven full-time staff members and three part-time contributors.

[216] Interview with All Stakeholders Interview for Parlameter Case Study
[217] Interview with Danes je nov dan
[218] Interview with All Stakeholders Interview for Parlameter Case Study
[219] Interview with Danes je nov dan
[220] Interview with All Stakeholders Interview for Parlameter Case Study
[221] Ibid.
[222] Interview with Danes je nov dan; Interview with the Ajdovščina Municipality; Interview with Zašto ne

Funding primarily comes from international sources, with around 3% coming from direct donations[223].

- Acting as the sole maintainer and de facto coordinator of the Parlameter community, DJND also facilitates a community of developers. They are mostly employed in larger tech companies, who contribute to the project in their spare time motivated by the social good and societal impact of the project[224].
- Initially, DJND's first major funding came from the Google Digital News Initiative, which allowed the organisation to create a payroll and have employees[225].
- The initial local government installations of Parlameter were funded through a public call, and the funder for those was an international organisation. DJND opted for international funding[226].
- For subsequent local governments, costs are incurred for the labour involved in setting up and hosting the instance, but a significant amount of work continues to be provided free of charge[227].
- The costs for implementing Parlameter are generally low, often falling below the threshold for public tenders. This enables local PSOs to select DJND without the need for a competitive bidding process, and also allows for agile development and more direct collaboration[228]. Koloniaris et al. (2018) note how on the more technical and financial side, the most favoured factors that would lead FOSS to be successfully accepted in a local government are the low or no cost of acquisition.
- In Slovenia, while there is no collaboration or joint procurement between local governments, neighbouring local governments often adopt the system after one takes the initiative[229].
- Nowadays, funding primarily comes from international sources, with only around 3% generated through direct donations. For instance, DJND receives its funding from non-Slovenian sources, including direct contributions from individuals and companies who support the organisation’s work and values[230].

Governance and Organisation

Parlameter's democratic community of 50 volunteers, coordinated by DJND, deploys and adapts the platform locally while identifying data issues, with minimal conflict due to technical specificity and collaborative culture that empowers stakeholders.

[223] Interview with Danes je nov dan
[224] Interview with Zašto ne
[225] Interview with Volunteer Contributor
[226] Interview with Danes je nov dan; Interview with Volunteer Contributor
[227] Interview with Danes je nov dan
[228] Ibid.
[229] Interview with Danes je nov dan; Interview with Ajdovščina Municipality
[230] Interview with Danes je nov dan

- The community of Parlameter contributors consists of around 50 members, many of whom are motivated by the social good and societal impact of the project. DJND is there to coordinate the volunteers, accept their requests to work on certain aspects of the platform, and organise their communication[231].
- Volunteers often take responsibility for deploying and operating the platform, collecting and processing data from local governments, and tailoring the system to fit the local context[232].
- The work of the volunteers, and especially the local ones, helps identify inconsistencies and data quality issues, which ideally should be addressed at the source[233].
- The governance of Parlameter is democratic, with decisions made collaboratively by the community 'Democracy of Action'. While new features can be freely implemented as long as they do not interfere with the core functionality of the platform, larger changes require broad community consensus[234].
- The community maintains a positive culture, with most members being friends, fostering collaboration and reducing conflicts[235].
- Most of the topics are too technical and specific to create different opinions that can lead to a conflict. The high technical barrier to entry reduces the likelihood of general conflict and ensures that any disagreements are more likely to be limited to specific, niche cases[236].
- The community, the users and the rest of the stakeholders of Parlameter have the ability to influence the project based on their needs[237].
- The constant use of the solution contributed positively to the maturity of the users. For example, employees of various local governments became more familiar with technological terms such as 'API' and structured their data appropriately to ensure it could be used by Parlameter[238].

4.4.3. Lessons Learnt from the Parlameter Case

This section summarises the key insights and takeaways derived from Parlameter case:

1. **Without effective capacity-building, those benefiting from a service supplier's services risk becoming passive users, disengaging entirely, or failing to utilise the solution, rather than becoming active contributors.** The Parlameter study shows that while local councils find the platform useful for accessing information, they make no

[231] Interview with Volunteer Contributor
[232] Ibid
[233] Interview with Danes je nov dan
[234] Ibid.
[235] Ibid.
[236] Ibid.
[237] Interview with Ajdovščina Municipality
[238] Interview with Danes je nov dan

upstream contributions. Technical developments are managed by DJND through user requests, potentially turning beneficiaries into passive users rather than contributors. For example, in the local government of Lendava, Parlameter operations stopped due to lack of funding for local contributions to the private cooperative handling upstream work. In this way, local adoption of open source solutions should not be treated only as a tool, but as a chance for collaboration and for the development of cost-effective solutions that are customisable to local needs.

2. **Adapting a solution for local-level use often requires close collaboration with local partners, otherwise the solution can stop its operations.** Local partners depending solely on the initial development team for all technical aspects of integration and maintenance creates long-term sustainability challenges. For Parlameter, local collaborators are responsible for providing data and reviewing content, while DJND handles all technical aspects. This creates a dependency on DJND for the development of new features and customisation. The expansion to Poland was cut short because there was no local contributor and DJND could not handle the workload. This approach results in lack of expertise on the user side, potentially leading to overwork of both volunteers and developers, and poses sustainability risks if DJND's operations were to cease.

3. **Local governments struggle with both the capability to implement and the ability to adapt to the technological demands of open source software, and might benefit from a model which allows them to share resources.** The Parlameter case study shows that in Slovenia, smaller local governments often lack resources to implement independently and rely on larger local governments, limiting potential for collective innovation and customisation. Local governments tend to expect one-time purchases rather than committing to ongoing expenses like hosting and maintenance costs. Despite local government associations existing, Slovenia lacks a collective procurement model for services like Parlameter, resulting in inefficient, fragmented implementation as each local government makes adoption decisions independently. Transparency and accountability in these joint efforts can also foster a trusting relationship between local governments.

4. **Open source adoption in local governments can sometimes also encounter challenges due to a lack of willingness or inactivity from users in contributing effectively to the solution. However, the constant use of the solution can contribute positively to the maturity of the users.** The lack of local responsiveness presents significant obstacles during implementation. For example, the council members of the Ajdovščina Municipality were slow to provide essential data, such as photos and personal details, which delayed the progress and development of Parlameter. The sustainable adoption of Parlameter

depends on user contributions. To avoid adding extra workload for DJND or local community volunteers, local governments should ensure that data is properly processed after each council meeting. This requires cultural and managerial changes both technically and in internal processes which can be costly and challenging, often leading to resistance to change.

4.5. Digitransit: Dynamics of city-to-city open source collaboration and cross-border sharing in the Nordic Region

Digitransit[239] is an open source journey planner platform that integrates multiple public transit modes, including public transit, bicycles, and e-scooters. It is a journey planner, but also provides info screen services to the several cities and public transit organisations for transport and other related services[240]. It also provides third-party APIs for 10.000+ developers using Digitransit data and services for various apps, for example, map and address APIs that are free to use and leverage in various apps[241].

Digitransit is utilised by multiple local governments to provide public transit journey planning solutions. The platform is provided as a service by Helsinki Region Transport (HSL) to Fintraffic, and the local governments in Finland. The Finnish long haul bus operator and national railway operator also use Digitransit but through their own implementations of the platform, as well as being used by HSL and other regional authorities. Digitransit enables local adaptations while maintaining a shared, upstream codebase, fostering cross-border knowledge exchange and innovation. Its flexibility allows for local customisations, enabling cities to adapt the platform to their unique public transit networks and user needs[242].

The Digitransit project was motivated by the need for a flexible, open source alternative to proprietary journey planners, enabling better customisability and community engagement for local governments and regions. Its success can be attributed to the open and cooperative approach taken by the Nordic developers. These developers were instrumental in driving both community growth within Finland and international contributions. Since 2014, it has been jointly developed by Fintraffic, HSL, and Waltti Solutions.[243] The platform provides a user interface and application layer to the upstream open source trip planning engine OpenTripPlanner (OTP)[244], which calculates potential routes based on input data.[245] Map data is collected from OpenStreetMap[246].

[239] Digitransit. (s.d.). Digitransit – Journey Planning and Routing Platform. Available: https://digitransit.fi/en/
[240] Ibid.
[241] Interview with Helsinki Regional Transport
[242] Interview with Helsinki Regional Transport; Interview with Fintraffic
[243] Ibid.
[244] OpenTripPlanner Project. (s.d.). OpenTripPlanner. Available: https://www.opentripplanner.org/
[245] Interview with Entur
[246] OpenStreetMap contributors. (s.d.). OpenStreetMap. Available: https://www.openstreetmap.org/#map=7/47.714/13.349

Digitransit was initially released in 2017, following the first stable release of OTP in 2016. Since, Digitransit has evolved into a collaborative ecosystem of open source developers in Finland, and has been adopted and adapted by local governments in Estonia, Germany, and the United States as well. For example, in Estonia, Digitransit is used by the national public transit organisations, and in Germany, Digitransit was adopted by the City of Herrenberg and later by Brandenburg and Berlin, inspired by its successful implementation in Finland. Additionally, the U.S. City of Oklahoma deployed Digitransit with minor UI modifications, showcasing its adaptability to different urban contexts[247]. These international projects have highlighted the importance of maintaining upstream contributions to minimise the maintenance burden associated with forks.

4.5.1. Key Stakeholders in Digitransit

Helsinki Regional Transport (HSL) Authority: Helsinki Regional Transport is the public transit authority for the Helsinki region which plays a central role in the Digitransit platform, which it uses to offer its customers applications to plan their public transit journeys. HSL was the organisation which initiated the Digitransit collaboration, which it initially did with the Finnish Transport Agency (now part of Fintraffic). HSL continues to lead collaboration on Digitransit while equally sharing development and staff costs with Waltti and Fintraffic, as well as contributes other data of its own to the platform and ensures its integration with other public transit services[248].

Fintraffic: Fintraffic is a state-owned company in Finland which is responsible for traffic management and control across various public transit modalities, and it acts as a National Access Point (NAP) where mobility providers are required to share their data. The mobility data, both static and real-time, can then be accessed via Digitransit, mainly targeting producers and developers of third party mobility services. In practice, Fintraffic's data department is the main one that works with Digitransit, and they share budget and development costs for Digitransit with HSL and Waltti Solutions. Through their collaboration, Fintraffic (amongst other things) provides data, helps build info screen services, and supports data integration for local journey and route planners[249].

Waltti Solutions: Waltti Solutions Oy is a service supplier organisation that is owned by the Helsinki Regional Transport local government regional authority and 22 urban regions and acts as a partner for IT projects related to public transit in its owner local governments. As part of its mandate, Waltti provides a unified ticketing system used across multiple Finnish cities and regions outside the Helsinki area. To do this, they integrate with Digitransit to provide complementary ticketing services for the journey planning platform. They have a jointly funded product owner and development team with HSL that helps to share costs and development[250].

[247] Interview with Digitransit Community
[248] Interview with Helsinki Regional Transport
[249] Interview with Fintraffic
[250] Interview with Helsinki Regional Transport; Interview with Fintraffic

Entur: Entur AS is a government-owned public transit organisation in Norway which provides Norway's national journey planner. It is owned by the Norwegian Ministry of Transport and Communications and has a subdivision which functions as a service supplier for the national journey planner, through which it collaborates extensively with the OTP community, and by extension Digitransit. They share some technological approaches, data standards, or development resources with Digitransit as part of a broader Nordic cooperation in public transit information systems. Much of the collaboration happens around Digitransit's use of OpenTripPlanner, which Entur helped to bring together and maintain the second version of[251].

OpenTripPlanner (OTP) Community: An open source community that develops the core journey planning software that powers Digitransit. This community consists of developers who contribute to maintaining and enhancing the routing engine that enables multimodal trip planning functionalities in Digitransit. Entur was responsible for helping to update the OTP software and released another version in 2017[252].

4.5.2. Key Findings from the Digitransit Case

Adoption and Use

Digitransit's adoption varies by region, with Finland establishing it as a national standard thanks to strong public-sector support and integration with other open source tools. Ongoing hurdles include a lack of commercial support, maintenance difficulties for smaller local governments, and insufficient documentation, but the open-source model remains a key driver of its success.

- Digitransit has spread differently across regions, in large part due to a flexible and adaptable design that is well integrated with other open source solutions, like OTP, which are used in many other jurisdictions.
- Across Finland, Digitransit has become the go-to national standard for journey planning, seamlessly connecting multiple cities and public transit types, and HSL keeps the whole system running smoothly[253].
- As initially demonstrated by Yaseen et al. (2020), the open source approach and technology taken by the Digitransit community in the national government seems to have been positive for smaller local governments, letting them customise public transit solutions without getting trapped in proprietary systems[254].
- Despite its widespread use and adoption across Finland, there's still a lack of commercial support options outside government, which creates a real challenge for long-term sustainability.

[251] Interview with Entur
[252] Interview with Digitransit Community; Interview with Entur
[253] Interview with Helsinki Regional Transport
[254] Ibid.

- Some commercial usage is reported, but the knowledge to what extent is limited[255].
- The City of Herrenberg, Germany pioneered an implementation there, as a strategic move to avoid service supplier lock-in[256].
- While initially successful, the Herrenberg installation eventually hit roadblocks due to short-term funding cycles and not enough maintenance resources, ultimately stalling out[257]. This shows the short-term attitude towards open source adoption, highlighted by Koloniaris et al. (2018) and others, which is insufficient on its own.
- This lack of long-term planning and funding was not true in Finland, which could perhaps be attributed to a number of factors such as a smaller population, cultural cohesion, or even a different attitude towards IT development.
- Ongoing maintenance remains challenging, even in the Finnish context, as many smaller local governments simply lack the technical know-how and funding to keep things running smoothly over time[258]. This is consistent with the literature, which often points out challenges related to service supplier lock-in and high maintenance costs.
- The community has stepped up to help address some of these challenges. For example, HSL developers provide support through an active Slack channel[259].
- Documentation continues to be a pain point, with multiple interviewees highlighting the need for better onboarding materials to help newcomers get up to speed[260].
- Despite some of these challenges, it is clear that Digitransit has taken off and been adopted because its technology approach works, and it is built on top of an established open source community.

Development and Maintenance

Digitransit's development is primarily driven by HSL, Fintraffic, and Waltti Solutions, with strong dependencies on the OpenTripPlanner community – especially Norway's Entur – while external contributions (though rare) face challenges in alignment and integration. Despite structured workflows and open discussions, incorporating community-driven changes remains a slow and resource-intensive process.

- Digitransit's development and maintenance is sponsored by a core group of three actors: HSL, Fintraffic and Waltti Solutions. HSL largely drives Digitransit's development and maintenance, with a dedicated set of

[255] Interview with Fintraffic
[256] Interview with Digitransit Community
[257] Ibid.
[258] Ibid.
[259] Interview with Fintraffic
[260] Interview with Digitransit Community; Interview with Helsinki Regional Transport

coordinators and internal team working alongside coordinators and/or consultants from several external companies[261].

- A lot of the Digitransit development is dependent on working with the OpenTripPlanner community and relies on contributions from Entur – the Norwegian state-owned public transit company and maintainer of OTP – and others in the OTP community[262].
- During the first version of OTP, there were several issues requiring extensive customisation of the Finnish Digitransit solution. Beginning in 2017, OTP 2.0 was released after a major revision by Entur, which had – amongst other things – a new algorithm, a different search logic, and a more modular design[263].
- HSL is able to contribute upstream directly to the OTP project, and thereby minimising technical debt, and ability to stay up-to-date with the latest releases of OTP[264].
- For Digitransit, external contributions are less common. One notable exception comes from Germany, where local entrepreneurs have developed features like car-sharing and multimodal public transit planning to meet specific needs in German cities[265].
- Getting contributions merged upstream to Digitransit is a challenge. In the German use case, this happened due to misaligned priorities between HSL and City of Herrenberg, as well as funding constraints[266].
- Digitransit's development follows a structured workflow. Monthly meetings tackle key development topics, while biweekly sprint and demo sessions allow stakeholders to prioritise and review new features[267].
- The broader community can suggest features and join technical discussions via Slack, but integrating community-driven changes into the core platform tends to be a slow, resource-intensive process[268].

Funding and Sustainability

Digitransit's financial sustainability is ensured through a state-subsidised three-way funding model between HSL, Fintraffic, and Waltti Solutions, covering core development but requiring local governments to fund additional features. Long-term sustainability is also tied to the OpenTripPlanner project, which faces its own financial uncertainties, although a dedicated service supplier could help with governance and cross-border adoption.

- Digitransit's financial sustainability relies on a joint annual budget split equally between Fintraffic, Waltti Solutions, and HSL. Each organisation

[261] Interview with Helsinki Regional Transport; Interview with Fintraffic
[262] Interview with Entur
[263] Ibid.
[264] Interview with Helsinki Regional Transport
[265] Interview with Digitransit Community; Interview with Helsinki Regional Transport
[266] Interview with Digitransit Community
[267] Interview with Helsinki Regional Transport; Interview with Fintraffic
[268] Interview with Fintraffic

provides one-third of the total cost, ensuring baseline development and maintenance[269].

- As the funding is entirely subsidised by the state and the three-way arrangement between these three actors, they have not had to give consideration to future arrangements to ensure the sustainability of the codebase[270].
- The three-way funding model between HSL, Fintraffic and Waltti is mainly dedicated to funding core functionality and main use cases. For example, if a local government wants something beyond the agreed scope, they need to secure their own funding to cover development costs[271].
- In Germany, funding constraints created challenges for maintaining Digitransit implementations. Cities often secure short-term grants to kickstart digital projects but lack ongoing support to sustain them[272].
- Many Digitransit instances have been left to languish without active maintenance. The Herrenberg project, for example, received initial funding for just a few months, requiring a rushed implementation. After deployment, there was no real plan for continued support, leaving the system to grow outdated and neglected[273].
- Digitransit's funding and sustainability is, in part, dependent on the OTP project. OTP is de facto maintained by Entur, which provides a substantial part of the financial support for maintaining the OTP codebase, although 80% of development is today mainly coming from the broader community[274].
- Entur itself as a PSO struggles to create financial sustainability for OTP that could create downstream issues later for projects like Digitransit, which are dependent on it[275].
- A dedicated service supplier offering commercial Digitransit support – similar to OpenTripPlanner's approach – which could support work both within Finland and abroad. This approach could help solve some of their challenges related to governance and organisation, which influence the development and maintenance of Digitransit[276].
- No concrete steps have materialised yet for explicitly creating or empowering a foundation that can help with cross-border implementations of Digitransit. The focus remains on making the Digitransit collaboration model financially viable and sustainable in Finland[277].

[269] Interview with Helsinki Regional Transport; Interview with Fintraffic
[270] Ibid.
[271] Ibid.
[272] Interview with Digitransit Community
[273] Ibid.
[274] Interview with Entur
[275] Ibid.
[276] Interview with Helsinki Regional Transport; Interview with Fintraffic; Interview with Entur
[277] Ibid.

Governance and Organisation

Digitransit's governance is structured yet centralised, with HSL, Waltti Solutions, and Fintraffic collaboratively shaping its direction through a consensus-driven process. That process is beneficial but can slow feature integration and make external contributions difficult, suggesting a need for more inclusive governance as the platform expands beyond Finland.

- Digitransit's governance structure is organised yet complex, involving multiple stakeholders across different regions. The core governance team includes representatives from HSL, Waltti Solutions, and Fintraffic. This three-way structure ensures collaborative decision-making, with each organisation shaping the platform's strategic direction[278].
- Each year, service coordinators from the three core organisations put together a roadmap of proposed developments, but they also meet regularly. In both the roadmap and regular meetings, representatives from each organisation review proposals and ideas for ongoing work[279].
- New features typically get evaluated based on their business case and alignment with Digitransit's strategic goals[280].
- While designed to be inclusive, the process often involves compromise, as major decisions require unanimous agreement. Decision-making following such a structured process, consensus-driven approach between multiple parties can slow down new feature integration[281].
- Despite an active community of users and developers, external contributors often struggle to navigate the governance structure, which is highly centralised and focused on Finnish use cases. Digitransit remains largely controlled by Finnish stakeholders[282].
- While the governance is well-suited for the needs of a local government project – and it is part of an established open source community (OTP) – it is not set up to receive external contributions through open source governance.
- Digitransit has maintained a strong commitment to open source principles, enabling local governments to leverage and customise the platform for their needs.

4.5.3. Lessons Learnt from the Digitransit Case

This section summarises the key insights and takeaways derived from Digitransit case:

1. **Multi-stakeholder governance models without clear ownership structures can create challenges for governance of open source**

[278] Interview with Helsinki Regional Transport; Interview with Fintraffic
[279] Ibid.
[280] Interview with Fintraffic
[281] Ibid.
[282] Interview with Digitransit Community

development. The Digitransit case reveals how a three-way governance structure between HSL, Fintraffic, and Waltti Solutions introduced complexity that limited external contributions, with decisions requiring unanimous agreement creating bottlenecks in the development process. The contrast with OpenTripPlanner's more streamlined governance highlights how governance structures directly impact project sustainability and external participation. While OTP successfully attracted international contributions, Digitransit struggled to cultivate a similar contribution ecosystem despite its usefulness, suggesting that complex governance can create high barriers to entry that discourage potential contributors.

2. **Cross-border collaborative development requires proactive engagement with, and contribution to, upstream communities and dependencies.** The Digitransit case study demonstrates how open source solutions can create thriving ecosystems that transcend national boundaries. The relationship between Helsinki's Digitransit platform and the upstream OTP project illustrates a successful model of collaborative development across international communities. The Norwegian experience with OTP shows how professionalising open source governance—through regular developer meetings, clear contribution processes, and consensus-based decision making—has strengthened the entire ecosystem, benefiting all downstream implementations including Digitransit.

3. **Cross-border open source communities need to be responsive and helpful to both new and existing users and contributors.** Digitransit's early success was driven by Finnish developers' proactive engagement, fostering collaboration and community ownership within Finland. However, expanding internationally has highlighted the challenges of maintaining responsiveness across different cultural and structural contexts, a common issue for public-sector-led open source projects. The Herrenberg experience shows that even with enthusiastic contributors, structural support and clear contribution pathways are essential for long-term success. To scale effectively, a stronger governance model with tiered support or funding mechanisms may be necessary, similar to OTP, which provides guidance but faces its own sustainability challenges.

4. **Developing documentation and onboarding processes that lower barriers for newcomers, particularly local governments, is vital for adoption.** Some new contributors to Digitransit struggled due to limited documentation, which created challenges for cross-border implementations, as seen in Herrenberg's case, where rapid deployment prioritised speed over maintenance and contribution. Even with good documentation, unclear contribution pathways can lead to fragmentation and duplicated effort, particularly for local governments lacking dedicated

development teams. To prevent isolated implementations, open source projects must provide both strong onboarding materials and a clear, accessible process for contributing back to the core project.

5. **Standards enable broader adoption and reuse of solutions in other contexts, or migration to a different platform.** Open standards are crucial for ensuring interoperability, facilitating integration with other systems, and enabling local government actors to benefit from economies of scale and established communities of practice. Digitransit's use of OpenTripPlanner and OpenStreetMap demonstrates how open standards support cross-border sharing, interoperability, and scalability. However, challenges remain, as seen in the difficulty of integrating Finnish adaptations into OpenTripPlanner and the fact that variations in implementation can still create barriers. This highlights the fact that open standards alone are not a silver bullet and makes plain that strong community governance and clear contribution guidelines are essential.

6. **Scalability and localisation are important to make open source projects easily adaptable to local contexts and requirements.** Digitransit demonstrates the importance of balancing scalability, localisation, and ensuring growth without compromising performance, allowing local governments to adapt the system to their needs. Left unchecked, local adaptations can lead to a fragmented codebase, as seen with the challenges in Germany, where cultural context and maintenance complexities resulted in forks. A modular architecture – coupled with strong governance – could help manage these tensions, enabling local adaptations while preserving the integrity of the core project and supporting long-term sustainability.

5. Open source collaboration archetypes: considering the local government, community, and supplier perspectives

Open source technology in local government contexts constitutes a complicated but exciting laboratory for innovation and collaboration related to open source. However, there are persistent challenges that are common for any PSO working on such technologies. Across Europe, cities and regions, like those highlighted in the case studies of Section 4, have embarked on ambitious digital initiatives that reveal the intricate dynamics of technological development, local governance, and community engagement.

Building on the insights gained from these case studies, this section presents open source collaboration archetypes based on three different perspectives regarding local government open source collaboration: the *local government perspective*, the *community perspective* and the *supplier perspective*. These archetypes exemplify how various actors collaborate to support the adoption, development, funding, and governance of open source in local government. They are intended to highlight how the different perspectives on local government open source collaboration are put in practice and help readers to better understand and lift lessons learnt from each of the case studies in Section 4 (see Section 6 for these lessons).

This section starts by presenting the different perspectives on open source collaboration and then briefly analysing the case studies from Section 4 from each of those perspectives. It then moves on to present a taxonomy of different local government-, community- and supplier-based archetypes that have been identified from the list. The list is based on the sample of five projects/collaborations and the 23 interviews done across those case studies. This taxonomy is therefore not exhaustive, but offers an initial taxonomy that we hope can be refined through further research and inquiry. Also, readers should vary that any simplification comes with its limitations, why the archetypes may not always be mutually exclusive pending the case and context.

5.1. Overview of selected case studies through local government, community, and supplier perspectives

The case studies of Consul Democracy, OS2borgerPC/MedborgarPC, Golemio, Parlameter, and Digitransit offer diverse perspectives on local government open source collaboration. To begin drawing out some common lessons from those case studies, this subsection first introduces the three perspectives: *local government*, *community* and *supplier*.

As will be noticed in subsequent sections, all these different perspectives may necessarily apply and be combined based on the circumstances to understand

a given collaboration, for example, the case studies featured in Section 4. For example, in the case of Consul, you can understand Consul from a local government perspective (for example, the City of Munich), from a community-based organisation (for example, the Consul Democracy Foundation), and from a supplier perspective (for example, Code for Romania/Commit Global). What follows is a summary of those perspectives, featuring key insights from the case studies.

5.1.1. Local government perspective: responding to diverse contexts, needs and challenges, and levels of capability

Local governments usually each have their own goals and strategy for leveraging open source. Local governments approach open source initiatives with remarkably diverse strategies and motivations, often driven by different contexts, needs, challenges, and levels of capability[283]. For example, the City of Munich's long-standing engagement with open source, as made evident by the formation of its OSPO in 2024 and its support for Consul Democracy, stands in stark contrast to the City of Prague's more selective use of open source technology in support of its workaround data analytics and data-driven decision-making. In this way, each local government experience reveals a unique negotiation between local technological needs and broader collaborative potential.

A few of the key findings around the importance of the local government perspective in understanding open source development and reuse in European local governments has been presented below. What follows situates the findings in the case studies presented in Section 4. While not exhaustive, the list should provide a useful foundation for beginning to think about the importance of when and how local governments adopt, reuse, and contribute to open source projects and ecosystems.

1. **The size of local governments impacts the approach and opportunities for open source adoption.** Context is an important factor in determining local government participation. A big factor driving local government participation is size, though this cannot be concluded as being determinative on the type of approach they take. In cities like Prague, Helsinki, Madrid or Munich, there are resources and capabilities to initiate and scale open source options to the otherwise dominant proprietary solutions, offering more flexibility and control, as well as an exit strategy. By comparison, with smaller towns/cities, for example, local governments in Denmark, Sweden or Scotland – or local town councils in Slovenia and Romania – there tends to be a more opportunistic embrace of open source which is both dependent on and driven by the benefits of collaboration and the associative model. There are also many examples of cities which sit in-between these two sizes, or for which their size doesn't determine the experience, but nonetheless this constitutes a

[283] Cf. Koloniaris et al. 2018.

general trend from the case studies.

2. **Local government open source solutions vary in scale and focus, depending on their needs and ambitions.** Another factor is local needs and challenges, which are often an important way of understanding what drives local government participation. Prague's Golemio platform exemplifies this local government-driven approach most dramatically. The city invested significant resources into creating a highly customised data platform addressing specific urban challenges in public transit, waste management, and city services. This was similarly true for the Helsinki region, which needed to build a public transit system that worked for its citizens and looked to open source tooling and principles to help them accomplish their ambitions. These investments highlight a spectrum on the scalability and generalisability of local government open source initiatives: from solving immediate local problems towards creating broadly applicable technological solutions on a national level.

3. **Similarities in language, culture, and ways of working usually ease cross-border collaboration.** Culture and language is another driving indicator of open source reuse. In Denmark and Sweden, there was a relative similarity and proximity of language, culture, and ways of working which made it easy to collaborate on and share solutions across borders. In the case of Digitransit, however, challenges in collaboration across borders were compounded by insufficient governance mechanisms as well as different approaches to localisation. Consul Democracy struggled a little bit to maintain and lead a diffuse network of PSOs across Europe who were working in different cultural contexts, while the Parlameter community, driven by the non-profit Danes je nov dan, had a relatively easier time in working with local governments with different levels of capacity thanks to a sensitivity to local culture and adoption dynamics.

4. **A focus on open source collaboration is dependent on local governments' capabilities and interest.** Cities also have different levels of capability more broadly. The implementation experiences across different regions demonstrate the complex dynamics of technological adoption. Smaller local governments like Ajdovščina in Slovenia primarily valued technological functionality, while simultaneously revealing how local decision-making can both enable innovation and create barriers to broader collaboration. Larger cities like Munich emphasised the importance of contributing back to project sustainability, while other local governments, often those participating through an association model, seemed to view open source solutions more as consumable services than collaborative platforms.

5. **Open source software can be considered differently by actors collaborating together on the same project, entailing different strategies and needs.** It can be important to consider open source both as a collaborative venture and a service among many. Cross-border initiatives like OS2borgerPC reveal particularly nuanced perspectives on drivers and strategies for collaboration and reuse. Danish and Swedish local governments approached the OS2borgerPC/MedborgarPC platform with distinctly different concerns. Danish local governments focused intensely on pricing and service supplier lock-in, while Swedish counterparts prioritised procurement flexibility and technological adaptability. Helsinki Regional Transport's approach to Digitransit further illustrates these complexities. The project emerged as a government-driven open source initiative, bringing together multiple public transit organisations. Yet, even in this collaborative environment, local governments often viewed the solution more as a service than the City of Helsinki, which viewed it more as an active open source project. This dynamic exposes a broader tension in local government technology adoption: the challenge of moving beyond consumption to genuine collaborative engagement.

6. **Community support structures need to scale along with the open source project.** What is clear is that the challenges and strategies for supporting local government adoption and reuse of open source changes as communities grow and evolve, but especially when they begin to collaborate across borders. That said, the collaborations that reach that point tend to be ones that start by solving local challenges and then share those lessons learnt internationally. For example, Consul Democracy worked by trying to solve local challenges in Madrid and then expanded internationally as a result of its utility, but challenges in making it work in places like the City of Groningen show the need for sensitivity in how foundations, stewards, and others support those local governments. Local governments need to keep this level of maturity of the community in mind as they seek to begin a collaboration.

5.1.2. Community perspective: structures, dynamics, and engagement

Both the role of the community and how potential community support structures themselves vary dramatically for open source initiatives in the case studies. In this sense, considering the perspective of communities reveals the intricate challenges of sustained open source collaboration in local governments. For example, Consul Democracy experienced particularly complex community dynamics. For an extended period, the absence of a structured community meant feature development occurred in an ad-hoc and patchwork manner. The Consul Democracy Foundation attempted to centralise community governance, but struggled with diminishing support, especially during the COVID-19 pandemic. For this reason, it is important to consider the role of different and

overlapping communities in a given open source project, as well as the presence of different open source projects in a given local government.

A few of the key findings around the importance of the community perspective in understanding open source development and reuse in local governments has been presented below. What follows situates the findings in the case studies presented in Section 4. While not exhaustive, the list should provide a useful foundation for beginning to think about the importance of when and how communities intersect with the goals of local government open source projects.

1. **Communities develop as the project's complexity increases with the number of participating public organisations, across jurisdictional borders and levels of government.** As open source projects grow and develop – whether driven by the local government, community participants or suppliers – communities of practice naturally emerge and can take many different shapes and forms. Sometimes, when projects emerge organically through local government innovations, like in the case of Consul or Digitransit, communities naturally surface because others become interested in leveraging or contributing to a project. Other times, when driven by suppliers, either within or outside of governments, communities are more carefully curated with a single organisation acting more as an intermediary. Beyond a certain point of growth, an external Open Source Steward[284] is often needed to host a project and enable its governance and collaboration. In the case of Consul, this came with a public foundation, while Digitransit does not yet have a foundation or single service supplier (in comparison to OTP, which it is dependent on). Sometimes, natural stewards – like OS2 or Consul Democracy Foundation – can come into conflict with service suppliers, creating fragmentation in the community, governance, and even technical development of a project.

2. **International foundations strongly support the growth and institutionalisation of open source projects across borders.** The Consul Democracy Foundation came together when support for the Consul project began to wane in the City of Madrid. The foundation has struggled, given the rapid growth and decentralisation of the Consul community, to "bring it back together" and maintain a single branch of the codebase and create a model for funding and sustainability, something it is now working on. Digitransit's community ecosystem presents another unique model. While primarily driven by Helsinki Regional Transport, the project benefits from collaboration with other Finnish transit organisations and global contributors to underlying technologies like OpenTripPlanner and OpenStreetMap. However, the community remains relatively closed, dominated by PSOs and limited by the project's specific focus on Finnish public transit needs. Moving forward, a foundation that can act as a

[284] The term Open Source Steward was introduced by article 18 in the Cyber Resilience Act, and is adopted in this report to refer to organisations that provide hosting of open source projects on behalf of its owners, or members, and caring for the projects' long-term sustainability.

single service supplier could be important for the project. In the case of Parlameter, there is a service supplier which is a civil society organisation that is de facto acting like a foundation, albeit primarily based on technical activities.

3. **Communities can improve a project's sustainability by lessening dependencies on single organisations, and helping to pool resources and funding.** The OS2borgerPC and MedborgarPC initiative revealed particularly interesting community dynamics through its various organisational structures. In Denmark, 42 local governments are actively using OS2borgerPC, of which half are organised under OS2's umbrella, and the other through direct bilateral ties with the main service supplier of the project. The Swedish counterpart, Sambruk, serves approximately 150 local government members, though this specific project is active in only two local governments. Similarly, COSLA, the association of Scottish local governments that have adopted Consul, shows how associations incentivise adoption and promote knowledge-sharing and collaboration. Entur, the maintainer of OpenTripPlanner, also shows how community actors can naturally emerge and support local government adoption and reuse, even if they do not steward an entire project built on top of their codebase. These structures demonstrate how community engagement can be mediated through complex organisational frameworks.

4. **Community is important but it is not the sole success factor of an open source collaboration.** While one of the main benefits of open source licensing is the way it enables collaboration between communities, it can also help improve collaboration within a community, which is good for breaking down silos and improving local government service delivery. For example, the Golemio platform arguably represents the most limited community engagement. Despite being open sourced, the platform received merely ten merge requests, with few external contributions or widespread adoption. The project's primary goal of providing transparency, and potentially inspiring other local governments, failed to generate significant community interest. However, it had success in bringing together different departments in Prague to collaborate on and leverage the analytics from a common project. Similarly, while Digitransit had less success internationally, it was very successful in bringing together different stakeholders – HSL, Fintraffic and Waltti – to collaborate towards a common goal within both the City of Helsinki and other local governments across Finland.

5.1.3. Supplier perspective: balancing innovation and sustainability

Supplier perspectives collectively demonstrate that local government open source initiatives require far more than technological expertise. The supplier

dynamics across these case studies reveal profound tensions between open source principles and business sustainability. Each project navigated these challenges through unique approaches that highlight the complexity of local government technology development. For example, Code for Romania emerged as an exemplary model of supplier engagement. The organisation provided non-profit development services with an approach emphasising capacity-building and knowledge transfer. In this way, considering the supplier perspective demands nuanced understanding of local contexts, ability to balance community needs with business sustainability, and flexibility in approach.

A few of the key findings around the importance of the supplier perspective in understanding open source development and reuse in local governments has been presented below. What follows situates the findings in the case studies presented in Section 4. While not exhaustive, the list should provide a useful foundation for beginning to think about the importance of when and how local governments adopt, reuse, and contribute to open source projects and ecosystems.

1. **The function (for example, role, tasks, etc) of a service supplier does not necessarily need to be performed by a private company or service supplier.** Many civil society organisations, including DJND (the maintainer of Parlameter) and Code for Romania (a systems integrator for Consul), have registered non-profit status and different business models from the extractive ones of many private companies, which local government entities are often accustomed to. Sometimes, associations like COSLA can also function as de facto service partners, providing technical and administrative support in configuring and maintaining local instances of open source. Even quasi-public IT companies, like the joint stock, local government-owned IT company Operator ICT in the City of Prague, can be service suppliers. There are different models for thinking about what a service supplier is, and these are just some examples.

2. **Conservative culture and procurement practices inhibit open source adoption, and suppliers can help provide the necessary elements to bridge the gap.** In many cases, local governments – including, for example, the City of Prague for Golemio or the City of Munich for Consul – are cautious or sceptical in supporting a given project or collaboration. In those cases, a service supplier, whether publicly owned or privately provisioned, can help inform local governments while building in the sense of reliability they expect from a traditional procurement process.

3. **Service suppliers are important for local governments with less capacity.** In the OS2borgerPC case, Magenta plays a pivotal role in providing technical resources, which the local governments involved in Sweden and Denmark generally are missing. In the case of Parlameter, local governments are typically dependent on local civil society organisations and volunteers in implementing the platform. Commonly, this is also done on the latter's initiative. The case of Code for Romania and how it supports adoption of Consul illustrates, in turn, how civil society organisations can initially support local governments in the adoption of open source solutions, and with time can help transfer the operation of it to the local governments.

4. **Suppliers have different levels of involvement in the governance and planning of open source collaborations.** In the case of Consul, service suppliers filled a critical gap in technical capacity in governments, as the community became highly decentralised in the post-COVID period. In the case of OS2borgerPC, the deep involvement of Magenta signals how outsourcing or not paying attention to governance can risk leading to soft lock-ins to service suppliers, and render ruptures and friction in communities. HSL describes the lack of service suppliers related to Digitransit as a risk for community growth, as they themselves do not have the resources or business model for providing such support beyond current levels.

5. **Public service suppliers or operators may function as a steward on behalf of its owners, and represent a potentially positive path forward.** Operator ICT's approach with Golemio was particularly innovative. Initially attempting to use an external solution, the local government-owned company transitioned to entirely in-house development. Their decision to open source the platform was primarily motivated by developer recruitment and code quality improvement, rather than widespread adoption. In the case of Digitransit, while HSL was not a service supplier as such, it acted like one in practice, even if it represented the leading department in a multi-organisation collaboration. Having this leading voice to forge the partnership helped, though in that case they were disadvantaged by not having a sole maintainer.

5.2. Local government-based archetypes

5.2.1. External capabilities

Local governments are historically reliant on the outsourcing of technical capabilities and digital solutions, for example, to enable them to focus on the core business of producing and delivering public services to their local populations[285]. This was also reflected in the case studies, as most of the local

[285] Cf. Koloniaris et al. 2018; Yaseen et al. 2020.

governments were reliant partly, though to widely varying degrees, on external capabilities outside of the direct control of the local government and its employees.

Many of the local governments surveyed, directly or indirectly, through the case studies, exemplify how proxy and umbrella organisations such as international foundations or national local government associations can be used to develop joint capabilities. Still, even in these cases, development is often procured through external service suppliers.

COSLA provides a counter-example as they maintain internal development capabilities to tailor the Consul based on the needs of their members. In the case of COSLA, they function as a sort of de facto service supplier to the local governments, providing limited support from (limited) central staff and a small roster of largely part-time consultants. Nevertheless, they do manage to do much of the work as a public association that a service supplier would do. OS2 functions in a sort of similar way, though the dynamics of collaboration between OS2 and Magenta, a service supplier, create friction.

Outsourcing of technical expertise and development resources also occurs for resourceful local governments such as the City of Munich. While residing over internal development teams, the city relies on an external supplier for the development, maintenance, and operation of the Consul platform. One reason refers to the fact that Consul is written in a programming language outside of the internal developers' expertise. They also prefer the reliability that comes from working with an external partner that is an engaged member of the Consul ecosystem, which may also improve chances of any development benefiting the larger community. Additionally, the work of the Munich OSPO is somewhat separate from other technical development work done in the city.

By growing and maintaining external capabilities, either collaboratively or alone, local governments are enabled to both initiate new, or adopt existing open source projects for addressing their internal needs. This helps strengthen these collaborations and make them adoptable and maintainable over the long-term, and can even lead to productive and mutually supportive relationships that are not solely profit-seeking.

5.2.2. Internal capabilities

Internal capabilities are those which are provided directly through the capacity and contributions of the local government, whether for community support, technical development and maintenance, or project management and generalised support.

The otherwise general reliance on outsourced external capabilities and expertise is challenged through a number of local government examples among the case studies. These examples come from resourceful local governments, both with technical capabilities, and a leadership that supports their long-term growth and availability.

For example, the City of Munich has followed the trend in other cities such as Paris and established its own OSPO. While the OSPOs in the City of Munich are limited to one individual only, they provide an internal voice of reasoning and interface between internal stakeholders and the external open source ecosystem. By maintaining their own dedicated budget, they can further help to integrate the local governments' key open source projects by influencing their roadmaps and supporting their sustainability, again exemplified by the City of Munich in relation to the Consul project.

The City of Madrid and the Consul project is further an example of how an organisation on its own can build an open source solution and scale an international community through its own resources when motivated by a political will. The case also shows the fragility of political will, and the need for external support for ensuring the sustainability of concerned projects. Decidim illustrates a similar example coming out of the City of Barcelona.

By continuing to expand and refine internal capabilities, local governments become better positioned to adopt and contribute to open source projects and ecosystems, as well as do the ongoing support and maintenance work required for addressing their internal needs, even in cases where they cannot do the bulk of upfront or ongoing development and maintenance work.

5.2.3. Quasi-internal capabilities

The technical capabilities of a local government cannot always be said to be directly internal to the local government but can instead be considered quasi-internal, by nature of cooperation with quasi-public organisations such as joint stock companies or quasi-public organisations owned or subsidised by the local government, usually with high degrees of knowledge sharing.

Some of the case studies point to open source collaborations that, from the perspective of a local government, cannot be understood as being solely dependent on internal or external capabilities, but instead on capabilities which blur the lines between the two.

The City of Prague, in particular, adds nuance and substantiation to this claim, as they have chosen to grow their technical capabilities and open source development through a separate, yet fully local government-owned service supplier, Operator ICT. The separation enables a talent attraction, and an open and agile way of working, otherwise considered impossible within the local government, according to the interviews. Additionally, the case of Digitransit shows how HSL, a local government organisation, can collaborate with private or quasi-private entities, including Fintraffic and Waltti, to develop and maintain an open source project in the public interest.

Developing innovative models for combining or amplifying the work of internal capabilities can be a valuable way for open source projects to flourish in the local government, and more experimentation can be seen as a desired outcome for the landscape of local government open source innovation in Europe.

5.3. Community-based archetypes

5.3.1. International foundation

When open source projects and their communities start to grow internationally, independent foundations can provide a pathway for growing a sustainable governance and collaborative development accordingly. They enable economies and collaborations of scale, while allowing resources and the benefits of collaboration to be funnelled back more intentionally towards the codebases they support.

The Consul case study demonstrates how the project was transitioned from the City of Madrid in 2019 to the newly instated Consul Democracy Foundation after the city withdrew its extensive support for the project. The foundation has since helped to establish Consul as a standalone project, seeking out various sources of funding, and ways to maintain the collaboration now spanning 100+ PSOs across a broad set of countries globally.

Similar journeys have been described by the Decidim and gvSIG projects, both coming out of the cities of Barcelona and Valencia respectively, into their own independent foundations, further enabling their continued scaling cross-border. Both were spoken to as part of this work. In the case of Decidim, they are officially registered as an association, but function like a foundation (more so than provider-oriented and development-oriented member associations, highlighted below). The Decidim Association, based in Barcelona, does many things, but has (in some ways) had more success to date than the Consul Democracy Foundation in bringing resources back into Decidim and maintaining a single modular codebase that local governments can customise and contribute to[286].

In this way, foundations are one of the most important community-based adoption archetypes and represent a standard model for successful and growing open source collaborations. They are very well-suited to support the needs of local government adopters and contributors, as they benefit from increased support and discoverability, as well as typically having built-in communities of practice.

5.3.2. National provider-oriented associations

When local governments are mainly interested in reusing existing solutions, rather than developing new ones, creating joint associations can provide a means of pooling resources and coordinating efforts related to the acquisition process.

For instance, the City of Sundsvall in Sweden reported in the workshops on difficulties in generalising the open source they produce, and growing the anticipated communities. The OS2borgerPC and MedborgarPC case study

[286] Interview with Decidim Association

illustrates how Sambruk, a Swedish local government association of about 150 local governments which Sundsvall is part of, identified a need among a smaller set of its members, and accordingly identified OS2borgerPC as a suitable solution. Sambruk coordinates its members' needs and requirements, and cares for the dialogue with the main service supplier of the open source solution. The association further procures the solution as a service on behalf of its members, which then can be used directly by the concerned members. Sambruk, hence, serves as an interface between the local governments and the service supplier, providing a unified voice, improving bargaining power, aligning requirements engineering, and ensuring the continued maintenance, and quality of the open source software and procured services.

A similar example comes from the case of Consul. COSLA, which adopted Consul on behalf of its members, obliged all Scottish local governments to adopt the citizen participation platform, allowing it to provide centralised material/technical support and facilitate knowledge sharing. COSLA maintained internal capabilities and capacity to customise Consul to their members' needs, and provided it as a service to be used directly by its members. In this way, the local government association provided a useful foundation for the COSLA team to act as a sort of service supplier, supporting technical development, community growth, and collaboration across the participating local governments they supported.

National provider-oriented associations constitute an efficient way of supporting smaller local governments in particular, as they assist with a lot of the logistics needed to make open source work well for under-financed and under-resourced jurisdictions, who often have fewer human resources for technical-oriented work in particular. They offer an interesting model for thinking about how to create economies of scale from open source collaboration within a given country or region.

5.3.3. National development-oriented associations

Developing new open source solutions is a complex endeavour, whether it is done internally of a local government or through a procured service supplier. National development-oriented associations offer another way of thinking about open source contribution and reuse, demonstrating how to channel resources towards common goals and objectives that support the interest of a given country.

Joining forces by pooling and growing the necessary capabilities as in the case of OS2, a Danish local government association, provides a model that local governments in other European countries can look to. The association enables its members to initiate and collaborate on the development and adoption of solutions that address common needs, while avoiding potential lock-in effects. Open source is considered their main tool of choice, and today stewards 25+ open source projects on behalf of their members. The association has established and standardised governance, development and collaboration

processes, along with establishing an ecosystem of service suppliers that can support the concerned local governments.

Another example is VNG, the Dutch Association of local governments, who participated in the workshops for this study. They reported on how the Signalen open source project, originating from the City of Amsterdam and reused by several other Dutch local governments, was in need of a steward that could facilitate and host the project long term, caring for the scaling and sustainability of the project. While the City of Amsterdam still sponsors much of the development through its internal resources, the City is not set up to steward open source projects. Here, national associations like VNG and OS2 provide a more suitable steward model, enabling further local governments to join the community and partake in the collaboration. Two similar associations that emerged during the workshops were ADDULACT in France and IMiO in Belgium.

National-development-oriented associations, in comparison to national provider-oriented associations, have a stronger focus on supporting the larger development and governance ambitions in a large region or country. They do not just provide services, but funnel productive assets and collaboration towards the generation of open source projects and collaborations which support their members in working on common goals.

5.4. Supplier-based archetypes

5.4.1. Civil society service supplier

In local governments where digital transformation and public services are less prioritised, or where capabilities and resources are limited, civil society can provide critical support[287]. These types of organisations typically do not have a for-profit business model and are driven by public interest and the desire to use technology collaboration, enabling different types of collaborations as service suppliers.

Coding for Romania, a non-profit organisation in Romania, exemplified how they adopted Consul based on the needs of a smaller set of local governments. Through a thorough research process, Consul was customised accordingly, and provided as a service, along with the necessary support and training. After an incubation period, the hosting and operation of Consul was turned over to the local governments, once they had grown the capabilities needed, through the help of Code for Romania. This approach encouraged knowledge transfer and intentionally sought to subvert the types of dependency that were common in procurements with commercial service suppliers, many of which drive local governments towards seeking open source alternatives (as seen in the examples of the cities of Munich and Prague, for example).

[287] Cf. Koloniaris et al. 2018; Mergel, 2021.

In contrast, the case of Parlameter illustrates how a non-profit organisation can take on a more long-term role as a service supplier of open source solutions for local governments. DJND, the Slovenian non-profit maintaining the Parlameter open source project, provides Parlameter as a service for local governments both in Slovenia and neighbouring countries. Their non-profit status limits the costs for local governments adopting the solution, and thereby enabling further adoption. The case further illustrates how local non-profit organisations and groups of activists and general citizens support the local implementation, motivated by the social good in the use case Parlameter addresses.

While there are not a lot of civil society service suppliers, they provide an interesting counterpoint to the extractive business models. Should they be available in a given region, they might enable more local governments to work on open source projects and collaborations without a high risk of high levels of profit extraction and the potential for service supplier dependency.

5.4.2. Local government service supplier

Local government service suppliers enable local governments to grow their own capabilities of acquiring and developing open source solutions according to their needs. They are either owned by the local government itself or provisioned from within the departments of the local government and its technical teams (should they even exist).

The case of Golemio illustrates how a single yet resourceful local government, for example, the City of Prague, established their own ‘internal’ service supplier, Operator ICT, as a means of easier acquiring talented engineers by enabling more competitive salaries, and the ability to work with agile and open source development. The agile way of working and horizontal open collaboration provides much value also to the local government, as the solutions become better tailored to the needs of the city, and released in shorter cycles, taking in feedback continuously from the users. Resistance in culture and conservative ways of working with traditional tendering still provide barriers, but may potentially be addressed with less internal scepticism as the service supplier is also part of the same overarching organisation as the customers.

Similarly, the case of Digitransit demonstrates how similar benefits may be achieved between several local governments through a co-owned service supplier. HSL, the regional public transit authority, co-owned by several of the Helsinki region’s local governments, develops and provides Digitransit as a journey planner for the region’s public transit, as well as nationally. The regional local governments have by extension grown the capabilities to collaborate nationally as well as internationally taking the benefit of open innovation, while being able to influence the functionality based on their own needs.

Local government service suppliers can, as in the case of Operator ICT, generate profit. It is key that joint stock companies and other organisational models will need to be experimented with, but they offer a promising way of thinking about how to develop and reuse open source solutions. They are

well-positioned to work with city OSPOs, like in the City of Munich, and to support open source collaborations as maintainers as those projects scale and/or get reused internationally/across borders.

5.4.3. Private service supplier

Private service suppliers, such as commercial providers, provide a traditional source of technical capabilities for the local government. They are one of the most common forms of service suppliers that a local government might be familiar with.

In the Consul project, many of the active service suppliers play a key role in the technical governance and development of the core project, as well as the national implementations of the project, for example, as reported for the City of Munich. The suppliers support local governments both nationally and internationally, taking on the role of a boundary spanner across local government and national borders. These service suppliers became especially critical for knowledge transfer in the period after 2019, when support to Consul from the City of Madrid waned. Consideration is being given to how Consul's extensive and invaluable community of service suppliers, many with technical knowledge dating back to the origins of Consul, can be better balanced with governance needs and the need to maintain a single codebase that local governments can install and customise more easily.

The case of OS2borgerPC illustrates how the main service supplier, accordingly, can sometimes take on a role as a mediator of an open source project, pushing and enabling the adoption beyond Denmark to the Swedish local governments through the Swedish local government association of Sambruk. In this case, the service supplier Magenta became active in the OS2borgerPC community and offered critical technical resources and support, often building friendly and highly productive relationships with many local governments. It was driven by the desire to do good and make open source work for the local government, even as differences with OS2 created challenges in governance.

Availability of high-quality service suppliers is a key enabler for many local governments when it comes to open source adoption. Limited availability of commercial support is a commonly referred to reason for avoiding open source alternatives. By promoting a healthy supplier ecosystem, local governments can accordingly improve adoption and sustainability of the open source solutions, while also minimising chances of becoming dependent on any single supplier.

6. Lessons learnt: analysing the case studies through key categories of evaluation

This section generalises lessons learnt from the case studies up to a higher level, in consideration of the open source collaboration archetypes presented in Section 5. In doing so, the section leaves aside the project focus of Section 4 and looks at key lessons from the perspectives of the local governments, community actors, and suppliers themselves, examining common challenges (organisational, cultural, technical, financial, etc) faced by the analysed entities in the process of collaborative development or reuse of software. It does so across five domains: Motivation and Incentives, Adoption and Use, Development and Maintenance, Funding and Sustainability, and Governance and Organisation. Where possible, it provides a description of solutions employed to overcome these challenges and offers considerations from the perspective of other actors participating in the city-based collaboration.

6.1. Adoption and use

6.1.1. Adopter's perspective

Communicating the benefits of open source clearly and transparently is critical for persuading policymakers to invest in and support those solutions. The case of Golemio shows that policymakers can be unaware of the benefits of open source alternatives. Persuasion is key to overcoming a conservative mindset and a preference for a status quo. Parlameter shows the importance of civil society organisations, both as potential service suppliers and as bridge-builders between suppliers and the local government, in advocating for change and communicating with policymakers about the benefits of open source and the adoption/use of open source in practice.

Maintaining sovereignty and control of digital assets and infrastructure are key drivers for the adoption of open source in the first place. Open source can, however, still render an organisation in a lock-in to a service supplier if key knowledge is kept internal, which is otherwise required to freely develop, build and run the software, despite its source code being open. A second risk is that an open source project becomes abandoned, no longer gets actively maintained, or that professional support is no longer provided. A third risk is that an open source project starts shifting focus and direction compared to the interests of the organisation.

An exit strategy should, hence, be defined before adopting an open source project and revisited continuously to ensure an organisation's technological and data sovereignty. COSLA highlights their awareness of alternative solutions to Consul, and how they ensure rights and access to their data, to avoid such risks. Workshop participants acknowledged the importance of having exit strategies for any software, but that these are seldom created in practice. Local

governments should rather be concerned with ensuring that development is conducted to open source norms and principles, and that all knowledge required to switch suppliers is openly available and up to date. Requirements that must be explicitly stated in any contracts with suppliers.

Local governments can also ensure their sovereignty by building internal capacity, and investing and engaging in the open source communities directly, for example, through sponsorship. For example, the City of Munich sponsors the Consul Democracy Foundation so that there is a market of suppliers that can support maintenance and the needs of the city. The city also presents an example for how setting up an internal OSPO can be a way to grow internal capabilities, and enable such sponsorships.

Open sourcing can help with developer recruitment and code quality, even if external contributions are limited. While Golemio received minimal external code contributions (around 10 merge requests), open sourcing proved valuable for attracting and retaining developers. The public nature of the code encourages higher quality standards among the development team, and the ability to showcase their work helps with recruitment, even when the local government cannot match private sector salaries.

While OSPOs typically focus on its overarching organisation, OSPOs can also be hosted by external PSOs to support one's own organisation. For local governments, associations such as OS2 and Sambruk provide a similar function, which can support the members and owners to address key challenges and barriers for open source adoption. For example, conservative culture and procurement practices are highlighted as commonly inhibiting openness towards open source adoption.

6.1.2. Role of external actors

Open source is seldom reusable out of the box for PSOs. Technical expertise and capabilities are commonly required to set up, customise and run an open source project[288]. Local governments often lack such expertise and capabilities, resulting in open source solutions being neglected or not thoroughly and equally considered compared with established (commonly proprietary) solutions. External support is, hence, critical for local governments if they are to consider and adopt open source solutions, something which was reiterated across interviews and workshops.

External service suppliers are highlighted as the main source of such support. Still, the availability of service suppliers, or knowledge of their existence is commonly limited. PSOs must work proactively in ensuring and promoting the availability of service suppliers by incentivising and ensuring sustainable business models, for example, by promising long term investments into open source. The latter was raised and discussed during the workshops among both suppliers and PSOs.

[288] Cf. Yaseen et al. 2020.

Availability of service suppliers was also iterated across the case studies as key for the sustainability of open source projects. HSL, describes the lack of service suppliers related to Digitransit as a risk for community growth, as they themselves do not have the resources or business model for providing such support beyond current levels.

A second source of external support also emerged in the form of civil society. Civil society organisations may play a key role in enabling open source adoption in areas where digital transformation and government is not prioritised by public spending. Civil society organisations may further provide trust in areas where the government lacks the same.

In the case of Parlameter, local governments are typically dependent on local civil society organisations and volunteers in implementing the platform. Commonly, this is also done on the latter's initiative. Parlameter is in turn also developed, maintained and commonly hosted by a Slovenian non-profit, which enables lower prices than what commercial service suppliers offer. Still, many local governments are restrictive in adopting the solution referring to cost as a main argument. Code for Romania illustrates how they initially support local governments in the adoption of Consul, to with time, transfer the operation of it to the local governments. The type of support civil society may or should provide will vary geographically, depending on the context and need of the local governments.

6.2. Development and maintenance

6.2.1. Designing for reuse

Open source should ideally be designed for reuse from day one, requiring a development strategy on how functionality can be generalised while still considering the specific use cases and requirements of the initially concerned PSOs. Several core aspects were highlighted in the case studies and workshops detailing how such generalisation may be enabled.

First, a modular and flexible design is critical for enabling public organisations to customise and implement their own specific requirements, as these may differ significantly across local government and national borders. Consul is, for example, typically customised to national contexts, yet still considered by some as too rigid. The City of Groningen highlighted how Consul required processes to be defined by the technology, while the opposite should be the default. Decidim, an early fork of the Consul open source project, described during the research's workshops how they adopted a modular approach from the beginning, stepping away from Consul's more monolithic design, and acknowledging how people have different needs. Code for Romania further emphasised the importance of flexibility, referring to in the workshops how they need to generalise the functionality of their open source solutions for supporting the management of refugee crises, and how these will differ across, for example, Romania, Jordan, and Mexico.

Second, interoperability, and standardised interfaces and formats, considering open standards first hand, need to be promoted and implemented from the start. Decidim highlights how each country may have different identification systems, but can be connected through a standardised interface. The Digitransit case enables the use of their solution in both Europe and North America through the implementation of GTFS and NeTEX, both globally adopted standards for mobility data.

Third, ease of localisation is pivotal for enabling cross-border reuse and addressing language barriers and local professional nomenclatures. The cross-border adoption of OS2borgerPC has, for example, been enabled by the ease of translating across languages natively supported by Ubuntu, the open source Operating system on which OS2borgerPC is based on. For Consul, Parlameter, and Digitransit, the ability to translate across languages has also been crucial in their international dissemination. For Golemio, which is focused on the City of Prague, localisation is not considered an issue.

While generalisation is important for reuse, several interviewees stress that the design of open source solutions should start with addressing the specific use case of its stakeholders, although still maintaining a flexible design. In the case of Golemio, rather than trying to create a standardised solution that could work anywhere, the local government service supplier Operator ICT was successful by focusing specifically on Prague's needs. This included working backwards from specific use cases rather than implementing standard approaches, and being willing to customise solutions even if it meant less reusability. This focus on local value helped ensure the platform's sustained utility and support.

Generalisation may also come at an extra cost, which may not be prioritised by the PSOs sponsoring the development of an open source solution. OS2 highlighted the need for an external fund on the European level that can sponsor extra work required to enable cross-border reuse and interoperability, something discussed with interest during the workshops. The City of Sundsvall, one of the leading local governments in Sweden related to the use of open source, describes during the workshops how in the last three years they have been building a broad set of open source solutions in the local government. They have not, however, been able to motivate the extra cost required to generalise the solutions, hence why the reuse of their work today is rather limited.

6.2.2. Open and agile collaboration

Agile development implies an iterative process where requirements for the software are defined, prioritised, implemented and evaluated in smaller batches, based on continuous communication between the service supplier and customer. The process is implicitly used in most open source development, and stands in contrast to the typical waterfall approach implied by the public procurement frameworks, where requirements are typically defined upfront, and then implemented accordingly when a tender is awarded to a supplier.

Case study and workshop participants converge on the idea that agile development is highly beneficial for open source development but requires a significant shift in culture and ways of working, particularly around planning, budgeting and procurement. In the case of Golemio, city officials were more comfortable with waterfall approaches that specified everything upfront. The local government service supplier Operator ICT had to convince stakeholders to try shorter three-month agile cycles and demonstrate value incrementally to build trust in this approach. The City of Sundsvall in Sweden emphasises that agile development is not inhibited by the legal frameworks, but rather internal culture and perspective on how procurement is done. They highlight a knowledge gap, where service suppliers need to support local governments in explaining how agile development can still be done with existing legal frameworks.

The collaborative dimension in agile development is expanded further in the context of open source development. Accordingly, cross-boundary horizontal collaboration within and across stakeholders (for example, local governments) is important for local government open source collaboration and adoption but requires a shift away from the commonly occurring siloed culture, and local focus of policymakers. Golemio shows how the most effective implementations came from creating cross-department teams based on agile thinking. The team found that ongoing collaboration with business owners was essential for generating value from the data, rather than just implementing technical solutions. Digitransit shows the importance of both intra-city and inter-city collaborations for improving the use and uptake of data, particularly in the public transit space (like with Golemio).

Building trust with stakeholders within and across organisations in a community is essential for open and agile development but requires continuous and transparent communication. In the case of Golemio, initial challenges included explaining why ongoing platform development was necessary rather than just a one-time investment. The team had to prove their value over time and build trust through delivering results. This process involved learning to communicate technical concepts to non-technical stakeholders and demonstrating concrete benefits to the city. OS2borgerPC shows how limitations in the communication between local governments and service suppliers may render temporary disruption in collaboration and siloed development efforts as consequence.

The case studies demonstrate a number of ways in how open and agile development can be enabled through (co-)owned or member-driven proxy organisations, such as open source stewards or local government service suppliers. OS2borgerPC illustrates the former in how requirements are continuously defined by the local governments through the Danish and Swedish local government associations, OS2 and Sambruk respectively, and then implemented through procurement of the main service supplier. Digitransit and Golemio illustrate examples of the latter, in how a co-owned service supplier in the form of HSL and Operator ICT can both facilitate the requirements engineering process and the implementation.

6.2.3. Engaging the community

Typically, much value from open source comes from having an active community contributing to its development and maintenance, as also illustrated throughout the surveyed cases[289]. Several key practices have been highlighted and align with best practice of general open source development. However, some were reiterated more extensively.

Open knowledge sharing and community interaction with other users from similar contexts and culture is critical for enabling cross-border collaboration while enabling local adoption. Consul demonstrates how a community can thrive through its open communication channels, yet also, how the experienced distance may become too big, causing abandonment. The City of Groningen in the Netherlands experienced too wide of a technical and cultural gap to engage in the international community, and preferred a national alternative with other Dutch local governments, with whom they shared language, culture and ways of working.

Responsiveness in communication, detailed documentation and onboarding processes are key in enabling reuse and community growth. In Digitransit, documentation is described as being of good quality, but the responsiveness as sometimes limited, tracing to narrow capacity of developers at HSL. If the intention is to grow a community, then proper resources need to be budgeted and maintained. Limited responsiveness was also reported in the case of OS2borgerPC from the technical steering committee inside OS2, hence why many local governments started engaging directly with the main service supplier.

Collaborating with communities of upstream projects can provide valuable contributions. HSL describes how their work with the community of the upstream OTP engine often results in features on their own backlog being implemented by others.

6.3. Funding and sustainability

6.3.1. Community perspective

Diverse funding and support improves resilience of the project and overdependence on any single actor[290]. If a main funder of a project would pivot, for example, due to change in government, project risk going unmaintained. Consul experienced such a risk in the aftermath of the 2019 elections when the City of Madrid retracted its support due to different priorities in the new local council.

Transferring hosting and facilitation of an open source project to a stand-alone steward, such as a foundation, helps to mitigate potential risks of a project

[289] Cf. Koloniaris et al. 2018; Mergel, 2021.
[290] Cf. Shaikh, 2016.

becoming too dependent on any single actor. The Consul Democracy Foundation was initiated during the same period in an aim to mitigate risk of the project becoming unmaintained, and keep the international community connected. gvSIG, a geospatial open source platform coming out of the City of Valencia tells a similar story, although with Valencia still remaining as a key sponsor of the project. The gvSIG Association, who were represented during one of the workshops of this study, was initiated also to help facilitate its international community of members and users.

The case studies further show how different models (for example, types of sponsorship) and organisational structures (for example, legal entities) may be required to enable various types of funding and funders. When the Consul Democracy Foundation was established, existing funding was limited. In recent years, they have managed to attain grants, while also experimenting with sponsorship models. The latter was initiated by the interest of the City of Munich who wanted to sponsor the foundation, but needed a formal sponsorship to donate funding, as a public procurement procedure would have otherwise been started. The foundation also reports on how they have established a certification programme for suppliers, where one criterion is that they contribute back actively, and also sponsor the development financially with a smaller percentage based on their revenue. Another model is presented by the gvSIG Association, which has established a business model where they offer technical consultancy (development, maintenance, migration) and support, as well as training and certification, similar to that of service suppliers.

6.3.2. Supplier perspective

There is a consensus across cases and the broader workshops that the presence of suppliers is pivotal for enabling the use and sustainable maintenance of concerned open source projects[291]. Therein, it is critical that there is room and conditions for sustainable business models of the concerned suppliers.

One point highlighted is that the choice of licence, ownership of copyrights and other legal matters should be considered up-front. These should on the one hand enable control for users, while on the other provide service suppliers with the ability to provide complementary services and product offerings based on the open source. In the case of OS2borgerPC, the licence was originally chosen with this balance in mind. The rationale was further echoed by several participants in the workshops. One supplier agreed that the customer should be able to take the code from the supplier and turn to someone else if they are not satisfied. Copyright ownership should ideally be owned by the PSO procuring the development, although the main points regarded that the licensing schema prevented open source solutions from becoming locked-in.

A second point raised was that procurement needs to consider market size and potential turnover in relation to the number of service suppliers to enable

[291] Cf. Shaikh, 2016.

sustainable business models for the suppliers. In the case of OS2borgerPC, a second service supplier was commissioned to review the codebase, and address a number of concerns from the OS2 perspective. That supplier later started providing hosting services related to the open source solution. While the main supplier welcomes competition they highlight how this limits their margins further, making it difficult to keep their engineers dedicated to developing the project.

The workshop discussions further confirmed that sourcing should be limited based on the potential market turnover, but that availability of suppliers should be promoted as communities and the market of potential paying customers grow. Until then, PSOs need to ensure that all know-how needed for another supplier to take over is openly available. Adopting a second supplier as in the case of OS2borgerPC may therefore be considered a suitable control mechanism while any potential procurement of new service offerings need to consider the supplier market as a whole.

A related point concerns how procurement needs to consider the market size and potential turnover in relation to how services are bundled in procurements, where hosting and support services is a source to sustainable income, beyond occasional development and maintenance. The point was, again, raised in the case of OS2borgerPC. The main supplier of the project describes how recurrent income from operation, support and implementation-related services is critical for enabling them to keep their engineers focused on the project. Procurement of development and maintenance occurs on an irregular basis and can therefore not be considered as a sustainable source of income. The different kinds of services should, hence, be procured through joint contracts per the main supplier of the case. Workshop discussions confirm the perspective, highlighting how, for example, Sambruk procures hosting and operation related services along with the occasional development and maintenance services from the main supplier alone. Local government representatives in the workshops, however, also add that it is important for the suppliers to seek out diverse sources of income, for example, in terms of projects.

6.3.3. Government perspective

The government perspective was mainly covered by local governments where most are characterised by limited resources and capabilities of using and adopting open source[292].

Across the cases there was hence consensus that there is a need for mechanisms that can enable co-funding of joint open source solutions, and that local government associations can provide such a mechanism. Sambruk and OS2 in the case of OS2borgerPC provides examples from Sweden and Denmark respectively. In the workshops, additional examples were provided by participants from VNG in the Netherlands and ADULLACT in France.

[292] Cf. Koloniaris et al., 2018.

These stewards help their members through coordinated co-funding and procurement, enabling a synchronised and common communication between the local governments and towards the service suppliers respectively. Such coordination is essential to avoid parallel and siloed communications between different cliques of local governments and the supplier. This issue was highlighted by interviewees who discussed the experience of Slovenian local governments working with Parlameter and their siloed approach to the project. This implicitly pushes the governance and coordination from the local governments towards the supplier, which in the long term may risk ending in lost control and soft lock-in. Single or smaller groups of local governments should still be allowed to procure directly from the supplier, but such procurements should be synchronised with the overarching coordination and requirements engineering process of concerned open source solutions to ensure compatibility.

To ensure a sustainable collaboration, a minimal number of organisations is needed to co-fund a joint open source project long-term relative to the costs and resources available. The OS2borgerPC case illustrates how local governments came together through OS2, and with time has grown a sustainable user base and in Sambruk, where the current user base is limited yet growing with a discount from the service supplier during this initial period. In the case of the Consul Democracy Foundation, there have been struggles in obtaining sponsorship from local governments, while now the City of Munich makes up the first and recent sponsor. From the workshops, the Dutch local government association VNG describes how they managed to reach 42 local governments using and sharing costs of their *Signalen* project, although with the main development being done by the development teams inside of Amsterdam's administration.

The latter example exemplifies the need for stronger and more resourceful public organisations to take a greater role in co-funding and sustaining open source projects, than those less resourceful. OS2borgerpc and MedborgarPC, through OS2 and Sambruk, use a relative co-funding where either the population size of a local government or the number of instances used determine the fee. Consul shows how larger local governments like Madrid and later Munich can both initiate and help sustain open source projects. This can also be seen in the efforts taken by the City of Barcelona to support Decidim, an alternative to, and early fork of Consul. Workshop participants highlight that it is fine to lean on the funding from one or a few strong actors in the beginning, but that it is not feasible in the long term why external stewardship, for example, through a local government foundation, and a co-funding mechanism is needed for a long term sustainable project.

6.4. Governance and organisation

6.4.1. Role of stewards

Across all the cases, there was a general consensus that sooner or later some form of stewardship was needed to enable a sustainable collaboration and maintenance of an open source project. The need will increase as more users across jurisdictional borders and levels of government enter the picture, increasing complexity and needs on joint processes and facilitation of governance, coordination and co-funding. The structure and responsibilities, however, may vary from context and needs of each open source project.

ADULLACT, VNG, Sambruk, OS2 and COSLA, all show different variants typically where they provide the tools and processes, but let their members fund and decide the direction of the projects. In Flanders, DigitalVlaanderen (represented during the workshops) mentioned how they are also looking into similar constructions for projects which they up until now have steward.

Opposite to these local government associations, there was also evidence on how public service suppliers or operators may function as a steward on behalf of its owners. In the case of Digitransit, the regional public transit authority HSL represents and is owned by the local governments in the Helsinki region, while Waltti Solutions correspondingly is owned by and represents the rest of the local governments in Finland. In the Golemio case, Operator ICT, a fully owned local government service supplier, maintains governance and development for the various departments and companies within the City of Prague.

Despite the model, the case studies highlight that governance needs to scale and enable potential subcommunities, for example, on the national levels for an international project to function freely, while still maintaining collaboration across the overarching community. Consul demonstrated how it is important for national communities to thrive, while providing opportunities to influence roadmap discussions and ongoing development. OS2borgerPC highlights how this scalability should be designed as early as possible to enable community growth.

At the workshops it was also highlighted how VNG has designed and tested its processes for the Signalen project, now incorporating 42 Dutch local governments, and now being discussed whether it should be a national standard. The project is also being trialled for the Danish context, among others including OS2.

6.4.2. Role of suppliers

The suppliers' role in the governance and organisation of local government open source projects was reiterated across the cases from different angles, and discussed intensely in the workshops.

In terms of stewardship, workshop discussions highlighted how private service suppliers can be considered as stewards for local government open source projects, as long as the project is kept free and open with all parts and knowledge required to switch suppliers if needed. The French local government association ADULLACT highlighted, however, that it is important to define what stewardship implies. If too much power and decision-making is put in the hands and delegated to the supplier, there is a risk of ending up in a lock-in. Sambruk notes that much is determined by who has the keys to the main source code repository of the solution.

The OS2borgerPC illustrates the point through how the role of governance and coordination slowly and implicitly was taken on by the main supplier. The supplier also became a bridge between the Danish and Swedish local governments and by effect brokering the needs and requirements between the local governments either independently or via the two national local government associations OS2 and Sambruk.

The case further highlights the need for continuous checks and reviews of projects that may help ensure adherence to open source principles and avoid potential lock-in effects for its users. OS2 observed potential concerns in a later stage on reports by some of their members. A second supplier was contracted to perform the review, causing tensions with the main service supplier. Established, transparent and reoccurring reviewing can help mitigate such reactions, and create mutual trust among involved actors.

While governance should or may not necessarily be delegated to a supplier, several points were raised in how including suppliers in the governance and planning process promotes collaboration, awareness, and synergies in development and knowledge-sharing. One rationale according to the main supplier in the OS2borgerPC case (and shared by VNG, ADULLACT and Sambruk in the workshops), is that associations and local governments, who may meet on for example, quarterly or monthly basis, lack the capability to stay reactive and make swift decisions, which can cause lag and issues in development and maintenance of the projects. Another rationale highlighted in the discussions was how the supplier may have a complementary understanding of requirements and needs across local governments, and understanding of implications of technical decisions.

Still, it remains unclear how and to what extent suppliers can or should be included in the governance. In the workshops, ADULLACT describes how their suppliers can be invited as observers to meetings to provide input, while there are separate forums where the local governments can talk more freely without their presence. Suppliers should, hence, be included in the technical decision-making, while still enabling the local governments who sponsor the development to maintain the final say, avoid ending up in a lock-in, and to speak freely on the collaboration. Essentially, a balance is needed to enable reactive and proactive product management.

7. Recommendations

Below, recommendations are presented based on the lessons learnt from the five cases, and the overarching cross-case analysis.

7.1. Recommendation #1: Open source as a multipurpose tool for achieving a diverse set of policy goals

Open source provides a tool for gaining and maintaining control of digital infrastructure and assets, which are key to ensuring the freedom and flexibility for local governments both in their day-to-day operations and future transformations. On the other hand, open source can also enable sharing and reuse of common technologies across both local and national borders, promoting an interoperable digital infrastructure of public services and systems. While promoting collaboration and innovation, it also stimulates competition and economic growth.

Based on the synthesised findings, it is specifically recommended that:

Local governments should first define policy goals, and then consider open source as one of the tools that can be used for achieving their policy goals.

7.2. Recommendation #2: Culture, competence, and resources limiting open source adoption

The common notions on the upside of open source align with the general incentives and motives uttered by the local governments surveyed in this study. The same organisations also unite in their view on the difficulties and challenges of attaining these benefits, as they do not come for free. There is a commonly occurring existence of conservative and risk averse culture and procurement practices, commonly inhibiting inclination toward open source adoption. Also, many local governments experience difficulties in communicating the benefits of open source clearly and transparently to policy- and decision-makers, whose support is critical when looking beyond traditional routes in software acquisition.

Based on the synthesised findings, it is specifically recommended that:

Local governments should self-assess and explicitly map out barriers and challenges, both perceived and experienced, that in any way inhibit the adoption, development and collaboration on open source solutions.

7.3. Recommendation #3: Capabilities needed to communicate and interact – internally and externally

Internal champions and competence centres (such as OSPOs) can help to provide a voice of reason, as well as external actors as, for example, open source stewards and service suppliers. To enable a long-term and sustainable strategy and adoption of open source, the local governments need to build or otherwise ensure access to such capabilities, which they otherwise commonly lack. For example, local governments need to ensure that any development or provisioning of open source solutions is conducted according to open source norms and principles, and that all knowledge required to switch suppliers is openly available and up to date. They also need to ensure that there is always an exit strategy defined for any type of software solution acquired (open or proprietary).

Based on the synthesised findings, it is specifically recommended that:

Local governments should inventory what capabilities are needed, both to address identified challenges, and to achieve the defined goals, and determine how these can be acquired either internally or externally.

7.4. Recommendation #4: Designing for reuse from day one requires consideration and funding

Much of the anticipated value of open source commonly comes from the reuse and collaboration happening through the community. As iterated through the case studies, this does not happen by itself. Modular and flexible design, standardised interfaces and formats (considering open standards first), and ease of localisation are pivotal for enabling cross-border reuse. Such generalisation may also come at an extra cost, which may not be prioritised by the local governments sponsoring the development of an open source solution. A proposal coming out of one of the OS2borgerPC case study, as well as discussed during the workshops, was for an external fund on the European level that can sponsor any extra work required to enable cross-border reuse and interoperability.

Based on the synthesised findings, it is specifically recommended that:

Local governments should design their solutions with interoperability and reuse in mind from day one, for example, by implementing a modular and flexible design, standardised interfaces and formats (considering open standards first), and the ability to localise solutions.

National and local governments should dedicate central funds that can support development and maintenance activities required to promote and enable local governments to create interoperable solutions with the potential for cross-border reuse.

7.5. Recommendation #5: Enabling an open and agile collaboration across the community

Agile development is implicitly used in most open source development, and stands in contrast to the typical waterfall approach implied by the public procurement frameworks. Case studies, however, agree on its value but also on the significant shift required in culture and ways of working, particularly around planning, budgeting and procurement. Cross-boundary horizontal collaboration within and across local governments is critical but also requires a shift away from the commonly occurring siloed culture, and local focus of policymakers. The case studies, however, demonstrate that these challenges are manageable, for example, through (co-)owned or member-driven proxy organisations, such as open source stewards (for example, OS2) or local government service suppliers (for example, Operator ICT).

Based on the synthesised findings, it is specifically recommended that:

Local governments should strive towards adopting an agile and open culture and practice in their procurement and development of new software solutions. When internal capabilities are not available, local governments should identify or establish potential conveners of such activities (for example, stewards or suppliers).

7.6. Recommendation #6: Limiting the dependence of open source projects on any single actor or source of funding is key to sustainability

Diverse funding and support improves resilience of the project and overdependence on any single actor. Transferring hosting and facilitation of an open source project to a stand-alone open source steward, such as a foundation or a local government association, may help to mitigate such risks, increasing diversity and inclusion. Stewards are, however, also at risk in creating sustainable funding, although the case studies demonstrate how different models of funding can be leveraged, such as sponsorships from local governments (as from the City of Munich for to Consul), certification programs of service suppliers (as done by Consul), and even service provisioning in competition with existing suppliers (as done by gvSIG).

Based on the synthesised findings, it is specifically recommended that:

Local governments should actively consider how they can support both the development and maintenance of key open source projects, for example, through procurement of service suppliers, and direct sponsorships.

7.7. Recommendation #7: Promoting a sustainable service supplier ecosystem in procurement

There is a consensus across case studies that the presence of suppliers is pivotal for enabling the use and sustainable maintenance of concerned open source projects. Local governments should, accordingly, pay attention to the sustainability of business models of service suppliers present, or consider how such models can be enabled to promote new suppliers to join the market. One consideration regards the selection of licence models that balance control for local governments with ability for service suppliers to create complementary services and product offerings based on the open source project.

Local governments further need to consider the market size and potential turnover in relation to the number of service suppliers they choose to procure from, and how services are bundled in procurements, where hosting and support services is a source to sustainable income, beyond occasional development and maintenance. A complementary approach is to require each service supplier to contribute back to development and maintenance of the open source projects as this would ease maintenance burden and resource costs for those suppliers doing the main part of the work.

Based on the synthesised findings, it is specifically recommended that:

While procuring open source solutions and related services, local governments should ensure that the defined conditions for service suppliers enable sustainable business models, and by extension, sustainable maintenance of the open source solutions.

7.8. Recommendation #8: Local government associations enable co-funding, coordination and stewardship of open source projects

Local governments are commonly characterised by limited resources and capabilities of using and adopting open source. The different case studies show, however, how local governments gain power by coming together under the umbrella of local government associations. These associations act as open source stewards for any joint open source projects, enabling coordinated co-funding and procurement, and a synchronised and common communication between the local governments and towards the service suppliers respectively. A minimal number of local governments is, however, needed to co-fund a joint open source project long-term relative to the costs and resources available. Here, stronger and more resourceful local governments may need to take a greater role in co-funding and sustaining open source projects, than those less resourceful.

Based on the synthesised findings, it is specifically recommended that:

Local governments should consider what role existing associations can play in supporting open source adoption, development, and collaboration, or if new organisational structures are required to steward current and future open source solutions.

7.9. Recommendation #9: Open Source Stewardship needed for projects scalability and sustainability

With time, some form of external stewardship is typically needed to enable a sustainable collaboration and maintenance of an open source project. This need will increase as a project grows in users and across jurisdictions, adding complexity and needs on joint processes and facilitation of governance, coordination and co-funding. The structure and responsibilities, however, may vary from context and needs of each open source project. Local government associations were exemplified through Sambruk and OS2 (in OS2borgerPC) and COSLA (in Consul), while public service suppliers or operators may function as stewards on behalf of their owners as in the case of HSL (in Digitransit) and Operator ICT (in Golemio). Despite the model, case studies highlight that governance needs to scale and enable potential subcommunities, for example, on the national level for an international project to function freely, while still maintaining collaboration across the overarching community.

Based on the synthesised findings, it is recommended that:

Local governments should consider early on who is to steward open source solutions long term, in order to scale adoption and create a sustainable funding of their continued development and maintenance.

7.10. Recommendation #10: Including suppliers in governance, while maintaining control and transparency

Suppliers provide technical and subject matter expertise, while also being reactive to urgent issues, abilities that local governments typically lack. Leveraging these in the governance and technical planning of open source projects is highly valued but less realised in practice, according to the case studies. While being included in the technical decision-making, local governments still need to be able to maintain the final say, avoid ending up in a lock-in, and to speak freely on the collaboration. Private service suppliers were also thought to be considered as stewards for local government open source projects, as long as the open source is kept free and open with all parts and knowledge required to switch suppliers if needed. Having continuous checks and reviews of projects that may ensure adherence to open source principles and avoid potential lock-in effects for its users.

Based on the synthesised findings, it is recommended that:

Local governments should from the start actively involve relevant service suppliers in the technical governance and coordination of the planning, development, maintenance, and day-to-day operations of the open source solution.

8. Conclusion

To support and provide guidance for local governments in their digital transformations, as required by the Interoperable Europe Act, this study provides an in-depth investigation of five mature cases of how local governments have grown the necessary capabilities to successfully adopt, develop and collaborate on joint open source software solutions. Such capabilities can be acquired in different ways depending on the context:

- Internal capabilities, provided directly by the local government, require substantial and long-term investment but can provide greater control and opportunity to leverage open source based on the local needs.
- Quasi-internal capabilities involve cooperation with quasi-public organisations, such as joint stock companies or entities owned or subsidised by local governments, blurring the lines between internal and external resources.
- External capabilities can be acquired by leveraging external proxy and umbrella organisations such as international foundations or national local government associations. These organisations act as open source stewards, bringing together local governments and other actors to pool their resources.

Case studies converge on the importance and need for open source stewardship as open source projects scales in complexity and across jurisdictions.

Three types of organisational structures further emerged among community actors that can support local governments based on their needs, and contextual settings.

- International foundations play a crucial role in the international growth of open source projects by providing sustainable governance and collaborative development.
- National provider-oriented associations are crucial for local governments interested in reusing existing open source solutions rather than developing new ones.
- National development-oriented associations, on the other hand, play a crucial role in developing new open source solutions by pooling resources and capabilities to address common needs.

The various community-based support structures play a pivotal role in further limiting dependence on any single actor or source of funding for the open source projects, which is generally regarded in the literature as key to their sustainability. Further, they also typically provide a proxy between local governments and service suppliers who provide the technical resources for conducting any development and maintenance activities.

The case studies further align on the importance of these suppliers as most local governments lack the necessary internal capabilities. Growing and promoting a sustainable service supplier ecosystem, is therefore a critical enabler and consideration for local governments, to ensure sustainability of any open source project itself, as noted by much of the literature reviewed for this project. As the suppliers possess the necessary know-how and capabilities the study also emphasised the importance of including the suppliers in the governance. Meanwhile, it is equally important for local governments to maintain control of the open source project ensuring full transparency into its development and guaranteeing compliance with open source norms and best practice.

Service suppliers come in different shapes, three of which emerged from the case studies.

- Civil society service suppliers play a crucial role in supporting local governments with limited resources and capabilities, offering non-profit development services driven by public interest.
- Local government-owned service suppliers enable local governments to develop open source solutions tailored to their needs, either through internal departments or co-owned entities.
- Finally, private service suppliers are a traditional source of technical capabilities for local governments playing a crucial role in open source projects.

The level of sharing and reuse varies across the analysed case studies – ranging from internally within a single local government, nationally across local governments and national governments, to cross-border involving local governments; and from two to over 20 countries. Enabling and promoting reuse is, however, not a simple exercise. Modular and flexible design, standardised interfaces and formats (considering open standards first), and ease of localisation should be considered from the outset of a project. Enabling an open and agile collaboration across the community further supports reuse, and more specifically a collaborative and inclusive development, helping to grow both adoption and contributions to the open source project.

In summary, the case studies show promise the potential of open source to enable the growth of interoperable solutions and their cross-border sharing and reuse. The in-depth case studies and lessons learnt across the cases demonstrate the importance of growing joint capabilities including both local governments, community actors, and suppliers. Culture and collaboration are foundational constructs that need to permeate and connect these actors to allow for any open source solution to stay sustainable and deliver on its underpinning expectations.

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Annex A: Interview Questions

- Privacy
  - Establish informed consent
- Demographics
  - Could you describe your internal role and main affiliation in relation to *[the open source project]*? What is your engagement with *[the open source project]*?
- Context
  - Could you provide the context of *[the open source project]* from your perspective?
  - Could you describe the main use cases of *[the open source project]*? Who are the end-users?
  - How does the national and EU policy context (regarding open source) your organisation impact you? Is the policy context hindering or benefitting you?
    - For example, how did the Interoperable Europe Act impact you and your organisation?
- Incentives
  - What are your main incentives in opting for open source in general?
    - Technical aspects (Customisability potential, security, etc.)?
    - Monetary?
    - Presence of advocates?
    - Autonomy?
    - Collaboration?
    - Legal?
    - Political?
  - How does your organisation use or gain value from *[the open source project]*? How are other actors benefitting from it?
  - Where is your solution being re-used? Has there been collaboration to parties outside your organisation? What are their incentives?
- Development process
  - How is the development of a new functionality performed and structured? What actors are involved and how?
  - How do you manage the development process?
    - Do you follow agile methodologies?

        - How are the interests of internal and external stakeholders aligned?
    - Who funds the development and maintenance costs? Is public procurement applied, and if so, how?
- Governance structure
    - Who decides what is implemented, and how? How are the decision makers appointed? Who is consulted?
    - How are discussions facilitated regarding requirements definition, development, testing, release, etc? How are disputes settled?
    - Is there a code-of-conduct or similar set of rules in place? How are they enforced? Are sanctions defined?
- Overcoming challenges
    - What challenges have you or the community of actors partaking in the collaboration experienced in terms of the development and maintenance activities? Examples to consider/probe:
        - Lack of interest by any parties?
        - Internal resistance, i.e., due to culture?
        - Availability of resources?
        - Availability of funding?
        - Internal expertise?
        - Training?
        - Maturity of open source?
        - Absence of standards/certifications?
        - External support?
        - Hidden costs?
        - Integration/Interoperability?
        - Migration?
        - Legal?
        - Political?
    - How would you say these challenges can be addressed? Examples to consider/probe:
        - Open Source Program Offices?
        - Foundations or associations?
    - What advice would you give to other organisations in their open source adoption efforts? What are the best practices to successfully adopt open source?
- Final thoughts
    - Any additional points you would like to discuss that we have not touched upon?

Annex B: Literature Review

Table 1 - Literature summary of the barriers and challenges for open source adoption

Topic	Barriers and challenges for adoption	References
Lack of interest	Low interest in open source and risk avoidance due to satisfaction with existing systems	(Glynn et al. 2005) (Larsen et al. 2004) (Magnusson 2011) (Mergel 2021) (Petrov & Obwegeser 2018) (Silic & Back 2017)
	Lack of prior exposure to open source or lack of perceived need of using open source	(Deller & Guilloux 2008) (Gurusamy & Campbell 2011) (Petrov & Obwegeser 2018)
	Absence of open source advocates	(Magnusson 2011) (Petrov & Obwegeser 2018)
	Disinterest in open source due to competitor behaviour	(Glynn et al. 2005) (Petrov & Obwegeser 2018)
	Perception of substantial effort required for adopting open source	(Magnusson 2011)
Adoption resistance	Internal resistance to adoption	(Glynn et al. 2005) (Gurusamy & Campbell 2011) (Koloniaris et al. 2018) (Mergel 2021) (Petrov & Obwegeser 2018) (Silic & Back 2017) (Tosi et al. 2015) (Yaseen et al. 2020)
	Cultural resistance to change	(Deller & Guilloux 2008) (Mergel 2021) (Petrov & Obwegeser 2018)
	Resistance and lack of support from management	(Bouras et al. 2013) (Larsen et al. 2004)
Personnel	Limited in-house open source competence	(Deller & Guilloux 2008) (Gurusamy & Campbell 2011) (Magnusson 2011) (Petrov & Obwegeser 2018) (Ven & Verelst 2009) (Yaseen et al. 2020)
	Long training required	(Koloniaris et al. 2018) (Robles et al. 2019) (Tosi et al. 2015)
	Difficulty of finding and receiving professional training	(Bouras et al. 2013) (Gurusamy & Campbell 2011) (Koloniaris et al. 2018) (Silic & Back 2017) (Ven & Verelst 2012)

	Difficulties finding skilled personnel or lack of resources for employing open source specialists	(Bouras et al. 2013) (Gurusamy & Campbell 2011) (Magnusson 2011) (Petrov & Obwegeser 2018) (Silic & Back 2017)
Open source maturity	Lower levels of maturity of open source products leading to increased perceived risk	(Bouras et al. 2013) (Glynn et al. 2005) (Magnusson 2011) (Mergel 2021) (Petrov & Obwegeser 2018)
	Lower levels of security management compared to commercial companies	(Bouras et al. 2013) (Koloniaris et al. 2018) (Petrov & Obwegeser 2018) (Yaseen et al. 2020)
	Limited documentation or low level of documentation quality	(Gurusamy & Campbell 2011) (Shaikh 2016)
	Low levels of user friendliness	(Bouras et al. 2013) (Tosi et al. 2015)
Comparability	Absence of open source standards and standardisation	(Magnusson 2011) (Silic & Back 2017)
	Lack of open source product certifications	(Shaikh 2016)
Support	Difficulty of finding external support	(Bouras et al. 2013) (Glynn et al. 2005) (Gurusamy & Campbell 2011) (Koloniaris et al. 2018) (Larsen et al. 2004) (Petrov & Obwegeser 2018) (Tosi et al. 2015) (Ven & Verelst 2009) (Yaseen et al. 2020)
Hidden costs	Hidden of high costs for support, maintenance, and training	(Bouras et al. 2013) (Gurusamy & Campbell 2011) (Magnusson 2011) (Silic & Back 2017) (Tosi et al. 2015) (Ven & Verelst 2012)
Integration and migration	Integration issues between open source products and existing systems	(Bouras et al. 2013) (Deller & Guilloux 2008) (Gurusamy & Campbell 2011) (Magnusson 2011) (Mergel 2021) (Petrov & Obwegeser 2018) (Silic & Back 2017) (Tosi et al. 2015)
	Migration issues towards open source and vendor lock-in issues	(Glynn et al. 2005) (Gurusamy & Campbell 2011) (Holck et al. 2005) (Mergel 2021) (Silic & Back 2017) (Yaseen et al. 2020)
Legal	Concerns regarding licensing and intellectual property rights	(Gurusamy & Campbell 2011)
	Compliance and legal issues	(Silic & Back 2017)

Political	Absence of regional laws supporting open source adoption in the public sector	(Tosi et al. 2015)
	Difficulties maintaining political support in the public sector	(Robles et al. 2019)
	Bias of government procurement policies towards COTS	(Petrov & Obwegeser 2018)

Table 2 - Literature summary of the incentives for open source adoption

Topic	Incentives	References
Technical	Customisability potential	(Allen 2010) (Deller & Guilloux 2008) (Glynn et al. 2005) (Koloniaris et al. 2018) (Magnusson 2011) (Mergel 2021) (Tosi et al. 2015) (Yaseen et al. 2020)
	Increased security of open source	(Tosi et al. 2015) (Yaseen et al. 2020)
	High level of perceived effectiveness of open source solutions	(Allen 2010)
Monetary	Saving costs	(Allen 2011) (Bouras et al. 2013) (Deller & Guilloux 2008) (Koloniaris et al. 2018) (Magnusson 2011) (Mergel 2021) (Tosi et al. 2015) (Ven & Verelst 2012) (Yaseen et al. 2020)
Autonomy	Increased autonomy and reduced vendor lock-in	(Bouras et al. 2013) (Deller & Guilloux 2008) (Yaseen et al. 2020)
Collaboration	Participation in the open source community	(Bouras et al. 2013) (Glynn et al. 2005) (Mergel 2021)
	Re-use of solutions and collaboration with other organisations	(Deller & Guilloux 2008) (Glynn et al. 2005)
	Collaboration with joint associations	(Viseur & Jullien, 2023) (Robles et al. 2019)
Testability	Rapid deployment of open source projects	(Allen 2010)
	Low risk and costs linked to open source projects	(Allen 2010)
Legal	Control over intellectual property rights	(Bouras et al. 2013)

Table 3 - Literature summary of the drivers for open source adoption

Topic	Drivers	References

Presence of advocates	Presence of a clear authority figure supporting open source	(Glynn et al. 2005) (Mergel 2021) (Van Loon & Toshkov 2015) (Yaseen et al. 2020)
	Presence of boundary spanners and open source champions	(Glynn et al. 2005) (Mergel 2021) (Van Loon & Toshkov 2015) (Ven & Verelst 2012)
	Presence of political activism in the public sector	(Van Loon & Toshkov 2015)
Personnel	Availability of open source literate staff	(Glynn et al. 2005) (Mergel 2016) (Yaseen et al. 2020)
	Improved relationship between IT department and its users	(Allen 2010)
	Growing internal talent	(Allen 2010)

Annex C: Interviewees

Table 1 - List of interviewees per case study

Name	Role	Organisation	Case study	Relation to case
Jens Kimmel	Coordinator	Consul Democracy Foundation	Consul	Works at foundation hosting Consul
Miguel Arana-Catania	Researcher	Cranfield University	Consul	Worked for City of Madrid when Consul was implemented
Andrés Pereira de Lucena	Lead Software Developer	Decidim Foundation	Consul	Member of fork project
John Munro	IT operation specialist	COSLA	Consul	Implements Consul on behalf of Scottish local governments
Klaus Müller	Head of the OSPO	City of Munich	Consul	Interface between City of Munich and Consul
Miruna Muscan	Assistant Director of Product	Code for Romania	Consul	Implemented Consul for Romanian local governments
Olivia Vereha	Co-Founder & Director of Product	Code for Romania	Consul	Implemented Consul for Romanian local governments
Sirin Yildiz	Digital Services Advisor	City of Groningen	Consul	Former user of Consul
Jannis Redmann	Developer	Freelance	Digitransit	Implemented Digitransit for German local governments
Joona Packalén	Head of Information	HSL	Digitransit	Works for HSL, overseeing development of Digitransit
Jaakko Rintamäki	Development manager mobility data	Fintraffic	Digitransit	Service coordinator for Digitransit on Fintraffic's behalf
Andreas Tryti	Software architect	Entur	Digitransit	Works with OpenTripPlanner
Benedikt Kotmel	Chief Product Officer	Operator ICT	Golemio	Responsible for Golemio at Operator ICT
František Hána	Head of Data engineering & Platform ops	Operator ICT	Golemio	Responsible for Golemio at Operator ICT
Zbyněk Jiráček	Product owner	City of Prague	Golemio	Product owner of Golemio at City of Prague
Beránek Jaromír	Member of the Prague City Assembly	City of Prague	Golemio	Member of executive advisory board for Operator ICT
Thomas Wennersten	CTO	Sambruk	OS2borgerPC	Association procuring solution on behalf of Swedish local governments
Rasmus Frey	Executive Director	OS2	OS2borgerPC	Association governing solution on behalf of Danish local governments
Morten Kjærsgaard	CEO	Magenta	OS2borgerPC	Main service supplier of OS2borgerPC
Jan Johannesson	Librarian	City of Borås	OS2borgerPC	User of Swedish implementation (MedborgarPC)
Kristofer Lecander	Librarian	City of Borås	OS2borgerPC	User of Swedish implementation (MedborgarPC)

Filip Muki Dobranić	Product owner	Danes je nov dan	Parlameter	Responsible for development of Parlameter at Danes
Lamija Haracic	Project Coordinator	Zašto ne	Parlameter	Implemented Parlameter for local government
Mojca Planinc	Director of the Municipal Administration	Ajdovščina	Parlameter	User of Parlameter
Mihec Susnik	Developer	Freelance	Parlameter	Contributor to Parlameter

Annex D: Case Studies

1. Case Study of Parlameter

The following is a longer version of a case study included in a comprehensive report titled 'Open Source Software Adoption and Reuse in European Local Governments: A Multiple-Case Study,' available on the OSOR website.

The case study was developed through a combination of secondary research and 4-6 original interviews with individuals representing the local government, community and supplier perspectives on the open source project/collaboration. The insights in the case study were validated through workshops, and specific findings have been reviewed by people originally interviewed for the case study. Insights have been pseudonymised in the case study narrative, but the full list of organisations and individuals participating in the case study can be found in Annex C of the main report.

Introduction

Parlameter, an open source platform for parliaments, began nearly a decade ago in Slovenia by the non-profit Danes je nov dan (DJND)[293] (translating to 'Today is a New Day'). DJND began with a simple premise: to provide a more meaningful way of tracking and comparing the work of parliamentarians. They built Parlameter to move beyond traditional political measures, which mainly gauge voting intentions and are more useful to political parties than to voters, and instead found innovative ways to evaluate parliamentary performance in a way that directly benefits the public.

Parlameter can be likened to the 'Google Analytics for the Parliament' [294]. The project digitalises transcripts and voting records for parliaments and has, over the years, evolved into a comprehensive analytics platform for tracking parliamentary performance. It provides details of parliamentary activities, such as how members vote, their meetings, and so on. Furthermore, it handles transcripts and voting records from their collection to visualisation and publishing, providing a complete solution for any organisation aiming for full transparency and digitalisation of sessions[295].

Parlameter is composed of four open source components: Parlacards, Parladata, Parlasite, and Parlassets[296]. Parlacards provide embeddable cards for Parlameter, while Parladata serves as the core data system. Parlasite includes EJS templates and a server for hosting the Parlameter website, and Parlassets consists of static assets for the frontend. Notably, Parlasite and Parlassets are licensed under 'The Unlicense',[297] a template that disclaims

[293] Interview with Danes je nov dan
[294] Ibid.
[295] Parlameter. (n.d.). *Parlameter – Making politics transparent.* Available: https://parlameter.org
[296] Danes je nov dan. (n.d.). Parlameter – parlanode component renders cards and makes them shareable and embeddable. Available: https://github.com/danesjenovdan/parlameter
[297] Unlicense.org. (n.d.). Unlicense Yourself: Set Your Code Free. Available: https://unlicense.org

copyright interests and dedicates the software to the public domain. This licence combines a copyright waiver inspired by the public domain SQLite project with a no-warranty statement from the MIT/X11 licence.

Parlameter initially started as a volunteer-driven initiative focused on monitoring the Slovenian parliament, and the first integration happened in 2016[298]. It eventually expanded to other countries as well, including Croatia and Bosnia and Herzegovina. With venture funding, the project transitioned to full-time work under the non-profit organisation DJND, which is a non-profit and independent private organisation established in 2013[299]. By utilising digital technologies and developing campaigns, it promotes participation in democratic processes and civic action, fostering a more just, open, and inclusive society[300]. As Parlameter was initially developed by volunteers, their first major funding for the organisation itself came from the Google Digital News Initiative[301]. This funding enabled some team members to leave their jobs and work full-time on Parlameter and other projects in DJND[302].

Having successfully expanded from Slovenia to other countries, driven in part by the need to secure funding, Parlameter is a successful example of cross-border sharing of open source, mediated by a civil society organisation and across multiple levels of government. Despite some setbacks in Poland and Ukraine, the project works in a number of countries, relying heavily on local partners, particularly civil society organisations who track the activities of these parliaments and can ensure the access, accuracy and relevance of data[303]. For the local councils, such work is often considered both too expensive or not possible due to the expertise required[304]. It's clear that for a Parlameter to succeed in any country, local expertise and oversight are essential.

Key Stakeholders

Danes je nov dan: Danes je nov dan is a non-profit and independent private organisation, established in 2013, that uses digital technologies and develops innovative campaigns for participation in democratic processes and civic action. The goal of the non-profit is to make society more just, open, and inclusive.[305]. The organisation is the main service supplier behind Parlameter.

Zašto ne: Citizens' Association Zašto ne ('Why Not') is an organisation working to create a safe, healthy, active, efficient, and responsible society in Bosnia and Herzegovina for citizens, civil society and government representatives. It does so by promoting political accountability, strengthening civic activism, and using new media and technologies, in collaboration with civil society organisations, other groups, and individuals[306]. Zašto ne is partnering with DJND to integrate

[298] Danes je nov dan. (n.d.). *Parlameter – Projects.* Available: https://danesjenovdan.si/en/projects/?projects=parlameter
[299] Interview with Danes je nov dan
[300] Danes je nov dan. (n.d.). About – Danes je nov dan. Available: https://danesjenovdan.si/en/about/
[301] Interview with Danes je nov dan
[302] Ibid.
[303] Ibid
[304] Ibid.
[305] Danes je nov dan. (n.d.). *About – Danes je nov dan.* Available: https://danesjenovdan.si/en/about/
[306] Zašto ne. (n.d.). *About Us – Citizens' Association "Zašto ne (Why not)".* Available: https://zastone.ba/en/about-us/

the Parlameter platform with Zašto ne's Javna Rasprava platform[307]. This platform leverages an established system to improve citizen engagement, streamline access to parliamentary data, and foster greater transparency and interaction between citizens and decision-makers[308].

Ajdovščina Municipality: This Slovenian local government collaborated with DJND to integrate Parlameter as a tool for analysing decision-making data within the local government council, which is the highest governing organisation at the local level. Beyond examining council members' voting records, the system also provided insights into their meeting attendance, submitted questions, adopted legal acts, and other legislative activities[309].

DJND Volunteer Community: Organised and coordinated by DJND, many operations of Parlameter rely on a volunteer-based approach, particularly involving a community of developers and individuals from diverse backgrounds who work in a 'democracy of action' manner. These developers are often professional programmers who are sympathetic to the cause of DJND and occasionally seek opportunities to contribute meaningfully to society. When they identify a long-standing feature that interests them, they request to work on it, and the task is then assigned to them while the team waits for the ticket to be completed[310].

Detailed Findings

Adoption and use

Over time, Parameter has expanded to several Slovenian local governments. For example, in Ljubljana, it was first adopted at the local government level on January 18, 2022, to monitor the activities of the Ljubljana City Council. It was also adopted in 2022 in Hrastnik, Lendava (in partnership with the local media outlet Lendavainfo)[311], and in Ajdovščina. Over time, the platform expanded to include the parliaments of Croatia and Bosnia and Herzegovina as well, in September 2018 and April 2019, respectively. Efforts were also made to implement the system in Poland and Ukraine, but these were eventually discontinued due to challenges in adapting the platform to the local political contexts.

The use of Parlameter varies depending on the specific contexts, particularly regarding political perceptions and the level of involvement from the local government council, which typically centres around data exchange[312]. For instance, while many local governments need local civil society organisations to provide essential data for the solution, this was not the case in Ljubljana. This

[307] Interview with Zašto ne
[308] Zašto ne. (n.d.). *About Us – Citizens' Association "Zašto ne (Why not)"*. Available: https://zastone.ba/en/about-us/
[309] Interview with the Ajdovščina Municipality
[310] Interview with Danes je nov dan; Interview with Volunteer Contributor
[311] Novak OnLine, Leon Novak s.p. (n.d.). *Lendavainfo – Lendavska informativna stran.* Available: https://lendavainfo.com
[312] Interview with Danes je nov dan

means that DJND does a lot of work to adapt Parlameter to the needs of local contexts, particularly in consideration of political and cultural factors.

This also gives DJND a lot of control over what happens in each local government they work with, which can give them outsized control as a vendor and reinforce dependency. According to the interviewee from DJND: '*For other municipalities, we always work in cooperation with the municipality or a local organisation, because municipalities don't publish data in a way that would allow us to just absorb, transform and display it. [...] Ljubljana already has very good data. So we don't really need the municipality to participate with us in any way. We manage the parliamentary affairs for Ljubljana completely on our own.*' [313] However, he also pointed out that despite initial enthusiasm and support for the use of Parlameter, the political interest in the solution eventually shifted, with no clear explanation provided for the change in perspective.

Development and maintenance

The Parlameter system's flexibility allows it to be tailored to local needs, though the quality of data across local governments varies, with some requiring substantial customisation. For example, in Ljubljana, the high-quality data enables DJND to maintain the local instance with minimal cost. However, local governments with lower-quality data require more manual processing, and local civil society organisations may step in when local governments show limited interest in developing the platform. These situations frequently require significant manual effort and, in some cases, financial support for data processing, depending on the local organisation. This combination of challenges complicates maintenance and monitoring, ultimately jeopardising the platform's long-term sustainability[314].

Local governments and parliaments working with Parlameter frequently request new features from DJND to help streamline these processes, but it requires a lot of effort and depends heavily on the local context and requirements. Parlameter's new features are often developed by first customising the platform for individual local governments, with these improvements later shared more widely. Local governments request updates to their Parlameter after noticing useful features implemented in neighbouring areas. DJND takes the lead in coordinating these efforts, noting that: '*... we do communicate with municipalities that whatever development we're going to do for them is going to be useful for everyone else.*' [315] These features are then generalised and shared across all instances of the platform.

The features and the general technical viability of Parlameter rely solely on DJND as the main service supplier. The development process is collaborative, with contributions from a small but engaged community of developers. Communication primarily happens through Slack, and long-term development depends on the interest and commitment of contributors. Short-term

[313] Ibid.
[314] Ibid.
[315] Ibid.

development tasks are typically handled by paid employees at DJND. The local governments take the role of the user benefitting from the platform's continuous improvement, such as from regular updates and enhancements at no additional cost. Additionally, using the platform provides local governments with better-structured data and better transparency towards their citizens, which they are prepared to share with Parlameter. Says one interviewee: '*Municipalities are very happy for the developments, and they are also very happy that now they have this data in a structured way and they can use it in different places as well.*' [316]

Most developers for the platform come from the tech industry, and they are volunteers. Local governments rarely employ developers themselves. While some IT staff at local governments may have the technical skills to deploy Parlameter with limited support, this is uncommon[317]. The interviewee from DJND mentioned: '*When we talk about developers, we usually talk about people who have a job as a programmer somewhere. And now and then, they would like to do something useful for society. So they show up, and if they find a long-standing feature that is interesting to work on, they request to work on that. Then we just assign this to that person, and we wait for the ticket to be finished.*' [318] However, this approach is designed for 'long-term, more complex developments' rather than urgent tasks with tight deadlines and specific budgets allocated by a local government for immediate implementation.

Funding and sustainability

DJND operates as a non-profit organisation, following a model where no profits are distributed to members or owners, as such distributions would be heavily taxed. The organisation currently employs seven full-time staff members and three part-time contributors. Acting as the sole maintainer and de facto coordinator of the Parlameter community, DJND also facilitates a community of developers, mostly employed in larger tech companies, who contribute to the project in their spare time, motivated by the social good and societal impact of the project[319].

Funding for Parlameter – and the work DJND does on Parlameter – primarily comes from international sources, with around 3% coming from direct donations[320]. For example, Zašto ne, the Bosnian and Herzegovinian NGO that is partnering with DJND, mentioned that they have a contractual relationship with DJND where they typically fund all the activities they are involved in. One interviewee from Zašto ne underlined that: '*We usually fund all the activities that we are doing, and we also have a part of the budget that is shared on the development of the website (...) We mostly provide the budget for those things, and the DJND covers the development and other costs of technical issues.*' [321]

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[316] Ibid
[317] Interview with Danes je nov dan; Interview with the Ajdovščina Municipality; Interview with Zašto ne
[318] Interview with Danes je nov dan
[319] Ibid.
[320] Ibid.
[321] Interview with Zašto ne

Initially, DJND's first major funding came from the Google Digital News Initiative, which allowed the organisation to create a payroll and have employees. Speaking to the significance of this funding, one of the volunteers DJND noted that: '*Part of the funding supported impactful community projects designed to address local issues and potentially go viral, while the rest sustained the organisation itself. (...) About ten years ago, the group sustained itself by taking on commercial Python projects during funding gaps to keep operations running. Members pooled resources, sharing projects to cover expenses and continue their unpaid, impactful local initiatives.*' [322]

Moreover, the initial local government installations of Parlameter were funded through a public call financed by an international organisation. DJND opted for international funding[323] For other local governments, costs are incurred for the labour involved in setting up and hosting the instance, but a significant amount of work is provided free of charge[324]. The costs for implementing Parlameter are generally low, often falling below the threshold for public tenders. This enables local governments to select DJND without the need for a competitive bidding process, and also allows for agile development and more direct collaboration with DJND[325].

In Slovenia, while there is no collaboration or joint procurement between local governments, neighbouring municipalities often adopt the system after one takes the initiative[326]. To that, the interviewee from DJND explained: '*There is this chamber of commerce-like organisation of municipalities in Slovenia called the Society of City Municipalities… [I]t is effective in promoting knowledge sharing among municipalities. However, based on our conversations with them over time, they appear to face challenges in coordinating larger collaborative efforts, such as organising joint orders for multiple Parlameters or participatory budgets. This capability has not been evident in our experience.*' [327] The latter statement has also been confirmed by the interviewee from Ajdovščina Municipality, which proposed the implementation of inter-local government administrations[328] for handling such matters.

Governance and organisation

The community of Parlameter contributors consists of around 50 members, many of whom are motivated by the social good and societal impact of the project. DJND is there to coordinate the volunteers, accept their requests to work on certain aspects of the platform, and organise their communication. According to one of the volunteer contributors of DJND: '*Danes fosters an environment where everyone matters and can contribute based on their skills, whether it's building websites as a software engineer or writing short monthly updates as a volunteer. Every contribution counts if it aligns with the shared*

[322] Interview with Volunteer Contributor
[323] Interview with Danes je nov dan; Interview with Volunteer Contributor
[324] Interview with Danes je nov dan
[325] Ibid.
[326] Interview with Danes je nov dan; Interview with Ajdovščina Municipality
[327] Interview with Danes je nov dan
[328] Interview with Ajdovščina Municipality

vision and makes a difference. It's about creating something meaningful together.' [329]

Volunteers often take responsibility for deploying and operating the platform. They also collect and process data from local governments, as well as the system to fit the local context[330]. The work of the volunteers, and especially the local ones, helps identify inconsistencies and data quality issues, which ideally should be addressed at the source. In the words of the interviewee from DJND: '*These volunteers aren't just programmers; they can be testers, designers, illustrators, or anyone contributing to the project. A significant effort goes into verifying data. Many people use Parliamentary resources in their daily lives, whether for research or simply out of interest in politics. When they spot errors in transcripts, they report them to us.*' [331]

The governance of Parlameter is open, with decisions made collaboratively by the community, often referred to by the community as 'Democracy of Action'. While new features can be freely implemented as long as they do not interfere with the core functionality of the platform, larger changes require broad community consensus. The community maintains a positive culture, with most members being friends, fostering collaboration, and reducing conflicts[332]. On the other hand, most of the topics are too technical and specific to allow for different opinions that can lead to a conflict. The high technical barrier to entry reduces the likelihood of general conflict and ensures that any disagreements are more likely to be limited to specific, niche cases. Additionally, some complex features may need to be postponed until the necessary resources or conditions are in place for their development[333].

The community, the users and the rest of the stakeholders of Parlameter can influence the project based on their needs. From both the point of view of the Ajdovščina Municipality and Zašto ne, the governance of the platform was largely managed by DJND. While the local government has limited influence on the platform's overall direction, it provided valuable feedback during the implementation process[334]. On the other hand, Zašto ne has a strong say in major decisions because they have their platform integrated with Parlameter, and thus they have significant influence specifically over the appearance and structure of the platform, as well as the overall direction of their local instance[335].

[329] Interview with Volunteer Contributor
[330] Ibid
[331] Interview with Danes je nov dan
[332] Ibid.
[333] Ibid.
[334] Interview with Ajdovščina Municipality
[335] Interview with Zašto ne

Lessons Learnt

1. **Without effective capacity-building, those benefiting from a service supplier's services risk becoming passive users, disengaging entirely, or failing to utilise the solution, rather than becoming active contributors.**

The Parlameter study cases show that although the users, such as the local councils, find the platform particularly useful for searching and accessing their statements[336]. There are no upstream contributions to the platform from their side[337]. In Ajdovščina, the platform analyses local government council activities, including voting patterns, attendance records, questions raised by council members, and adopted legal acts. This adaptation allows the platform to enhance transparency by providing citizens, journalists, and researchers with detailed insights into decision-making processes. It enables comparisons between local governments, fostering interoperability, transparency, accountability and collaboration among local governments[338].

All the technical developments are managed by DJND through user feedback and requests[339], specifically national/local parliamentarians and their respective parliaments. This can turn beneficiaries into passive users and not contributors, which in turn limits the potential that open source collaboration can offer. Moreover, Parlameter's operations in the local government of Lendava came to a halt due to a lack of funding, which in turn led to insufficient resources to support the local contribution to a private cooperative of journalists responsible for upstream work[340].

In this way, local adoption of open source solutions should not be treated only as a tool, but as a chance for collaboration and for the development of cost-effective solutions that are customisable to local needs.

2. **Adapting a solution for local-level use often requires close collaboration with local partners; otherwise, the solution can stop its operations. However, those same partners, depending solely on the initial development team for all technical aspects of integration and maintenance, create long-term sustainability challenges.**

In the case of Parlameter, the local collaborator's role focuses on voluntarily providing data and reviewing content, while DJND manages all technical and development aspects. While Parlameter also shows how open source can be adopted in low-capacity contexts (e.g. locations where the capacity to customise, implement, and maintain open source code and solutions), with civil society organisations serving as important bridge-builders, the flip side is that it creates a sort of dependency for development of new features and tailoring them to their needs and contexts. The expansion of Parlameter to Poland was

[336] Ibid.
[337] Interview with Danes je nov dan
[338] Interview with Ajdovščina Municipality
[339] Interview with Ajdovščina Municipality; Interview with Danes je nov dan
[340] Interview with Danes je nov dan

cut short because there was no local contributor, and the work effort could not be handled by DJND[341].

Relying solely on the initial development team for all technical aspects of integration and maintenance poses a significant challenge. This approach often results in a lack of expertise on the user side, which can, in turn, lead to an increased workload for the developers/service suppliers. As a result, while the local collaborator bridges the gap in data collection and addresses the lack of proper documentation of parliamentary activities that is needed for Parlameter to operate, it is not empowered or well-equipped to contribute that knowledge back upstream, particularly in terms of technical development. Feedback from the general collaborators (Zašto ne, Ajdovščina) of DJND is incorporated into the platform[342].

However, both for the use case of Parlameter in Bosnia and Herzegovina and for its local use in Slovenia, the technical development of the platform relies only on DJND[343]. This can lead to overwork of both the volunteers and the developer team, and it also showcases the lack of IT expertise from the government side. Potential future sustainability challenges should something stop the operations of DJND as a service supplier. As a non-profit, their services are not extortionate, and thus, they could disappear over time, leading to the choice of a proprietary solution from the users.

3. **Local governments struggle with both the capability to implement and the ability to adapt to the technological demands of open source software, and might benefit from a model that allows them to share resources.**

The Parlameter case study shows that in Slovenia, smaller local governments often lack the resources to implement the system independently and rely on larger local governments for support, which limits the potential for collective innovation[344]. This also hinders the ability to tailor the system to their specific needs, as they must adhere to the customisations preferred by the larger local government. There is also a cultural mismatch, as local governments in general are not accustomed to prioritising long-term sustainability of the solution.

Instead, they tend to expect one-time purchases for services rather than committing to ongoing expenses such as hosting, domain registration, and other recurring costs[345]. Additionally, political differences within local governments can limit the adoption of new technologies and disrupt the contribution to the stable governance of the solution. For example, in Ajdovščina, some council members questioned the platform's purpose and necessity, expressing scepticism, and in Ljubljana, the support for the solution stopped because of fear that it would be used as a tool against the current mayor[346].

[341] Ibid.
[342] Interview with Danes je nov dan
[343] Interview with the Ajdovščina Municipality; Interview with Zašto ne Ne
[344] Interview with the Ajdovščina Municipality
[345] Interview with Danes je nov dan
[346] Interview with Danes je nov dan; Interview with Ajdovščina Municipality

Another factor that can undermine the governance of the solution is the lack of coordinated action and maturity within the local government. One of the main challenges for Parlameter was shifting public and governmental mindsets toward transparency and collaboration, and persuading decision-makers – like mayors and councils – rather than solving purely technical problems[347]. Moreover, despite the presence of local government associations, in Slovenia, there is no collective procurement model for services like Parlameter. As a result, each local government generally makes its own decision to adopt the platform independently, creating inefficiencies when scaling the system.

For example, the implementation process in Slovenia was marked by fragmented collaboration between the local governments. Ajdovščina moved forward independently, without engaging with other local governments, despite being aware of Parlameter's adoption in Ljubljana and Medvode. This isolated approach missed opportunities for knowledge sharing, resource pooling, and a more coordinated, cost-effective implementation[348]. Some forms of local government cooperation were limited between neighbouring local governments or those of similar size, which can share resources and collaborate to overcome challenges.

These challenges show that local governments have an opportunity to improve by identifying common problems and seeking solutions that delegate implementation to inter-local government administrations. Such administrations can manage tasks for multiple local governments and receive co-funding from the state. Moreover, to further foster transparency and accountability in their joint efforts, local governments can work with national anti-corruption organisations. Transparency and accountability in these joint efforts can also create a trusting relationship between local governments.

4. **Adopting open source solutions in local governments can sometimes be challenging due to users' unwillingness or inactivity in contributing effectively to the solution. However, the constant use of the solution can positively impact users' maturity.**

The sustainable adoption of Parlameter depends on user contributions. To avoid extra workload for DJND or community volunteers, local governments should ensure that data is properly processed after each council meeting. This requires cultural and managerial changes, both technically and in internal processes. These changes can be costly and challenging, and often lead to resistance to change. Nevertheless, the interviewees from DJND and one of the volunteers confirmed that, through using the solution, local governments have become more mature in how they interact with Parlameter and manage their internal processes related to its adoption and use. For example, many local governments have, over recent years, improved their file organisation to better integrate with Parlameter.

[347] Interview with a volunteer contributor to Danes je nov dan
[348] Ibid.

A key challenge in implementing Parlameter is data collection, which is essential for the platform's functionality and for the development team at Danes. The lack of local responsiveness presents significant obstacles during implementation[349]. For example, the council members of the Ajdovščina Municipality were slow to provide essential data, such as photos and personal details, which delayed the progress and development of Parlameter. From a personal experience point of view, it was also very difficult to come into contact with representatives of the local government and parliamentary users for this study. This slow response also highlights a broader issue: the lack of in-house IT expertise within parliaments and local governments, along with scepticism, limited enthusiasm, and a lack of understanding of the platform's benefits in government[350].

Additionally, for the use of Parlameter in Bosnia and Herzegovina, data collection and organisation are also common bottlenecks, often exacerbated by limited internal capacity. More specifically, one of the biggest challenges in using the Parlameter in Bosnia and Herzegovina is the absence of open data formats and the disorganised structure of the country's official parliamentary website[351]. Nevertheless, as the government becomes more digitally savvy through the usage of technology, both the culture behind open source software and the collaboration between local governments and the Parlameter developers are improving[352].

2. Case Study of OS2borgerPC and MedborgarPC

The following is a longer version of a case study included in a comprehensive report titled 'Open Source Software Adoption and Reuse in European Local Governments: A Multiple-Case Study,' available on the OSOR website.

The case study was developed through a combination of secondary research and 4-6 original interviews with individuals representing the local government, community and supplier perspectives on the open source project/collaboration. The insights in the case study were validated through workshops, and specific findings have been reviewed by people originally interviewed for the case study. Insights have been pseudonymised in the case study narrative, but a full list of organisations and individuals participating in the case study can be found in Annex C of the main report.

[349] Interview with Danes je nov dan
[350] Interview with the Ajdovščina Municipality; Interview with Zašto Ne
[351] Interview with Danes je nov dan; Interview with Zašto Ne
[352] Interview with a volunteer contributor to Danes je nov dan

Introduction

OS2borgerPC[353] and MedborgarPC[354] are open source operating system solutions implemented in public spaces, notably libraries and citizen service centers. Adoption has been strongest in Denmark, where approximately 50 local governments use OS2borgerPC, while MedborgarPC – recently launched in Sweden – still has only a few local governments as users. While most local governments organise through OS2 and Sambruk, a Danish and a Swedish municipal association respectively, hosting and operational contracts are contracted directly with the service suppliers, where Magenta stands out as the main supplier.

Magenta serves as the primary developer and maintainer of the system on behalf of the local governments in Denmark and Sweden, who mostly collaborate through OS2 or Sambruk, respectively[355]. Some development is also procured directly by local governments from Magenta, which today has two developers more or less dedicated to the project. The development model has been a source of tension in Denmark, where disagreements between OS2 and Magenta on a potential lock-in situation and transparency in development processes have resulted in a temporary code freeze from OS2 while Magenta continues to develop on a fork with direct relationships with a number of local governments. The Swedish local municipalities have, through Sambruk, continued their development of specific features outside of the ongoing tensions, in collaboration with Magenta.

The governance of OS2borgerPC (the Danish version) is *formally* centred on OS2, yet with some parts *de facto* centred on Magenta. It is, in essence, a packaged version of the open source operating system Ubuntu[356], enabling visitors to use public library PCs in a safe yet easy way through a custom and simplified interface. MedborgarPC (the Swedish version) is supported by Sambruk, in more direct collaboration with Magenta. MedborgarPC provides the same core software system[357], with some key operational and organisational differences in how they are managed and deployed in Sweden, as well as some necessary localisation efforts[358].

Funding for OS2borgerPC or MedborgarPC is largely centralised through OS2 or Sambruk for the Danish and Swedish local governments, respectively. Local governments can also procure directly from a service supplier like Magenta, which has reportedly become more common since tensions emerged between OS2 and Magenta on the development and maintenance efforts of the project[359]. Tensions centre around a wish from OS2 for multiple suppliers, and separation of services (development, maintenance, hosting, support) in contracts, while Magenta is calling for increased bundling of services and a limit

[353] OS2 – Offentligt digitaliseringsfællesskab. (n.d.). *OS2borgerPC*. Available: https://www.os2.eu/os2borgerpc
[354] Sambruk. (n.d.). *MedborgarPC – Publika datorer.* Available: https://sambruk.se/medborgarpc/
[355] Interview with Magenta
[356] OS2borgerPC. (n.d.). *OS2borgerPC Server Image Documentation.* Available: https://os2borgerpc-server-image.readthedocs.io/en/latest/
[357] Sambruk. (n.d.). *MedborgarPC – Publika datorer.* Available: https://sambruk.se/medborgarpc/
[358] Interview with Sambruk
[359] Interview with OS2 Interview with Sambruk; Interview with Magenta

on the number of suppliers involved. Vendor independence and the need for sustainable business models are driving the two sides.

Key Stakeholders

OS2: OS2 is a Danish municipal association focused on enabling its members to initiate and collaborate on common software solutions, mainly in the form of open source. The association today manages 28 projects, with a secretariat providing support[360]. In the OS2borgerPC project, they hold the copyright and governance but have faced challenges in exercising the latter due to a variable focus of the involved local governments, leading to increased bilateral agreements between Magenta and local governments[361]. They have recently pushed for more service supplier independence and transparency in development processes.

Sambruk: Sambruk is a Swedish collaboration of about 150 members, primarily local governments, that co-create and co-maintain digital resources[362]. Similar to OS2, they operate on a membership model that leverages fees paid by local governments, based on their population size per project[363]. In the MedborgarPC project, they work directly with Magenta as a service supplier while ensuring open source principles are maintained. They have contributed to the project through Swedish translation and funding new features like SMS authentication and appointment booking integration[364].

Magenta: Founded in 1999, Magenta is the primary service supplier for both OS2borgerPC and MedborgarPC. Magenta was part of founding OS2 on the service supplier side and developed the original system based on a request from Aarhus Municipality. They provide the solution as a SaaS offering, handling development, security, and maintenance. They currently serve a large number of the Danish local governments and have expanded to serve Swedish local governments through collaboration with Sambruk. Recent tensions have emerged with OS2 over governance and development control.

Borås Public Library: Borås City Library[365] – located in Borås Municipality, Västra Götaland County, Sweden – transitioned to MedborgarPC after years of using Netloan, an expensive and outdated library computer management system[366]. The library connected with Sambruk through another software project and discovered MedborgarPC as a cost-effective open source alternative[367]. The implementation has been largely successful, with MedborgarPC proving significantly faster. Borås covers about 50% of the shared costs and sees the shift to open source solutions as financially advantageous despite the initial investment and the need for enhanced technical skills among library staff[368].

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[360] OS2 – Offentligt digitaliseringsfællesskab. (n.d.). *In English – OS2.* Available: https://www.os2.eu/in-english
[361] Interview with OS2
[362] Sambruk. (n.d.). *Sambruk – Kommunal verksamhetsutveckling.* Available: https://sambruk.se/
[363] Interview with Thomas Wennersten
[364] Ibid.
[365] Borås TME. (n.d.). *The City Library – Borås.* Available: https://boras.com/en/experiences/the-city-library/
[366] Interview with Borås Public Library
[367] Ibid.
[368] Ibid.

Detailed Findings

Adoption and use

OS2borgerPC, the seed of which was created over 15 years ago, originated in the City of Aarhus. The city laid the foundation for the system through the largesse of an IT system, which had an outsized mandate to innovate and do what it wanted[369]. Since then, the system has grown and expanded as an open source collaboration between local governments, in coordination with the OS2 association and service suppliers like Magenta[370].

Today, in Denmark, approximately 50 local governments are customers of the solution, either by participating through OS2 or operating outside the association's framework. Each of the local governments participates in the OS2 in different ways, working with a service supplier (e.g. Magenta) directly or working in a more coordinated way through OS2[371].

In Sweden, the adoption is more recent, with two local governments actively using the system and several others showing interest[372]. To onboard local governments to the system more quickly, Sambruk worked directly with Magenta, the same service supplier who was working with local governments in Denmark[373]. One example was the Borås City Library[374]. Speaking to the experience of adopting the solution, one interviewee noted: *'When we just looked at the numbers and everything like that, we saw this might be an opportunity to [adopt a solution] much cheaper than having the [proprietary system] NetLoan. [...] That's the strength of open source.'* [375]

Denmark has a longer history of open source at the municipal level than in Sweden. Sambruk was more of a traditional municipal association, and its engagement with the world of open source IT has been a relatively recent development[376]. *'Since I've been working in the Swedish municipality for a number of years, we never used open source. That was more or less banned there [...] It [just] wasn't a big deal in Sambruk. They didn't talk a lot about open source stuff.'* [377]

Development and maintenance

Magenta serves as the primary developer and maintainer of the system on behalf of the local governments in Denmark and Sweden, who mostly collaborate through OS2 or Sambruk, respectively[378]. Some development is also procured directly by local governments from Magenta, which today has two developers more or less dedicated to the project.

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[369] Interview with Magenta
[370] Interview with OS2; Interview with Magenta
[371] Interview with OS2
[372] Interview with Sambruk
[373] Ibid.
[374] Interview with Sambruk; Interview with Borås Public Library
[375] Interview with Borås Public Library
[376] Ibid.
[377] Ibid.
[378] Interview with Magenta

The development model has been a source of tension in Denmark, where OS2 has pushed for more service supplier independence and transparency in development processes[379]. OS2 describes how they: '... *have tried to make sure that the project was actually reusable by anyone and not only by contacting Magenta [the current vendor]"*. They further noted how: *'... it's basically minor technical stuff that you would expect from any open source project."* OS2 further adds *"our vision has always been [...] that the project is 'real open source', so any vendor or anyone can download it, install it, start using it, and start contributing to the project. And that wasn't the case."* Magenta, on the other hand, disagrees, noting that reuse is possible but that certain technical capabilities are required, which some local governments may not necessarily possess[380]. In these cases, suppliers such as Magenta can provide support.

Recently, there has been a freeze on the main codebase while these issues are being resolved by a second service supplier, with Magenta continuing development in their own fork of the project[381]. That said, the development of the Swedish version, MedborgarPC, has contributed new features such as SMS authentication and appointment booking integration. *'Magenta would gladly cooperate, I think, around new features. And we have had conversations with them [to] develop SMS and booking facilities, but no municipality in Denmark has shown an interest, as far as I know, to use that functionality.'* [382]

Funding and sustainability

Funding for OS2borgerPC or MedborgarPC is to a large degree centralised through OS2 or Sambruk for the Danish and Swedish local governments, respectively. Local governments can also procure directly from a service supplier like Magenta, which has reportedly become more common since the tensions increased between OS2 and Magenta on the development and maintenance efforts of the project[383].

The association model works similarly for OS2 and Sambruk, though there are some small differences. For local governments organised through OS2 and Sambruk, a base membership fee is provided to the respective associations[384]. An additional fee is provided per solution that a member's local government chooses to adopt. In OS2, the fee is based on the number of inhabitants, while in Sambruk, the fee is based on the number of instances of MedborgarPC used per local government. Those local governments in Denmark that are not organised via the OS2 fund development directly through Magenta[385].

On the OS2 side, the joint funding model for OS2borgerPC is focused on development and maintenance costs, while subscription services are managed directly between the local governments and the preferred service supplier[386].

[379] Interview with OS2; Interview with Magenta
[380] Interview with Magenta
[381] Ibid.
[382] Interview with Sambruk
[383] Interview with OS2; Interview with Sambruk; Interview with Magenta
[384] Interview with OS2
[385] Interview with Sambruk
[386] Interview with OS2

There is a preference from the association for a transparent pricing structure of how funds are allocated between development, maintenance, and services[387]. The project achieved financial sustainability after about three years, when it had enough clients to support two full-time developers[388]. Current challenges include balancing service supplier sustainability with municipal cost expectations and ensuring transparent allocation of funds between different aspects of the service[389].

For Sambruk, the relationships remain stronger with Magenta. Sambruk supports local governments working with Magenta on feature development, maintenance, and customisation[390]. *'It was the easy way to go, and they had a quite fair pricing model. It was a no-brainer for me anyway to go [with Magenta]. But if they had been expensive or so, then we might have considered doing a procurement of another vendor instead.'* [391]

On the service supplier side, Magenta prefers a funding model from the local governments that incorporates continuous development and maintenance costs with the SaaS subscription. A lag in procurement requests from local governments on development and maintenance implies a risk of the number of resources being dedicated to the project. The sustainability and quality of the project, by extension, come at risk due to the lack of continuous maintenance and oversight, and competing solutions taking root[392].

Governance and organisation

The governance structure of OS2borgerPC and MedborgarPC is both complex and multifaceted, incorporating OS2, Sambruk and Magenta from different perspectives. In Denmark, a de facto dual governance structure is emerging with OS2 and Magenta facilitating and orchestrating two parts of the community of local governments, which overlap to a certain extent [393].

From OS2's side, the OS2borgerPC project follows OS2's standardised governance model that they have refined through the years and applies to all of their open source projects[394]. A technical steering committee performs and facilitates the collaborative requirements engineering process and procures the development and maintenance activities accordingly from the service suppliers[395]. Amounts are generally below thresholds, which is why direct procurement can be applied, hence[396]. From Magenta's side, they serve as a focal point for its customers, coordinating requests and development efforts.

[387] Interview with OS2; Interview with Magenta
[388] Interview with OS2
[389] Ibid.
[390] Interview with Sambruk; Interview with Magenta
[391] Interview with Sambruk
[392] Ibid.
[393] Ibid.
[394] Interview with OS2
[395] Ibid.
[396] Ibid.

A transfer of local governments from the auspices of OS2 to Magenta is attributed to a period of inattention from the local governments involved in OS2's governance structure. Today, the governance for OS2borgerPC has reportedly been revitalised, including a dedicated project coordinator helping to facilitate the collaboration.

Between the two factions, differences relate not just to financial matters, but also to issues of choice and autonomy in response to the governance of the solution itself. There are differing views over how contracts are procured and the existence, or lack thereof, of exit strategies for local governments that would like to change how the solution is leveraged, developed, or maintained[397]. Sambruk, by comparison, has a more straightforward relationship with Magenta, operating primarily through a service supplier-client model while ensuring open source principles are maintained[398]. In Sweden, governance is facilitated through Sambruk and its technical coordinators, who maintain communication with concerned members. The engineering requirements were coordinated with Magenta, and the necessary activities were procured accordingly.

The cross-border collaboration lacks formal governance structures, relying mainly on service supplier-mediated coordination. The unique tripartite relationship between OS2, Magenta, and Sambruk creates some complicated dynamics for the cross-border collaboration, given that there is no formal organisation or mechanism for facilitating it. One interviewee noted: *'My intention [has been] that we should have a couple of meetings a year in order to synchronise what we are doing and what they are doing. That hasn't actually happened to a very large extent because [...] Magenta has been doing what OS2 has been saying to them to do. And Magenta has also been doing what we have said to them to do. And they have merged the code in there.'* [399]

In effect, in this relationship, Magenta becomes the hub for developing and maintaining OS2borgerPC, while the governance is managed in clusters of OS2 and Sambruk, as well as directly by single local governments through bilateral direct contacts with Magenta. This seems to be working for now, but there are questions about the long-term sustainability of the model, especially if local governments in other countries or jurisdictions become interested in developing their own business models for customising and maintaining the solution at the local government level.

Lessons Learnt

1. **Local governments should continuously check and review relevant projects to ensure compliance with open source principles and avoid potential lock-in effects.**

The case of OS2borgerPC and MedborgarPC illustrates the real and sometimes challenging realities PSOs face when maintaining and improving open source

[397] Extrapolated from: Interview with OS2; Interview with Magenta
[398] Interview with Sambruk
[399] Ibid.

code over time. In the case of OS2borgerPC, OS2 identified concerns at a late stage, prompting them to contract a second supplier for a code review[400]. This move led to longer-term tensions between Magenta and OS2, the main service supplier, highlighting the importance of transparent and recurring reviews to build mutual trust and prevent misunderstandings. Such practices also support a more balanced competitive landscape by encouraging accountability and ensuring software sustainability, while addressing risks of dependency on a single service supplier.

Local governments should generally strive to retain some technical expertise (internally or through collaborations such as OS2 and Sambruk) and introduce regular checks and reviews of open source projects to ensure adherence to open source principles and good practices in open source software engineering. Over time, this may help to improve code quality and prevent service supplier lock-in.

2. **Procurement should consider market size and turnover in relation to the number of suppliers and service bundling, enabling sustainable business models and open source project maintenance.**

A mutual understanding between local governments and service suppliers is critical to, on the one hand, ensure competitive prices and digital sovereignty, while on the other, ensuring profitable business models for service suppliers, and by extension, a healthy maintenance of the open source projects.

One factor to consider in this balance is the number of service suppliers that are actively procured by the local governments, in relation to the market turnover these local governments make up. After the use of a second service supplier to review the code base of OS2borgerPC and address a number of concerns, the supplier started providing hosting services for the software. From Magenta's point of view, competition is welcome, yet it limits their margins, making it difficult to keep their engineers dedicated to developing and maintaining the project. A second factor to consider regards the bundling of services in the procurement from service suppliers. A separation between development and maintenance activities and operation, support and implementation-related services, as in the case of OS2, enables service suppliers to potentially focus on the latter only.

A consequence is that development efforts are concentrated on one supplier, Magenta, in the case of OS2borgerPC, who will have difficulty in upkeeping their engineers dedicated to the project, when development and maintenance are procured sporadically. Operation, support and implementation-related services provide a higher and continuous margin (based on the business model), enabling the funding of dedicated resources. By requiring service on both development and use from suppliers, local governments will also reduce

[400] Interview with OS2

the risk of lock-in effect further, while strengthening the sustainability by encouraging more investments into the project.

3. **Local governments must decide whether to take an active or passive role in the governance and maintenance of their open source projects and engage service suppliers accordingly.**

Robust and active governance and coordination are crucial for the sustainable management of open source projects. A period of inactivity from OS2's side related to OS2borgerPC led some local governments to engage directly with Magenta, bypassing community structures of the association[401]. This undermined collaborative governance within the association itself and created divisions within the community, which should have been bound to their participation in a collective.

To prevent this, local governments must maintain clear and active communication channels and uphold consistent governance practices. Quarterly meetings to discuss roadmaps are not sufficient, as maintenance is a continuous effort. An alternative approach is to outsource maintenance and lower-level governance to suppliers, while remaining active on high-level roadmap decisions and the strategic matters of the projects. The latter requires extra care in establishing transparent decision-making processes, including recurring reviews, and involving all stakeholders – local governments, service suppliers, and associations – can enhance trust and mitigate the risks of lock-in.

4. **Including suppliers in the governance and planning process from the outset of a project promotes collaboration, awareness, knowledge-sharing, and synergies in development for PSO open source projects.**

Irrespective of whether local governments must decide whether to take an active or passive role in the governance and maintenance of their open source projects, involving suppliers from the outset of open source projects has the potential to foster collaboration, awareness, and knowledge-sharing, leading to more efficient development cycles and better project outcomes. By integrating suppliers into governance and planning processes, open communication can be maintained and misunderstandings avoided. In OS2borgerPC, tensions emerged when local governments communicated directly with the service supplier because they were bypassing established governance channels.

The local governments should still ensure a safe and controlled space where suppliers are not involved. Such a space is needed to discuss procurement and higher-level strategies where they, as customers, can talk freely and without risk of influencing or favouring certain suppliers over others.

5. **Coordinated co-funding and procurement enable a synchronised and consistent communication between users and service suppliers.**

[401] Extrapolated from: Interview with OS2; Interview with Magenta

Coordinated co-funding and procurement are essential for aligning communication between users and service suppliers in open source projects. In the case of OS2borgerPC and MedborgarPC, OS2 and Sambruk implemented their respective co-funding models, where fees are determined by the population size of a local government or the number of instances used. This approach helps distribute costs fairly and encourages broader adoption of both solutions across local governments and libraries.

While direct procurements may be necessary to address specific development needs, as some local governments did with Magenta, even though they were part of the OS2 association, such arrangements can also cause silos and disrupt community cohesion if not properly synchronised. There also needs to be consideration of what role such business arrangements play in impacting development and maintenance across local governments. There could also be some debate over whether this approach scales across countries of different sizes, as opposed to Denmark and Sweden, where the populations are quite small.

In any case, what remains clear from the OS2 and Sambruk example is that a coordinated funding approach enables transparent communication and shared development goals, minimising conflicts and ensuring that the different stakeholders involved remain aligned around a common support model. While it will vary case by case, maintaining a balanced ecosystem should mean that local governments should be encouraged to collaborate through structured co-funding arrangements, promoting a unified approach to procurement and sustaining the PSO open source community.

6. **Local governments should consider generalisability and localisation beyond local use cases early on to enable reuse, but typically require external funding to make this a reality.**

To enable cross-border reuse, local governments sharing solutions and code – even via associations – should generally prioritise generalisability of solutions and the ability to localise them from the start. For MedborgarPC, localisation to Swedish and feature integration were relatively straightforward due to the underlying open source project's maturity (Ubuntu).[402] However, other local governments faced challenges due to high customisation costs, limiting the potential for reuse over time.[403] By way of comparison, a more modular design approach with native localisation support can facilitate broader adoption across local governments with varying cultural and administrative processes.

Conversely, excelling in localisation needs can lead to other challenges for open source development and reuse. For example, while localisation to Swedish from Danish was relatively straightforward, other cross-border use cases might require significant customisation, which might be too expensive for a local open source project, even one supported by an association. This demonstrates the

[402] Interview with Sambruk
[403] Ibid.

need for additional funding sources beyond local budgets to localise solutions for broader use.

External funding, such as national or European grants, can support the development of modular designs and native localisation features, making the software adaptable to different administrative contexts. A funding approach that encourages the development of more customisable architecture that can cater to different local needs might be important if the use of OS2borgerPC continues to expand into other contexts. If it does, planning for generalisability and securing appropriate funding will allow future potential end-users in local governments to maximise the impact and scalability of their projects.

3. Case Study of Golemio

The following is a longer version of a case study included in a comprehensive report titled 'Open Source Software Adoption and Reuse in European Local Governments: A Multiple-Case Study,' available on the OSOR website.

The case study was developed through a combination of secondary research and 4-6 original interviews with individuals representing the local government, community and supplier perspectives on the open source project/collaboration. The insights in the case study were validated through workshops, and specific findings have been reviewed by people originally interviewed for the case study. Insights have been pseudonymised in the case study narrative, but a full list of organisations and individuals participating in the case study can be found in Annex C of the main report.

Introduction

Golemio is a smart city data platform developed and maintained by Operator ICT[404], a joint stock organisation fully owned by the City of Prague. The platform integrates, manages and analyses data from various urban systems, providing a comprehensive data management and analytics platform that enables B2G ('business-to-government') and G2G ('government-to-government') services in Prague and the surrounding Central Bohemia region, particularly in public transit and waste management. While it uses an Open Source Initiative-approved MIT licence[405], Golemio is heavily customised for Prague's specific needs and context[406]. The decision to open source the code of Golemio was done largely for developer satisfaction and transparency (more on this later)[407], and it is governed like a single service supplier open source solution, albeit one owned by a public organisation[408].

[404] Operátor ICT a.s. (n.d.). *We are creating a new Prague.* Available: https://operatorict.cz/en
[405] Open Source Initiative. (2025). *Introducing the new API for OSI Approved Licenses®.* Available: https://opensource.org/licenses
[406] Interview with Operátor ICT (Operational)
[407] Ibid.
[408] Ibid.

Developed with a focus on creating value through data services rather than merely collecting information[409], the platform functions as an intermediary between local government data sources and citizens. Its modular architecture includes integration engines, input/output gateways, and visualisation capabilities, all designed to handle complex data workflows while maintaining flexibility for evolving city needs[410]. The platform processes both real-time sensor data and static information from various local government data sources, with approximately 70% of its use cases focused on public transit, alongside energy consumption and waste management applications.

The platform emerged from Prague's Smart City Initiative in 2016-2017, when the mayor provided substantial funding for smart city development across multiple domains[411]. Rather than centralising all smart city efforts under a single local government organisation, the city strategically launched several pilot projects, including initiatives in waste management, ‘smart benches’, and public transit[412]. Initially, the city purchased a Cisco-based solution through a Czech business as a 1.5-year pilot project, but after approximately 6-7 months, it became evident that an externally-supplied platform could not meet their evolving requirements due to unclear specifications and the need for continuous platform enhancement[413].

This realisation led Operator ICT to make a pivotal decision: develop Golemio entirely in-house using an agile development approach[414]. This transition involved not only organising an internal team using Scrum methodology but also teaching city stakeholders to embrace agile, incremental thinking – moving away from long-term roadmaps toward building team capacity and delivering solutions in short iterations[415]. Since its inception, the development team has grown to approximately 30 people, including developers, data analysts, product managers, and domain experts, working collaboratively to evolve the platform based on the city's emerging needs[416].

The primary use case for Golemio is public transit, where the platform manages data for Prague and the Central Bohemia region's integrated transport system[417]. Operating under a three-sided contract between the City of Prague, Central Bohemia region, and Operator ICT, the platform handles data from 2,000-3,000 buses during peak hours, providing real-time vehicle tracking, journey planning, and analytics for public transit organisations[418]. Central Bohemia contributes approximately one-quarter of the funding for running the platform, with Prague covering the remainder[419].

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[409] Interview with Operátor ICT (Operational)
[410] Ibid.
[411] Interview with Operátor ICT (Operational); Interview with City of Prague
[412] Interview with Operátor ICT (Operational)
[413] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[414] Interview with Operátor ICT (Technical)
[415] Ibid.
[416] Ibid.
[417] Interview with Operátor ICT (Operational)
[418] Interview with Prague Integrated Transport
[419] Ibid.

Beyond public transit, Golemio supports various smart city applications, including waste management, energy monitoring and environmental sensing[420]. The platform serves approximately 500 users, and Operator ICT provides open APIs that allow external developers and organisations to access and utilise city data[421]. This has enabled various integrations, from Google using the public transit data to students leveraging it for analysis projects[422]. While the platform was designed primarily for Prague's specific context and requirements, Operator ICT provides consulting services to other cities interested in implementing similar data platforms, sharing experiences and approaches rather than expecting direct software reuse[423].

The case of Golemio is hard to generalise to the level of normal open source communities; it does demonstrate the advantages of open source software in terms of collaboration and open governance, even in cases where the code or software is not used widely outside of a single jurisdiction. Moreover, its development model offers a positive example of intra-city collaboration. Nevertheless, some challenges remain for Golemio in terms of sharing and reuse, and much of its success remains very limited and context-dependent.

Key Stakeholders

Operator ICT: Operator ICT is a fully local government-owned IT service supplier responsible for delivering software and products to Prague, with a focus on building smart city platforms. They developed the Golemio data platform internally after an unsuccessful attempt to use an external Cisco solution, employing an agile approach with a team of developers and data analysts[424]. The organisation chose to publish Golemio under an open source licence primarily to attract and retain talent, showcase their work, and create transparency, rather than expecting widespread reuse of the platform[425].

Regional Organiser of Prague Integrated Transport (ROPID): ROPID is a public service organisation (PSO) directed by the City of Prague, responsible for coordinating technical resources and supporting the transport system in Prague and Central Bohemia[426]. They serve as an external product owner for IT systems and public transit networks, helping to set priorities, provide specifications, and validate solutions for the Golemio platform[427]. While not deeply involved in technical development, they play a crucial role in defining requirements and guiding the platform's development from the client perspective[428].

City of Prague: The City of Prague provided the initial mandate and significant funding for the smart city initiative in 2016/2017, tasking Operator ICT with

[420] Interview with Operátor ICT (Operational)
[421] Ibid.
[422] Interview with Prague Integrated Transport
[423] Interview with Operátor ICT (Operational)
[424] Interview with Operátor ICT (Operational)
[425] Ibid.
[426] Interview with Prague Integrated Transport
[427] Ibid.
[428] Interview with Operátor ICT (Technical); Interview with Prague Integrated Transport

developing innovative solutions across various domains like public transit, waste management, and public services[429]. As the primary funder and owner of Operator ICT, the city played a critical role in supporting the Golemio platform's development, requiring continuous education about the platform's value and potential beyond simple data collection[430].

Central Bohemia Region: The Central Bohemia Region is a peripheral stakeholder in the Golemio project, paying approximately 25% of the platform's operational costs and occasionally providing requirements or feedback[431]. They are closely integrated with Prague's public transit system, with buses crossing between Prague and Central Bohemia, and benefit from the data analytics and backend services provided by the Golemio platform through a three-sided contract with Operator ICT and the City of Prague[432].

Detailed Findings

Adoption and use

In the case of Golemio, the City of Prague is a producer and consumer of open source, rather than purely a consumer of open source – as seen in some of the other case studies. While produced by Operator ICT, the City's internal IT solutions provider, the PSOs within the city make up the users of the data platform, Golemio. In terms of uptake, the adoption of Golemio within the City of Prague ecosystem has been driven primarily by practical use cases[433], with the team deliberately taking a data-first approach focused on addressing specific local government needs rather than adhering to predetermined standards[434]. This pragmatic strategy has resulted in approximately 500 users across various city departments and affiliated organisations utilising the platform's business intelligence capabilities[435].

The most substantial adoption of Golemio has occurred in the public transit sector, where ROPID (Regional Organiser of Prague Integrated Transport) serves as an engaged external product owner[436]. As part of their mandate, ROPID sets priorities quarterly and collaborates with the Golemio team to define requirements and specifications[437]. As one of the big users of Golemio, ROPID regularly reports tickets for new features or functionality requests, which Operator ICT reacts to and discusses with them on an ongoing basis[438]. They even work on co-defining priorities for each quarter and do regular check-in calls, all of which work to help build confidence in the adoption and use of the system[439].

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[429] Interview with City of Prague
[430] Interview with Operátor ICT (Operational); Interview with City of Prague
[431] Interview with Prague Integrated Transport
[432] Interview with Operátor ICT (Technical); Interview with Prague Integrated Transport
[433] Interview with City of Prague
[434] Interview with Operátor ICT (Operational)
[435] Ibid.
[436] Interview with Operátor ICT (Technical)
[437] Interview with Prague Integrated Transport
[438] Ibid.
[439] Ibid.

When it comes to encouraging other PSOs to use the platform, there is a necessary element of upskilling that needs to take place[440]. For example, they need to train potential technical users or even just civil services to work with both the dashboard they have, which provides data and analytics, and the open API they have, to enable interoperability and integration on the backend[441]. One interviewee described the importance of these elements as follows: *'We have a few types of our outputs or outcomes. The first one is the dashboard. And these outputs are usually customised for the precise or exact client that's for some department of the city hall, for example. [...] The second case is our API, which is mostly [an] open API. So anyone from the world can just register and use our API based on the open API documentation.'* [442]

External adoption beyond Prague's local government boundaries has been selective but significant, particularly with the Central Bohemia region, which contributes approximately one-quarter of the funding for Golemio's operations[443]. This regional collaboration has been especially fruitful for public transit use cases, with the platform providing backend services for ticketing systems and facilitating data exchange between Prague and the surrounding communities[444]. Moreover, the open API approach has fostered additional external adoption, with organisations ranging from Google to local startups and student projects utilising the public transit data feeds[445].

As noted in the interviews, Operator ICT and the City of Prague have found that despite interest from other Czech cities and regions, few have directly adopted Golemio's code due to its customisation for Prague's specific context and the substantial investment required to implement a similar system[446]. As such, few international collaborations happen around Golemio, and it is not a focus of them,even though there has been some discussion of expanding the use of Golemio across Czechia[447]. Instead of widespread code reuse, the impact of Golemio's open source approach has manifested more in knowledge sharing and consultation. The development team has engaged in approximately ten different conversations with interested local governments, including discussions with German cities and the Government of Slovakia[448], though most of these engagements resulted in the adoption of principles and approaches rather than the platform itself.

One learning from this process of external engagement was that solutions like Golemio depend on context. Many smaller cities and regions found Golemio to be 'too big' to adapt to their contexts, opting instead to learn from Prague's experience while building more tailored solutions. *'For the [Prague] region and for the rest of our cities, [Golemio is] too big a project. So we [often] cooperate like in the knowledge base sharing, [even] though they decided not to use the*

[440] Interview with Operátor ICT (Technical)
[441] Ibid.
[442] Ibid.
[443] Interview with Prague Integrated Transport
[444] Interview with Operátor ICT (Technical)
[445] Interview with Prague Integrated Transport
[446] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[447] Interview with City of Prague
[448] Interview with Operátor ICT (Operational)

code of Golemio.' [449] This pattern reflects both the challenges of scaling complex data platforms to different local government contexts and the value of open source as a vehicle for knowledge exchange, in cases where direct technology transfer is not feasible for any reason[450].

Development and maintenance

Since 2017, the development of Golemio has been maintained by Operator ICT, with increasing support and contribution from other city agencies, including ROPID[451]. The platform was released as open source software under an MIT license, though not primarily to encourage code reuse or external contributions[452]. Rather, the open source decision was driven by several strategic considerations: attracting and retaining talented developers who value transparency, improving code quality by making developers conscious that their work would be publicly visible, adhering to "public money, public code" principles, and facilitating potential collaborations with IoT startups and other technology providers[453].

This is a rather unique feature of Golemio's development, not least given the effort it takes to convince the city government to allow the use of an open source licence for Golemio[454]. One interviewee described this phenomenon as follows: *'Why [did] we open source [Golemio]? The main reason is because of developers, because you have to hire developers. That's the toughest thing we're doing. When you're hiring developers, [open source] really helps them to understand what we do, what we work on, and what is the quality of what we do.'* [455]

The platform's open source nature has significantly influenced development practices, with the team maintaining high code quality standards, knowing their work is publicly visible. However, while the platform is open source, external contributions have been limited, with only about ten merge requests received for minor bug fixes[456]. This reality reflects the highly contextualised nature of the platform – while the code is open, its specific design for Prague's needs has meant that direct code reuse by other cities has been minimal, with most external organisations drawing inspiration from the platform's principles rather than its code[457].

More broadly, the development process follows an agile methodology with sprints and iterative development. One interviewee describes the value in: *'... having a team of data analysts and developers that is constantly developing the solutions and doing the data integration and data analytics and providing*

[449] Interview with Operátor ICT (Technical)
[450] Interview with City of Prague
[451] Interview with Operátor ICT (Operational)
[452] Ibid.
[453] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[454] Interview with City of Prague
[455] Interview with Operátor ICT (Operational)
[456] Ibid.
[457] Ibid.

feedback on data so we can enhance the sensors to deliver better products.' [458] The interviewee adds how they: *'... after one or two years, decided to go fully agile, because agile development is [a] really good approach. It's the only approach, actually, that makes sense in this field.'* [459]

This approach has proven particularly valuable in the government context, where traditional waterfall methods often struggle to accommodate evolving requirements. The horizontal cooperation between Operator ICT and other city departments like ROPID enabled collaboration without the constraints typical of public-private contracts, allowing for more flexible requirement definition and adaptation[460]. While this collaboration took time to establish effective meeting cadences and working practices, it has resulted in a more responsive and effective development process tailored to city needs[461].

In this way, it provides a very positive example of horizontal collaboration between government departments, all while using an agile methodology for development and maintenance of the platform. As one interviewee noted: *'It's not typical to use agile methodology in the public sector, [and] it's very hard, maybe even impossible, to use agile methodology in contrast with the private sector. [By comparison,] Operator ICT is owned 100% by the municipality of Prague. It enables us to work in [an agile] way – we can call it something like horizontal collaboration – because we are owned by the same city. I have very positive feelings from this.'* [462]

Golemio's ongoing development and maintenance are uncommonly well-resourced for a local government open source project. Between Operator ICT (primarily) and a few of the other local government organisations, Golemio is managed by a dedicated team of around 30 professionals, almost evenly split between developers and data analysts/product managers[463]. When additional capacity is needed, they integrate external programmers through hiring contractors. These contractors are fully embedded within the team rather than operating as traditional outsourcers[464], an integrated approach which helps to maintain consistency in development practices and culture.

Funding and sustainability

The financial foundation of Golemio rests primarily on funding from the City of Prague, supplemented by a significant contribution from the Central Bohemia region, which covers approximately 25% of operating costs, whereas Prague spends around three-quarters[465]. Additionally, the operation of Golemio by Operator ICT is driven by a profit motive, as the organisation has an incentive to sell the use of the solution to new local government clients[466]. This funding

[458] Ibid.
[459] Ibid.
[460] Interview with Operátor ICT (Technical); Interview with Prague Integrated Transport
[461] Ibid.
[462] Interview with Prague Integrated Transport
[463] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[464] Interview with Operátor ICT (Technical)
[465] Ibid.
[466] Interview with City of Prague

arrangement is formalised through a three-sided contract involving the City of Prague, Central Bohemia Region, and Operator ICT[467]. This contractual arrangement, while unusual in allowing payment of money from one PSO to a local government service supplier, provides the financial stability needed for ongoing development and maintenance of the platform.

Operator ICT also has other sources of revenue and operates under a joint stock organisation model, which has proved advantageous for them in terms of talent management[468]. Beyond the core city funding, the team has established standard business arrangements with various local government companies for specific development work[469]. As stated in the interview: *'In terms of financing and our business model, we have huge funding from the City of Prague, which is sponsoring the development of the platform itself and the core team. But we also have a standard business relation with different stakeholders.'* [470] This business model creates additional revenue streams to support the growth of Golemio, which is not the only project of Operator ICT, but can be considered their flagship[471].

Attracting and recruiting high-quality developers has been central to developing and running an open source data platform for Operator ICT. They have a salary table which makes it easier to provide more competitive salaries for developers and gives them freedom to work on an open source project[472]. Nevertheless, as one interviewee acknowledged, the salaries are a little better than is usual for the government, but the real advantage is the public purpose nature of the work[473]. '*We're hiring developers for lower salaries, but we have to offer them some kind of purposefulness of the work. If I would just like to hire developers and then sell them to different regions, it wouldn't make any sense because people in my team work for the City of Prague and that's what they want to do. It helps me to make a better culture [in the organisation] and there is less split focus.*' [474]

One of the ongoing challenges the Operator ICT team has faced in maintaining financial sustainability has been educating city officials about the nature of platform development and maintenance costs[475]. Many stakeholders in the city government initially expected a one-time investment to suffice, not fully appreciating the ongoing resources required[476]. As described in one interview: '*The first thing that is always very difficult is to explain [to officials] that it's not just about getting the data and visualising them and then suddenly you see what's going on. [It] is about continuous work on data that we should work on as the private companies, which have huge business intelligence teams that are*

[467] Interview with Operátor ICT (Operational); Interview with Prague Integrated Transport
[468] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[469] Interview with Operátor ICT (Operational); Interview with City of Prague
[470] Interview with Operátor ICT (Operational)
[471] Interview with City of Prague
[472] Interview with Operátor ICT (Technical)
[473] Interview with Operátor ICT (Operational)
[474] Ibid.
[475] Interview with Operátor ICT (Operational); Interview with City of Prague
[476] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)

continuously working and working with business owners and creating and helping them to generate the added value.' [477]

The team has had to develop effective strategies for communicating the platform's value proposition and justifying continued investment. That said, it often also struggles to bridge the gap between technical realities and administrative expectations in budget discussions, particularly when the platform is to be published under and maintained under an open source licence[478].

Governance and organisation

Operator ICT has positioned itself as a crucial intermediary between the various parts of the city's departments. It drives and coordinates the roadmap and requirements engineering, while taking input from its various customers, weighing their needs and priorities against the bigger picture. Horizontal collaboration is described as key in enabling these partnerships.

The governance setup enables direct dialogues and horizontal collaboration, e.g., with ROPID, to be more easily possible[479]. This arrangement has been particularly valuable for public transit-related services, where collaboration with ROPID has resulted in an integrated approach for both Prague and the surrounding Central Bohemia region[480]. The approach is supported by a distributed product ownership structure, with dedicated owners for both platform and transport components, ensuring focused development while maintaining overall system coherence. Notes one of the interviewees: '*We have the product owners. For each development team, now we have the two development teams. One is mainly focused on public transport. And the second team is the platform team, which does all other cases, the platform and all other cases – like the sorted way stations and this stuff. And the product owner is responsible for the communication with the client and coherence between core development and transportation.'* [481]

The transit sector has emerged as a particular success story, with strong partnerships enabling sophisticated data integration and service delivery[482]. That said, there are other use cases such as in energy and waste management, some of which are already implemented and others which are in the process of being developed[483]. The team maintains regular engagement with stakeholders to define requirements and priorities, though the depth of collaboration often depends on the technical sophistication of the partner department and their ability to articulate clear use cases[484]. This variability has led to the development of different engagement models, from highly structured collaboration in areas

[477] Interview with Operátor ICT (Operational)
[478] Ibid.
[479] Interview with Prague Integrated Transport
[480] Ibid.
[481] Interview with Operátor ICT (Technical)
[482] Ibid.
[483] Interview with City of Prague
[484] Interview with Operátor ICT (Operational); Interview with City of Prague

like public transit to more flexible, advisory relationships in less technically mature departments[485].

Despite these successes, the governance of the solution remains bound to a single city. Despite some collaboration on public transit networks with the larger Central Bohemia Region that the City of Prague belongs to, actual collaboration outside of Prague and its immediate surroundings is nonexistent[486]. Furthermore, concrete expressions of interest – such as in Germany – have not led to collaborations with other cities and regions, whether they be in or outside of Czechia[487]. Part of the reason for this is the lack of political buy-in needed for a large-scale open source platform like Golemio, as one interviewee noted: *'I consulted with [some cities in Germany]. I told them what needs to be done, what funding they need to get. Ultimately, it's not about the money [though]. It's about the buy-in from the city, from the governments, from the local governments. I told them: 'If you want to do it in the way we are doing it, you need to do a lot of things before building a data strategy and get the funding and have this competence analysis.'*[488]

Lessons Learnt

1. **The lack of an external community could pose a long-term challenge for the sustainability of an open source project.**

While Golemio's open source licence adds transparency and fosters a sense of public ownership, its ecosystem has not yet developed into a robust, collaborative community. Despite being released under an MIT licence and receiving some peripheral engagement (e.g. bug fixes and student use cases), Golemio has seen little in the way of sustained or strategic third-party contributions. This is due in part to the platform's deep customisation to Prague's needs, but also reflects a governance and community model that does not actively cultivate external adoption or development. Unlike other open source civic projects that prioritise modularity and standardisation for broader reuse, Golemio's architecture and roadmap remain tightly controlled by Operator ICT and the City of Prague.

This limited engagement, while useful in the narrow use case of Prague, poses a subtle but meaningful risk to the project as open source software: the project could become overly dependent on a narrow team of internal developers and funders, especially if there were to be changes at Operator ICT. This could potentially undermine its long-term sustainability and create migration challenges, like with many commercial alternatives. Such dependence may undermine long-term sustainability and resilience, particularly if political priorities shift or key personnel leave. Additionally, without a stronger external contributor base, Golemio may miss opportunities for innovation and shared maintenance burden. Recognising and addressing this as a potential risk –

[485] Interview with Operátor ICT (Operational)
[486] Ibid.
[487] Ibid.
[488] Ibid.

rather than a benign side-effect of its unique context – could help the team build a more sustainable and inclusive data platform model in the future.

2. **Public sector agile development is vital for the development of open source software and requires horizontal cross-departmental collaboration and continuous stakeholder engagement and education.**

The shift to agile methodologies in government requires substantial effort to change mindsets. During this process, continuous stakeholder engagement can help to ensure that technical solutions actually solve real problems and deliver meaningful value. In the case of Golemio, city officials were more comfortable with waterfall approaches that specified everything upfront, as this provided more certainty in public spending[489]. The team had to convince stakeholders to try shorter agile cycles and demonstrate value incrementally to build trust in this approach. This required teaching the city how to have an agile way of thinking rather than focusing on the short-term, and instead helping them to focus on building team capacity and delivering in short periods[490].

The most effective implementations of Golemio – for example, in public transit – were a direct result of this agile thinking. Its success was particularly evident in how Golemio managed to integrate data from various city services and departments. The team found that ongoing collaboration with business owners was essential for generating value from the data, rather than just implementing technical solutions[491]. This required significant effort to maintain relationships and ensure continuous engagement across departments, with the team noting that while discussions could be lengthy, they led to better understanding and more productive outcomes[492].

The cultural transformation required to make it happen was not just about changing processes; it required fundamental shifts in how government stakeholders thought about software development and project management. The Golemio team had to demonstrate that while agile might seem less structured than traditional waterfall approaches, it actually provided better value and more responsive solutions for the city[493]. For example, an open source license allowed them to demonstrate the connection between the transparency of building in the open and agile methods[494]. They were successful in proving their responsiveness and ensuring results over short periods, gradually building trust that this new agile approach – and the use of open source principles – could work within government realities and constraints[495].

[489] Extrapolated from: Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[490] Extrapolated from: All Golemio Interviews
[491] Interview with Operátor ICT (Technical)
[492] Interview with Operátor ICT (Technical); Interview with Prague Integrated Transport
[493] Interview with Operátor ICT (Technical); Interview with Prague Integrated Transport
[494] Extrapolated from: Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[495] Interview with Operátor ICT (Technical)

3. **Open sourcing can help with developer recruitment and code quality, even if external contributions are limited.**

Open sourcing was not done solely for intellectual or economic reasons, but was a very pragmatic choice based on how Golemio was being developed and to help attract and retain talent. But the decision to make the project open source was not as easy as initially expected. Some parts of Operator ICT, and in particular the City of Prague, raised concerns, especially from the perspective of the organisation's financial goals[496]. As a joint-stock organisation, albeit one fully owned by Prague, the primary aim was to generate profit. Some individuals were concerned that releasing the code as open source could potentially harm future profit-making opportunities[497]. The discussions with the Operator ICT supervisory board were challenging, as some members worried that making the code publicly available could damage the organisation's competitive edge[498].

After thorough deliberation, Operator ICT ultimately agreed that the long-term benefits of open sourcing the code outweighed the potential risks. The interviews revealed that while Golemio received minimal external code contributions through open source, the long-term effect was that it proved valuable for attracting and retaining developers[499]. The public nature of the code encouraged higher quality standards among the development team, because they knew their code would be published and could focus on quality instead of quantity. The ability to showcase their work also helped with recruitment, particularly important since they often could not match private sector salaries[500].

In this way, open source licensing and principles created a culture of quality and accountability within the development team. Developers knew their code would be publicly visible and potentially scrutinised by peers, which naturally led to higher standards of documentation and cleaner code[501]. This transparency also helped build trust with stakeholders and potential partners, as they could directly examine the quality of the work being done. Even though external contributions remained limited, the mere fact of being open source helped create a more professional and motivated development culture within the organisation.

4. **Building trust with political stakeholders takes time, but it is essential for the sustainable operation of open source software solutions.**

The case of Golemio highlighted how initial challenges included explaining why ongoing platform development was necessary rather than just a one-time investment[502]. The team had to prove their value over time and build trust through delivering results[503]. This process involved learning to communicate

[496] Interview with Operátor ICT (Technical)
[497] Ibid.
[498] Ibid.
[499] Extrapolated from: Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[500] Ibid.
[501] Extrapolated from: Interview with Operátor ICT (Operational); Interview with Prague Integrated Transport
[502] Interview with Operátor ICT (Operational)
[503] Interview with Operátor ICT (Technical)

technical concepts to non-technical stakeholders and demonstrating concrete benefits to the city. As one interviewee noted, they had to prove their quality to both internal and external stakeholders and ensure some results, to build a certain level of trust over time[504].

One key way they built trust with city officials was by working to persuade external companies, such as IoT startups, to share their data with Prague[505]. If they wished to integrate their systems with the data platform, open source code would allow them to create their own connectors, ensuring compatibility with the platform's specifications[506]. This would streamline the process and foster greater collaboration between the city and external organisations. Another way they built trust was related to recruitment[507]. By making the code open source, potential candidates could see the quality of the code, the team's coding standards, and the overall work environment[508]. The open source approach offered the potential for external collaborators to contribute, especially in identifying and resolving vulnerabilities[509]. This fostered a cycle of continuous improvement and collaboration, strengthening collaboration and trust on the team.

This trust-building was particularly important given the need to justify ongoing costs to city officials who might not fully understand the technical requirements, but it extended beyond just demonstrating technical competence. The team had to learn to interface between budgetary and policy language when brokering conversations with the city, effectively becoming translators between technical and administrative domains[510]. They found that trust was built incrementally through successful delivery of smaller projects, which then enabled them to take on larger, more complex initiatives[511]. This approach helped beneficiaries and users of Golemio in Prague to understand that software development and maintenance are ongoing processes, rather than one-time deliverables.

5. **Publicly owned service suppliers can more easily than external providers adopt an agile collaborative development process with their owners.**

The local government-owned organisation structure can be particularly valuable for developing agile, open source solutions, as it allows the organisation to better mediate between technical and policy domains. In the case of Golemio, Operator ICT's public ownership was crucial for enabling agile development of the data platform and the public transit use cases it supported[512]. The horizontal collaboration between city departments and Operator ICT allowed for more

[504] Interview with Operátor ICT (Operational)
[505] Interview with Operátor ICT (Technical)
[506] Ibid.
[507] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[508] Interview with Operátor ICT (Technical)
[509] Interview with Operátor ICT (Operational)
[510] Ibid.
[511] Extrapolated from: All Golemio Interviews
[512] Interview with City of Prague

flexible, iterative development processes that would have been difficult under traditional public procurement rules requiring detailed upfront specifications[513].

Their experience with the initial Cisco solution highlighted this advantage. After trying to work with an external service supplier, they found that requirements were too unclear and evolving for a traditional procurement approach to work effectively[514]. Operator ICT began developing a custom solution to meet its specific needs because those were not met by the previous data platform solution, called Cisco AnyConnect. The local government ownership structure allowed them to pivot more easily to an internal development team that could work more flexibly and responsively with city stakeholders[515]. This enabled them to adopt true agile methodologies, with regular sprints and iterative development that would have been difficult to contract for through traditional procurement processes[516].

Their status as a local government-owned organisation provided other administrative advantages which enabled them to deliver on their work[517]. These advantages included more flexibility in salary structures to attract and retain technical talent, the ability to maintain specialised teams (30 people working on the data platform), and freedom to work horizontally across departments without bureaucratic barriers. As a result, their position as a local government-owned organisation allowed them to effectively balance public service mission with operational efficiency while building and maintaining technical expertise over time. This was especially important in their role as a coordinator across different city departments and initiatives, where they could leverage their technical expertise while maintaining strong relationships with various stakeholders throughout the city government.

6. **Standards are vital for facilitating interoperability and real-world applications when using open source technologies, but they demand a nuanced understanding rather than a 'one-size-fits-all' approach.**

Standards can enable interoperability both within and across jurisdictions, allowing for more rapid migration to – and adoption of – open source solutions, but also often requiring a nuanced approach to standard-setting and implementation. In the case of Golemio, while they use (open) standards selectively where they provide clear value, they found that strict adherence to standards could sometimes limit their ability to solve local problems[518]. For example, the team had found that in many cases, especially with rapidly evolving technologies like IoT sensors, strict adherence to standards could be counterproductive[519].

[513] Extrapolate from: All Golemio Interviews
[514] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[515] Interview with Operátor ICT (Operational)
[516] Interview with Operátor ICT (Technical)
[517] Interview with City of Prague
[518] Interview with Operátor ICT (Technical)
[519] Ibid.

Operator ICT monitors and adopts standards for data sharing and APIs when it makes sense, e.g. in public transport data where there is an established standard (GTFS). In other contexts, such as waste management, technology is outpacing standardisation work, there are no established standards yet and they have not seen a need to impose one as such[520]. Another example was the FIWARE standards for their API, which proved very complicated and covered so many use cases that it became less useful for general users, forcing them to reconfigure their API based on this decision[521].

Thus, standards are important for interoperability, just like open licensing and open APIs, but their value is not universally applicable[522]. For Golemio, Operator ICT took a pragmatic approach, using standards where they enabled meaningful interoperability, but not letting them constrain their ability to solve local problems effectively. Instead, they adopted a 'data-first approach', focusing on what data they needed rather than starting with standards[523]. For their team, development of a new feature or module would typically start with the user needs and data first, rather than drawing from a standard which may not cover the client's needs[524]. This balanced approach proved particularly valuable in maintaining flexibility while still enabling interoperability where it mattered most.

4. Case Study of Digitransit

The following is a longer version of a case study included in a comprehensive report titled 'Open Source Software Adoption and Reuse in European Local Governments: A Multiple-Case Study,' available on the OSOR website.

The case study was developed through a combination of secondary research and 4-6 original interviews with individuals representing the local government, community and supplier perspectives on the open source project/collaboration. The insights in the case study were validated through workshops, and specific findings have been reviewed by people originally interviewed for the case study. Insights have been pseudonymised in the case study narrative, but a full list of organisations and individuals participating in the case study can be found in Annex C of the main report.

Introduction

Digitransit[525] is an open source journey planner platform that integrates multiple public transit modes, including buses, trains, trams, bicycles and e-scooters[526]. As well as being a journey planner, it provides info screen services to several cities and public sector organisations (PSOs) for public transit and other related

[520] Ibid.
[521] Workshop #2
[522] Ibid.
[523] Interview with Operátor ICT (Technical)
[524] Ibid.
[525] Digitransit. (n.d.). *Digitransit – Open journey planner platform.* Available: https://digitransit.fi/en/
[526] Ibid.

services[527]. In addition, it provides third-party APIs to over 10,000 developers using Digitransit data and services for various apps, e.g., map and address APIs that are free to use and leverage in various apps[528].

Digitransit is utilised by multiple local governments to provide journey planning solutions. The platform is provided as a service by Helsinki Region Transport (HSL) to Fintraffic, as well as to the local governments in Finland[529]. In Finland, long-haul bus operators and national railway operators also use Digitransit, but through their own implementations of the platform, as well as being used by HSL and other regional organisations. Digitransit enables local adaptations while maintaining a shared, upstream codebase, fostering cross-border knowledge exchange and innovation. Its flexibility allows for local customisations, enabling cities to adapt the platform to their unique transit networks and user needs[530].

The Digitransit project was motivated by the need for a flexible, open source alternative to proprietary journey planners, enabling better customisability and community engagement for local governments and regions[531]. Its success can be attributed to the open and cooperative approach taken by the Nordic developers. These developers were instrumental in driving both community growth within Finland and international contributions. Since 2014, it has been jointly developed by Fintraffic[532], HSL[533] and Waltti Solutions[534]. The platform provides a user interface and application layer to the upstream open source trip-planning engine OpenTripPlanner (OTP)[535], which calculates potential routes based on input data[536]. Map data is collected from OpenStreetMap[537].

Digitransit was initially released in 2017, following the first stable release of OTP in 2016. Digitransit's financial sustainability is ensured through a state-subsidised three-way funding model between HSL, Fintraffic and Waltti Solutions, covering core development but requiring local governments to fund additional features. Long-term sustainability is also tied to the OpenTripPlanner project, which faces its own financial uncertainties, although a dedicated service supplier could help with governance and cross-border adoption.

Digitransit has evolved into a collaborative ecosystem of open source developers in Finland, and has been adopted and adapted by local governments in Estonia, Germany, and the United States as well[538]. For example, in Estonia, Digitransit is used by the national public transit organisations[539], and in Germany, Digitransit was adopted by the City of

[527] Ibid.
[528] Interview with Helsinki Regional Transport
[529] Interview with Fintraffic
[530] Interview with Helsinki Regional Transport; Interview with Fintraffic
[531] Interview with Helsinki Regional Transport
[532] Fintraffic. (n.d.). *Fintraffic – Safe and Smooth Traffic.* Available: https://www.fintraffic.fi/en
[533] HSL – Helsinki Regional Transport Authority. (n.d.). *Journey Planner, tickets and fares, customer service.* Available: https://www.hsl.fi/en
[534] Waltti. (n.d.). *Waltti – Public Transport Services.* Available: https://waltti.fi/en/front-page/
[535] OpenTripPlanner. (n.d.). *Multimodal Trip Planning Platform.* Available: https://www.opentripplanner.org/
[536] Interview with Entur
[537] OpenStreetMap contributors. (n.d.). *OpenStreetMap.* Available: https://www.openstreetmap.org/#map=7/47.714/13.349
[538] Interview with Digitransit Community
[539] Ibid.

Herrenberg and later by Brandenburg and Berlin, inspired by its successful implementation in Finland[540]. Additionally, the U.S. City of Oklahoma deployed Digitransit with minor UI modifications, showcasing its adaptability to different urban contexts[541]. These international projects have highlighted the importance of maintaining upstream contributions to minimise the maintenance burden associated with forks.

Key Stakeholders

Helsinki Regional Transport (HSL) Authority: Helsinki Regional Transport is the public transit authority for the Helsinki region, which plays a central role in the Digitransit platform. It offers Digitransit to its customers as a tool to plan their public transit journeys. HSL initiated the Digitransit collaboration, initially alongside the Finnish Transport Agency (now part of Fintraffic), and is perhaps the most important and leading organisation in developing the solution. HSL continues to lead collaboration on Digitransit while equally sharing development and staff costs with Waltti and Fintraffic, as well as contributing other data of its own to the platform and ensuring its integration with other public transit services[542].

Fintraffic: Fintraffic is a state-owned company in Finland responsible for traffic management and control across various public transit modalities, and it acts as a National Access Point (NAP) where mobility providers are required to share their data. The mobility data, both static and real-time, can then be accessed via Digitransit, mainly targeting producers and developers of third-party mobility services. In practice, Fintraffic's data department is the main one that works with Digitransit, and they share budget and development costs for Digitransit with HSL and Waltti Solutions. Through their collaboration, Fintraffic (amongst other things) provides data, helps build info screen services, and supports data integration for local journey and route planners[543].

Waltti Solutions: Waltti Solutions Oy is a service supplier organisation that is owned by HSL and 22 urban regions and acts as a partner for IT projects related to public transit in its owner local governments. As part of its mandate, Waltti provides a unified ticketing system used across multiple Finnish cities and regions outside the Helsinki area. To do this, they integrate with Digitransit to provide complementary ticketing services for the journey planning platform. They have a jointly funded product owner and development team with HSL that helps to share costs and development[544].

Entur: Entur AS is a government-owned public transit organisation in Norway that provides the country's national journey planner. It is owned by the Norwegian Ministry of Transport and Communications and has a subdivision that functions as a service supplier for the national journey planner, through

[540] Ibid.
[541] Ibid.
[542] Interview with Helsinki Regional Transport
[543] Interview with Fintraffic
[544] Interview with Helsinki Regional Transport; Interview with Fintraffic

which it collaborates extensively with the OTP community, and by extension, Digitransit. They share some technological approaches, data standards, or development resources with Digitransit as part of a broader Nordic cooperation in public transit information systems. Much of the collaboration happens around Digitransit's use of OpenTripPlanner, which Entur helped to bring together and maintain the second version of[545].

OpenTripPlanner (OTP) Community: An open source community that develops the core journey planning software that powers Digitransit. This community consists of developers who contribute to maintaining and enhancing the routing engine that enables multimodal trip planning functionalities in Digitransit. Entur was responsible for helping to update the OTP software and released another version in 2017[546].

Detailed Findings

Adoption and use

Digitransit has spread differently across regions, in large part due to its flexible and adaptable design that is well integrated with other open source solutions, like OTP, which are used in many other jurisdictions. Across Finland, Digitransit has become the go-to national standard for journey planning, seamlessly connecting multiple cities and public transit types, and HSL keeps the whole system running smoothly[547]. Furthermore, the open source approach and technology taken by the Digitransit community in the national government seems to have been positive for smaller local governments, letting them customise transit solutions without getting trapped in proprietary systems[548]. But despite its widespread use and adoption across Finland, there is still a lack of commercial support options outside government, which creates a real challenge for long-term sustainability.

Some commercial usage is reported, but the knowledge of to what extent is quite limited. In this respect, an interviewee from Fintraffic noted: '*[T]here are some other actors who are using Digitransit functionalities in part of their commercial services, like [a few] real estate companies that are using our address and map data on their services, for example. But how those other companies or organisations are using the Digitransit capabilities and what kind of business model they have, we don't have any knowledge.*' [549]

Germany's adoption story looks quite different. Herrenberg pioneered implementation there, championed by a passionate local government employee who strongly believed in open source solutions[550]. This was not mandated from above, but instead emerged as a strategic move to avoid service supplier

[545] Interview with Entur
[546] Interview with Digitransit Community, Interview with Entur
[547] Interview with Helsinki Regional Transport
[548] Ibid.
[549] Interview with Fintraffic
[550] Interview with Digitransit Community

lock-in[551]. While initially successful, the project eventually hit roadblocks due to short-term funding cycles and not enough maintenance resources, ultimately stalling out[552]. '*In the beginning, they were a bit hesitant to merge things, especially if it wasn't exactly implemented the way they wanted. And then later, they focused more on reducing the burden on forks by also merging things that more or less fit their use case and resource. But this was a long process. And then the project finished, the Herrenberg project, and ever since, it has been there, kind of rotting because nobody really maintained it.'* [553]

Despite some issues in maintaining the project, the Herrenberg effort did spark further adoption in the State of Brandenburg, north of Berlin. In that state, local governments tried to stick close to the original code while adding necessary local tweaks, like integrating German scooter and bicycle providers[554]. As the same interviewee noted: '*[T]hey wanted to copy it to Brandenburg, to the local state around Berlin. They saw that one municipality in Germany could do it and then figured that they could do it too. It was a slightly different setup. It was driven by someone else, but also taking municipalities on board.*' Nevertheless, that project stalled out, and they made similar mistakes, due to, as it was described: '*… a very short-term funding-based nature of how those projects work in Germany, where[by] you can spend loads of money in a few weeks or months, but then things are over, and it's extremely hard to get money or even time after that.*' [555]

This lack of long-term planning and funding was not true in Finland, which could perhaps be attributed to a number of factors, such as a smaller population, cultural cohesion, or even a different attitude towards IT development. Similarly, while not interviewed for this case study, the Estonian use of Digitransit seems to have found more success than the German installations did, possibly for similar reasons[556]. Nevertheless, ongoing maintenance remains challenging, even in the Finnish context, as many smaller local governments simply lack the technical know-how and funding to keep things running smoothly over time[557].

Here, the community stepped up to help address some of these challenges. For example, HSL developers provide support through an active Slack channel[558]. Even in Germany, local entrepreneurs have continued to play crucial roles in customising and deploying the platform, helping to revive some work, even as it languishes in administrations Herrenberg and Brandenburg[559]. Documentation, however, continues to be a pain point, with multiple interviewees highlighting the need for better onboarding materials to help newcomers get up to speed[560].

Despite some of these challenges, it is clear that Digitransit has taken off and been adopted because its technology approach works and builds on top of an

[551] Ibid.
[552] Ibid.
[553] Ibid.
[554] Ibid.
[555] Ibid.
[556] Interview with Helsinki Regional Transport
[557] Ibid.
[558] Interview with Fintraffic
[559] Interview with Digitransit Community
[560] Interview with Digitransit Community

established open source community. While other local governments have not had as much success as Finland has, there are lessons to be learned from its collaboration model. It might be necessary to provide options for installing and maintaining Digitransit through a service supplier model, e.g., by HSL or commercial suppliers.

Development and maintenance

Digitransit's development and maintenance is sponsored by a core group of three actors: HSL, Fintraffic and Waltti Solutions. HSL largely drives Digitransit's development and maintenance, with a dedicated set of coordinators and an internal team working alongside coordinators and/or consultants from several external companies[561]. A representative of HSL described this development and project management approach to coordination as follows: '*... the coordinator role is shared by three different people from different companies. We are meeting weekly – or monthly, depending on the situation – on the development and coordinating [decisions]. Unanimity is the basic need for us; we have to be unanimous on doing things.*' [562]

A lot of the Digitransit development is dependent on working with the OpenTripPlanner community and relies on contributions from Entur – the Norwegian state-owned transport organisation and maintainer of OTP – and others in the OTP community[563]. During the first version of OTP, there were several issues requiring extensive customisation of the Finnish Digitransit solution. Beginning in 2017[564], OTP 2.0 was released after a major revision by Entur, which had – amongst other things – a new algorithm, a different search logic, and a more modular design[565]. HSL can contribute upstream directly to the OTP project, and thereby minimise technical debt and improve HSL's ability to stay up-to-date with the latest releases of OTP[566].

For Digitransit, however, external contributions are less common[567]. One notable exception comes from Germany, where local entrepreneurs have developed features like car-sharing and multimodal public transit planning to meet specific needs in German cities. Getting these contributions merged upstream in Digitransit, however, was a challenge, e.g., due to misaligned priorities between HSL and the German use case and funding constraints[568]. *'Some [features] we have developed are really subtle, but take a lot of time [to merge] due to what the Digitransit codebase looks like. So, if you want to move one button slightly, it takes surprisingly long.'* [569]

Digitransit's development follows a structured workflow. Monthly meetings tackle key development topics, while biweekly sprint and demo sessions allow

[561] Interview with Helsinki Regional Transport; Interview with Fintraffic
[562] Interview with Helsinki Regional Transport
[563] Interview with Entur
[564] Ibid.
[565] Entur. (2020). *OpenTripPlanner 2.0 is here.* Available: https://om.entur.no/aktuelle-saker/opentripplanner-2-0-is-here
[566] Ibid.
[567] Interview with Digitransit Community; Interview with Helsinki Regional Transport
[568] Interview with Digitransit Community; Interview with Entur
[569] Interview with Digitransit Community

stakeholders to prioritise and review new features[570]. The product owner coordinates these efforts, making sure developments align with strategic goals[571]. The broader community can suggest features and join technical discussions via Slack, but integrating community-driven changes into the core platform tends to be a slow, resource-intensive process[572]. One interviewee from Fintraffic noted: '*We try to work as openly as possible, and if there's a new organisation [that] wants to join the development work, of course, it's free for them to do so. There's no fees or anything, [they] just join the Slack channels and read how the development is done. […] So, if you want to come and discuss these kinds of topics and [do] this very grassroots development work, [the community is] meant to be very developer-oriented, even if it takes time to get involved.*' [573]

Funding and sustainability

Digitransit's financial sustainability relies on a joint annual budget split equally between Fintraffic, Waltti Solutions, and HSL. Each organisation provides one-third of the total cost, ensuring baseline development and maintenance[574]. As the funding is entirely subsidised by the state and the three-way arrangement between these three actors, they have not had to give consideration to future arrangements to ensure the sustainability of the codebase. For example, they have not had to think about service suppliers or local government contributions, as everything is financed out of local IT budgets[575].

The three-way funding model between HSL, Fintraffic and Waltti is mainly dedicated to funding core functionality and main use cases. If, for example, a local government wants something beyond the agreed scope, they need to secure their own funding to cover development costs[576]. In Germany, funding constraints created serious headaches for maintaining Digitransit implementations. Cities often secure short-term grants to kickstart digital projects, but lack ongoing support to sustain them[577]. As a result, many Digitransit instances have been left to languish without active maintenance. The Herrenberg project, for example, received initial funding for just a few months, requiring a rushed implementation. After deployment, there was no real plan for continued support, leaving the system to grow outdated and neglected[578].

Another point on Digitransit's funding and sustainability relates to its dependency on the OTP project. OTP is *de facto* maintained by Entur, which provides a substantial part of the financial support for maintaining the OTP codebase, although 80% of development is today mainly coming from the

[570] Interview with Helsinki Regional Transport; Interview with Fintraffic
[571] Ibid.
[572] Interview with Fintraffic
[573] Ibid.
[574] Interview with Helsinki Regional Transport; Interview with Fintraffic
[575] Ibid.
[576] Interview with Helsinki Regional Transport
[577] Interview with Digitransit Community
[578] Ibid.

broader community[579]. That said, Entur itself as a PSO struggles to create financial sustainability for OTP that could create downstream issues later for projects like Digitransit, which are dependent on it. An interviewee from Entur attributes this to procurement processes, which are often not set up in PSOs to support open source stewardship and maintenance[580].

One interviewee suggested creating a dedicated service supplier offering commercial Digitransit support – similar to OpenTripPlanner's approach – which could support work both within Finland and abroad[581]. This approach could help solve some of their challenges related to governance and organisation, which influence the development and maintenance of Digitransit. If they are to learn anything from Entur, though, it's that this can be challenging to implement in practice. The interviewee from Entur notes that: *'We find that we want to have some kind of central funding for OTP, so [that] we can hire an independent project leader or project manager who can manage the project day to day. And typically, we would have no problem to finance such a role together with the other organisations. But being a public organisation – which [has] a lot of laws to abide by when it comes to procurement processes – it is actually quite complex just to get hold of those funds without having to do a procurement process.'* [582]

Despite recognising this gap and potential need, however, no concrete steps have materialised yet for explicitly creating or empowering an entity that can help with cross-border implementations of Digitransit. In this way, the focus remains on making the Digitransit collaboration model financially viable and sustainable in Finland. But, as Digitransit continues to establish itself as a community in its own right, some consideration will need to be given to the impact of funding on processes, and vice versa. Different arrangements may need to be explored to help the project scale and stay sustainable as it does.

Governance and organisation

Digitransit's governance structure is organised yet complex, involving multiple stakeholders across different regions. The core governance team includes representatives from HSL, Waltti Solutions, and Fintraffic. This three-way structure ensures collaborative decision-making, with each entity shaping the platform's strategic direction[583]. Each year, service coordinators from the three core organisations compile a roadmap of proposed developments, but they also meet regularly. In both the roadmap and regular meetings, representatives from each entity review proposals and ideas for ongoing work[584].

New features typically get evaluated based on their business case and alignment with Digitransit's strategic goals. One interviewee exemplified the process: *'We have to be unanimous that [external] funding doesn't hurt the main*

[579] Interview with Entur
[580] Ibid.
[581] Interview with Helsinki Regional Transport; Interview with Fintraffic; Interview with Entur
[582] Interview with Entur
[583] Interview with Helsinki Regional Transport; Interview with Fintraffic
[584] Ibid.

focus, which is the up-and-running service and making the minor improvements. So often it's some smaller, bigger epic that they want to do, which is not needed for us or needed for Waltti, but Fintraffic might have one that they keep funding, and then we have to decide together that it isn't hurtful for the main project.' [585]

While designed to be inclusive, the process often involves compromise, as major decisions require unanimous agreement. As this quote demonstrates, the consensus-driven, structured approach to decision-making between multiple parties can slow down the integration of new features, as various local requirements and priorities need to be reconciled before major changes can be approved[586]. As this process was described, one gets a sense of how it might be slow and occasionally cumbersome. The whole process takes time and effort, and is rather centralised by comparison to some open source communities.

Despite an active community of users and developers, external contributors often struggle to navigate the governance structure, which is highly centralised and focused on Finnish use cases[587]. Unlike OpenTripPlanner with its more formalised open governance model, Digitransit remains largely controlled by Finnish stakeholders. While the governance is well-suited for the needs of a PSO project – and it is part of an established open source community (in this case, the OTP community) – it is not set up to receive external contributions through open source governance.

One interviewee notes of this approach to governance and organisation: *"Yeah, I mean [with Digitransit], it's kind of de facto governance; like, it's their project, and they say that they are open to contributions, which is actually true, but it's not as open as OpenTripPlanner where they have a governance document and where there's votes happening and open calls and so on. It's more [of] an HSL project, I would say.'* [588] The limited amount of external contributions coming from the community can, hence, to certain extents be explained by the relatively closed governance model the project has adopted.

Where they do happen, international contributions to Digitransit mainly flow through the official community channels on Slack and occasional meetings[589]. Some interviewees suggested that greater transparency and streamlined contribution processes could enhance international collaboration and broaden the platform's accessibility[590].

Despite these challenges, through its three-way governance, Digitransit maintains a strong commitment to open source principles, enabling local governments to leverage and customise the platform for their needs. For long-term success, though, stakeholders may need to explore new governance approaches that allow for greater flexibility and inclusivity, particularly as the

[585] Interview with Fintraffic
[586] Ibid.
[587] Interview with Digitransit Community
[588] Interview with Digitransit Community
[589] Interview with Digitransit Community; Interview with Fintraffic
[590] Interview with Digitransit Community; Interview with Entur

platform expands beyond Finland. They will also need to consider what more structured and inclusive contribution models look like.

Lessons Learnt

1. **Multi-stakeholder governance models without clear ownership structures can create challenges for governance of open source development.**

The Digitransit case study reveals how a three-way governance structure between HSL, Fintraffic, and Waltti Solutions introduced complexity that limited external contributions. While decisions required unanimous agreement from all three organisations, this consensus-based approach created bottlenecks in the development process, with interviewees noting that municipalities often provided requirements rather than code contributions. The contrast with OpenTripPlanner's more streamlined governance, which featured weekly developer meetings, clear contribution processes, and a dedicated release committee. This highlights how governance structures directly impact project sustainability and external participation.

The difference in external contribution levels between OTP and Digitransit demonstrates how governance affects community growth. While OTP successfully attracted contributions from Norway's Entur, U.S. cities, and other international participants, Digitransit struggled to cultivate a similar contribution ecosystem despite its usefulness. As one interviewee noted regarding the German implementation, they pushed as many changes as possible upstream, but there was not much responsiveness from HSL's side[591]. This suggests that complex governance can create high barriers to entry, discouraging potential contributors and ultimately limiting a project's long-term sustainability compared to communities with more accessible participation pathways and clearer decision-making structures.

2. **Cross-border collaborative development requires proactive engagement with, and contribution to, upstream communities and dependencies.**

The Digitransit case study demonstrates how open source solutions can create thriving ecosystems that transcend national boundaries. The relationship between Helsinki's Digitransit platform and the upstream OTP project illustrates a broadly successful model of collaborative development across international communities. While the German municipality implementations offer important insights into adoption challenges, the broader significance lies in how OTP serves as a foundation for other such public transit solutions worldwide. The Norwegian experience with OTP, as described by Entur's representative, shows how the professionalising of open source governance – through regular developer meetings, clear contribution processes, and consensus-based

[591] Interview with Digitransit Community

decision making – has strengthened the entire ecosystem, benefiting all downstream implementations, including Digitransit[592].

In this way, the case study highlights the value of investing in a project's upstream communities and dependencies rather than maintaining isolated forks, as well as the importance of community support between projects more broadly. Finland's HSL, Norway's Entur, and other international partners actively contribute to OTP's core functionality, ensuring the platform evolves to meet diverse needs while maintaining interoperability. This collaborative approach has enabled the adoption of OTP-based solutions in cities across the United States, Germany, Estonia, and beyond[593]. The ecosystem's success demonstrates how local governments and other PSOs can leverage shared development resources to create sophisticated transit solutions that would be prohibitively expensive to build independently, while simultaneously fostering innovation through open standards and data exchange frameworks mandated by regulations like Finland's 2017 mobility data law.

3. **Cross-border open source communities need to be responsive and helpful to both new and existing users and contributors.**

Active communication and responsiveness are crucial for sustaining an open source community, especially in cross-border projects. In the case of Digitransit, its early success was heavily influenced by the proactive engagement of Finnish developers, who were committed to fostering a collaborative environment. Their responsiveness to requests from other local governments in Finland[594] highlights the importance of consistent and clear communication channels within open source projects, as it helps resolve immediate issues and also fosters a sense of community ownership. While their engagement was possible in Finland, aided by a similar culture and working dynamics, their collaboration across borders highlighted the complexities of being responsive and collaborating actively. This is common for open source collaborations originating from PSOs, particularly at a local or regional level, but is notably absent in Digitransit, which is a relatively mature collaboration already.

As Digitransit scales internationally, a more robust governance model, perhaps with tiered support structures or funding mechanisms for smaller local governments, might be necessary to help alleviate and remediate some of these challenges. The Herrenberg experience suggests that even with enthusiastic individuals and helpful communities, structural support and guidance for contributions is essential for long-term success[595]. A good model for this is OTP, though they have their own sustainability challenges as well[596]. But by providing support, guidance, and resources, open source communities can lower the barrier to entry for newcomers and encourage active participation. This collaborative spirit not only aids in growing the project but also enriches it

[592] Interview with Helsinki Regional Transport; Interview Fintraffic; Interview with Entu
[593] Interview with Helsinki Regional Transport; Interview Fintraffic
[594] Interview with Helsinki Regional Transport
[595] Ibid.
[596] Interview with Entur

with diverse perspectives and expertise, driving innovation and ensuring its relevance in a global context.

4. **Developing documentation and onboarding processes that lower barriers for newcomers, particularly local governments, is vital for adoption.**

Lowering barriers for new contributors, particularly local governments, is essential for adoption. In the case of Digitransit, some new contributors to the software struggled to become active due to limited documentation, leading to challenges in cross-border implementations[597]. The challenges faced by Herrenberg[598] suggest potential gaps in these areas. In those cases, rapid implementations – driven by the limited funding period – seemed to prioritise speed over thorough documentation and training[599]. This could have contributed to the project's eventual abandonment, as the local government lacked the internal expertise to maintain the system.

One interviewee's comments about Finnish adaptations to OpenTripPlanner struggling to be integrated into the main branch hint at a broader issue with contribution processes[600]. Even if documentation is excellent, there is not always a clear pathway for contributing back to the core project, which can lead to fragmentation and duplicated effort. Local governments, like the City of Herrenberg or the State of Brandenburg, often lacking dedicated development teams, may be particularly vulnerable to this issue[601]. Local governments, typically the end-users or beneficiaries of open source projects like Digitransit, may have limited technical expertise or resources to navigate complex platforms[602]. Therefore, providing comprehensive documentation, tutorials, and support can significantly ease their onboarding process.

By creating means to streamline the initial engagement with the project, upstream developers and maintainers can help downstream users, such as local governments, more effectively utilise and customise the open source solution to fit their specific needs. These dynamics are complicated depending on where the local government is in the ‘stream’. In any case, while strong documentation and onboarding are essential, they must be complemented by a clear and accessible contribution process. Such processes should not only guide local governments on how to use the software but also empower them to contribute their own adaptations and improvements back to the community, fostering a sense of shared ownership and reducing the risk of isolated implementations.

5. **Standards enable broader adoption and reuse of solutions in other contexts or migration to a different platform.**

[597] Interview with Digitransit Community; Interview with Entur
[598] Interview with Digitransit Community
[599] Interview with Digitransit Community; Interview with Helsinki Regional Transport
[600] Interview with Entur
[601] Interview with Digitransit Community
[602] Interview with Digitransit Community; Interview with Helsinki Regional Transport

The use of open standards facilitates the reuse of solutions in various contexts, as they can be easily adapted and customised to fit specific needs without requiring extensive modifications. In the Digitransit case, the use of OpenTripPlanner clearly demonstrates the benefits of open standards, which help to enable cross-border sharing and interoperability[603]. This flexibility is crucial for local governments with diverse existing systems and data sources. In addition to OTP, Digitransit's use of other open standards, like OpenStreetMaps – which has a broad international community – also seemed to enable broader adoption and reuse across different contexts, as it facilitated easier migration between platforms and supported international scalability[604].

However, as the interviewee also notes, even with open standards, challenges remain. The difficulty in integrating Finnish adaptations into the main branch of OpenTripPlanner shows that using open standards is not a silver bullet[605]. Variations in implementation and customisation can still create significant barriers to collaboration and code reuse. Therefore, while open standards are a crucial foundation, they must be complemented by strong community governance and clear contribution guidelines[606], and they may not be appropriate or useful in all circumstances. A better consideration of the context appropriateness of open standards (and APIs) will ensure that local adaptations, while leveraging the flexibility of openness, can also contribute back to the broader project, rather than creating isolated and incompatible implementations.

Regardless of the challenges, open standards are vital for the portability and reuse of open source solutions, particularly for PSOs, who often benefit from economies of scale and tapping into established communities of practice. They play a crucial role in ensuring interoperability and compatibility across different systems and platforms. By adhering to such standards, open source projects like Digitransit open up the possibility of more easily integrating with other software, services, and communities, enhancing their functionality and expanding their potential user base while also providing benefits to code quality and reuse[607]. This not only saves time and resources but also promotes collaboration and knowledge sharing among different communities and projects. Additionally, standards enable easier migration between platforms, allowing users to switch to different systems or upgrade their infrastructure without facing significant challenges in transferring data or functionalities.

6. **Scalability and localisation are important to make open source projects easily adaptable to local contexts and requirements.**

The Digitransit project, by its very nature, needs to be both scalable and localisable. Scalability ensures that the project can grow and adapt to increasing demands without compromising its performance or stability, while localisation is about ensuring the project can be adapted to the specific needs

[603] Interview with Helsinki Regional Transport; Interview with Entur
[604] Interview with Helsinki Regional Transport
[605] Interview with Helsinki Regional Transport; Interview with Entur
[606] Workshop Discussions
[607] Interview with Entur

of different local governments, while also maintaining a core codebase that is manageable and sustainable. In this way, balancing scalability and localisation is critical for the success of open source projects – especially when they aim to serve diverse communities with varying needs and contexts – but hard in practice. One interviewee's comments about trying to have OpenTripPlanner 2.0 as clean as possible suggest an awareness of the challenges of balancing these competing demands[608]. The experience with Finnish adaptations struggling to be integrated into OpenTripPlanner highlights the tension between local customisation and maintainability[609].

While local adaptations are essential for meeting the specific needs of each local government, they can also lead to a fragmented codebase if not properly managed. For example, Digitransit scaled to Germany, but perhaps failed to be localised properly into a different cultural context, leading to forks that increase maintenance complexity and were ultimately left to languish, as seen in Herrenberg and Brandenburg[610]. A modular architecture might help to address this challenge. By allowing for independent updates and customisations, a modular design can enable local governments to tailor the system to their needs without compromising the integrity of the core project. However, this modularity must be coupled with a strong governance model to ensure that valuable local adaptations are shared and integrated back into the main codebase.

For this reason, developing a more modular architecture could enhance scalability and localisation while reducing those maintenance burdens and allowing for more collaboration between upstream and downstream developers. This is a frequent challenge as open source projects scale, and can be seen as especially acute for the private sector, which has less capacity to absorb maintenance and customisation costs. In this way, as projects like Digitransit scale, taking such factors into account can promote the long-term sustainability of the project.

5. Case Study of Consul Democracy

The following is a longer version of a case study included in a comprehensive report titled 'Open Source Software Adoption and Reuse in European Local Governments: A Multiple-Case Study,' available on the OSOR website.

The case study was developed through a combination of secondary research and 4-6 original interviews with individuals representing the local government, community and supplier perspectives on the open source project/collaboration. The insights in the case study were validated through workshops, and specific findings have been reviewed by people originally interviewed for the case study. Insights have been pseudonymised in the case study narrative, but the full list of

[608] Interview with Entur
[609] Interview with Helsinki Regional Transport; Interview with Entur
[610] Interview with Digitransit Community

organisations and individuals participating in the case study can be found in Annex C of the main report.

Introduction

Consul Democracy[611], often referred to simply as 'Consul', is a robust and scalable citizen participation platform that supports participatory democracy initiatives by enabling direct citizen engagement. The platform supports budgeting, collaborative legislation, and citizen consultations, fostering transparency and community involvement in governance. Over time, it has been adopted by various international governments and organisations, making it a key tool for civic participation globally for governments and civil society organisations[612].

Consul is built using Ruby on Rails as its core framework[613], utilising PostgreSQL for database management and integrating Elasticsearch for advanced search capabilities, enhancing user experience. The platform is licensed under the GNU Affero General Public License (AGPL), guaranteeing that any modifications remain open source[614]. Consul's active community of developers and contributors continuously updates the platform, ensuring security, usability, and adaptability to evolving governance needs in different contexts where it is deployed.

Madrid City Council developed Consul originally in the wake of political change on the back of anti-austerity protests, which had started in 2011 and culminated in the elections of 2015. During those elections, it was the reformist and pro-democracy party *Ahora Madrid* that helped bring Consul into the world. The party swept to power in the Madrid City Council elections, largely because of a commitment to initiating political change, most notably through bottom-up democracy[615]. At the same time, similar political changes were happening in Barcelona and many other cities across Spain, a result of bottom-up local government initiatives that were tied into the critiques of left-wing parties and coalitions[616].

The new mayor in 2015 was Manuela Carmena, a politician who was influential in launching *Decide Madrid*, the open source platform that would later become Consul[617]. *Decide Madrid* promised to enable individual voices from across the city to be heard and included in local government decision-making processes. In particular, it was designed to facilitate 'direct democracy' or 'participatory

[611] Consul Democracy Foundation. (n.d.). *CONSUL DEMOCRACY – The most complete citizen participation tool.* Available: https://consuldemocracy.org/
[612] Ibid.
[613] Interview with Former City of Madrid Employee
[614] Consul Democracy Foundation. (n.d.). *CONSUL DEMOCRACY – The most complete citizen participation tool.* Available: https://consuldemocracy.org/
[615] Ibid.
[616] Kleiner, C., & Rogers, S. (2021). *Democratic innovation in the European Union: A case study of the Conference on the Future of Europe*. Social Movement Studies, 21(1–2), 254–271. Available: https://www.tandfonline.com/doi/full/10.1080/14742837.2021.1967121
[617] Cushing Rodriguez, S., & Veciana, E. (2023). *Decide Madrid and Consul Democracy: When the Export Surpasses the Original.* Available: https://democracy-technologies.org/participation/decide-madrid-and-consul/

democracy', allowing citizens to engage in bottom-up decision-making processes such as participatory budgeting and policy proposals[618].

Since its inception, Consul has expanded globally, influencing participatory governance in numerous local governments, regions, and organisations. In the period from 2017 to 2019, Consul gained international traction, especially in Latin America and Europe[619], with an expansion of interest made possible by open community collaboration via the Internet. Since it was released openly, Consul has been widely adopted worldwide, including in cities like Buenos Aires, Paris, and New York, as well as by regional governments and civic organisations[620].

While its use declined a little bit after 2019, the last five years have been characterised by an increasing pan-European collaboration, with large influence coming from Germany, Scotland and,to a lesser extent, the Netherlands. This expansion has forced Consul to evolve into more consolidated modalities for sharing and collaboration, even as the development of formal governance structures has not kept up with the need of contribution and maintenance support[621]. While the Consul Democracy Foundation has focused largely on community-building and collaboration so far, it hopes to improve the governance and financial sustainability of Consul in the year ahead[622].

In spite of these challenges, Consul has proved a successful and durable enabler of direct democracy processes, particularly around participatory budgeting, and continues to provide local governments and other organisations with essential tools for participatory democracy.

Key Stakeholders

Consul Democracy Foundation: The Consul Democracy Foundation was established in 2019 to ensure Consul's continued maintenance as political support from the Madrid City Council declined following elections[623]. Rather than maintaining the codebase with its own developers, the Foundation focuses primarily on community development and expanding the use of Consul internationally[624]. It manages limited funding sources, including an annual €20.000 contribution from the City of Munich, European Union grants, and private donations[625]. The Foundation sponsors annual "ConsulCon" events to facilitate knowledge exchange[626], maintains active communication channels like Slack for the community[627], and has created a certification program for service suppliers that requires them to contribute back to the project and donate a

[618] Ibid.
[619] Interview with Former City of Madrid Employee
[620] Consul Democracy Foundation. (n.d.). *Use Cases – Consul Democracy Documentation.* Available: https://docs.consuldemocracy.org/use_cases
[621] Extrapolated from: Interview with Consul Democracy Foundation, Interview with City of Munich
[622] Interview with Consul Democracy Foundation, Discussion with Consul Democracy Foundation
[623] Interview with Miguel Arana-Catania
[624] Ibid.
[625] Interview with City of Munich
[626] Interview with Consul Democracy Foundation
[627] Interview with COSLA

percentage of revenue[628]. Despite these efforts, the Foundation struggles financially and lacks the capacity to centrally coordinate technical development across the fragmented Consul ecosystem, something it hopes to change.

COSLA (Convention of Scottish Local Authorities): COSLA serves as a central facilitator for Consul implementation across Scottish municipalities, providing technical management, hosting, deployment, and onboarding support[629]. This centralised approach reduces duplication of effort across 32 councils and leverages shared expertise, though it faces capacity constraints[630]. COSLA emphasises the importance of data portability and system interoperability, ensuring local governments have clear exit strategies when adopting open source solutions like Consul[631]. Their approach balances standardisation with local needs to lower barriers of entry for participatory democracy, while also maintaining a degree of control over future developments through proactive planning[632].

Decidim: Decidim originated as a fork of Consul when the City of Barcelona sought more flexibility and customisation options for citizen participation[633]. Unlike Consul, Decidim adopted a modular architecture, allowing for simpler development of new features, easier updates, and enhanced security. This critical architectural choice – modular design – also enabled more localised translations and customisation, fostering a larger international community[634]. Like Consul, the project has since grown beyond its initial Spanish roots, with active communities in Latin America, Europe, and even Japan. The Decidim Association governs the project through a Coordination Committee elected democratically, ensuring community-driven decision-making[635].

Code for Romania: Code for Romania, now operating under Commit Global, began working with Consul in 2019 and deployed the first instance in Brașov, a medium-large city in Romania of about 237.000 people[636], around 2020 to 2021. That first instance focused on participatory budgeting, aiming to implement end-to-end processes before handing them over to local governments to ensure autonomy and prevent dependency[637]. During the transition, Code for Romania emphasised knowledge transfer and maintained independence by avoiding long-term hosting responsibilities[638]. They found the Consul community supportive, particularly collaborating with service supplier Rock&Ror[639], a key contributor to the early project in the City of Madrid. Their approach to deployment included promoting local ownership and leveraging community knowledge for customisation[640].

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[628] Interview with Consul Democracy Foundation
[629] Interview with COSLA
[630] Ibid.
[631] Ibid.
[632] Ibid.
[633] Interview with Decidim Association
[634] Ibid.
[635] Ibid.
[636] Wikipedia contributors. (2023, September 24). *Brașov.* In Wikipedia. Available: https://en.wikipedia.org/wiki/Bra%C8%99ov
[637] Interview with Commit Global / Code for Romania
[638] Ibid.
[639] Research Organization Registry (ROR). (n.d.). *ROR – Research Organization Registry.* Available: https://ror.org/
[640] Interview with Commit Global / Code for Romania

City of Munich: The City of Munich adopted Consul to implement direct democracy digitally, continuing a policy priority from a previous administration[641]. The Open Source Program Office (OSPO), established in 2024, supported Consul through sponsorship and service supplier support, instead of direct code contributions. This was in part due to internal expertise being Java-focused, while Consul is built on Ruby on Rails[642]. Munich became the sole sponsor of the Consul Democracy Foundation, contributing €20.000 annually to support the project's core development and sustainability[643]. Their involvement is strategic and aims to contribute towards securing Consul's future without directly influencing feature development[644].

City of Groningen: The City of Groningen was highly active in the international Consul community early on and played a leadership role in promoting the platform within and beyond the Netherlands[645]. However, their involvement has diminished recently[646]. Groningen's engagement demonstrates the challenges of sustaining momentum and participation in open source projects, especially when local priorities and political landscapes shift[647]. Their experience highlights the importance of maintaining international collaboration and knowledge exchange to support long-term project sustainability.

Detailed Findings

Adoption and use

Adoption and use of Consul have varied significantly across different countries and local governments, shaped by local contexts, resource availability, and strategic goals. Initially developed in Madrid to support participatory democracy, Consul rapidly gained traction across Madrid in 2015 and early 2016, continuing to spread around Spain, and international attention came in 2016 and 2017, all the way through 2019[648]. During this period, it spread to many countries, not just in Europe but in Latin America as well.[649] As one interviewee noted: *'The project [was] a fire that spread around Europe and Latin America, [for example] different cities from Argentina, Guatemala [and] Eastern Europe.'* [650]

The platform's adaptability allowed for diverse implementations, with each local government customising features to suit local needs. However, this led to fragmentation, as multiple forks emerged without a streamlined process for reintegration into a core codebase.[651] In Germany, for instance, localised

[641] Interview with City of Munich
[642] Ibid.
[643] Ibid.
[644] Ibid.
[645]Dussutour, Chloé. (2020). *Voice of Groningen: Case Studies on Sustainability of Public Sector Open Source Communities.* Available: https://interoperable-europe.ec.europa.eu/collection/open-source-observatory-osor/document/voice-groningen-case-studies-sustainability-public-sector-open-source-communities
[646] Interview with City of Groningen
[647] Ibid.
[648] Interview with Consul Democracy Foundation; Interview with Former City of Madrid Employee
[649] Ibid.
[650] Interview with Consul Democracy Foundation
[651] Interview with City of Munich

versions tailored to national requirements resulted in parallel developments that were difficult to reconcile.[652] According to one interviewee: *'I think this is a big problem in the open source world that you have so many projects with no paid maintainers doing so much work. [...] It's a problem [if] you can fork and there is no other maintainer who will maintain the core. For me, it's important that you have a very secure and clean core of your software.'* [653]

The adoption process has also been influenced by organisational models and governance structures. In Scotland, COSLA facilitated implementation across local governments by centralising technical management and costs, lowering the barrier to entry for local governments[654]. This model promoted widespread use but constrained customisation, as individual councils lacked the resources to adapt the platform to their unique needs[655]. Speaking to this, it was noted that: *'All of [COSLA's] technical management is done by COSLA on behalf of the councils or municipalities. We deal with all of the technical hosting and deployment and technical onboarding, and that's one of the bits of the model which works reasonably well, apart from our lack of capacity.'* [656]

Conversely, in Romania, Code for Romania focused on knowledge transfer to ensure local governments maintained autonomy and did not become dependent on external support[657]. This approach highlighted the importance of strategic exit planning and sustainability considerations for long-term success. Reflecting on this process, another interviewee stated: *'It's important for us to make sure that these solutions stay within the municipalities. And [that] we don't become an IT provider for them because all the support we're providing and offering is for free.'* [658]

Challenges in adoption were not limited to technical fragmentation but also involved cultural and language barriers. In the case of the City of Groningen, they were initially highly active in the international Consul community and played a leadership role in promoting the platform within the Netherlands[659]. Over time, they encountered challenges in localising the system to Dutch and maintaining it in a way that met the needs of the Dutch context, which forced Groningen to effectively collaborate with the predominantly Spanish-speaking Consul community and technical core group[660]. Combined with minimal opportunities for local governments to influence the project's technical direction, these factors eventually led Groningen to withdraw from the Consul ecosystem[661].

There were also political barriers. One interviewee highlights: *'There is a political barrier that has to do with the understanding of the governments of what their role is and what they can do. [E]specially for city governments, this*

[652] City of Munich
[653] Ibid.
[654] Interview with Convention of Scottish Local Authorities (COSLA)
[655] Ibid.
[656] Ibid.
[657] Interview with Commit Global / Code for Romania
[658] Ibid.
[659] Interview with City of Groningen
[660] Ibid.
[661] Ibid.

idea of collaborating in international projects and really being a relevant part of it usually is a bit of an alien idea.' [662]

In some regions, participatory democracy was perceived as a politically charged activity, impacting stakeholder engagement[663]. The same interviewee stated: *'In the case of Consul in particular, in some cases, there are governments who [...] could think that citizen participation or that democracy is more like a left-wing political idea. It was not so common during the whole project. Actually, in the Consul project, most of the governments outside of Spain, probably most of them actually were more conservative or right-wing governments.'* [664]

Despite these challenges, Consul has fostered vibrant international communities, facilitating knowledge exchange through conferences, webinars, and active Slack channels[665]. Each year, the Consul Democracy Foundation sponsors ConsulCon, the most recent one of which took place in the Canary Islands in February 2025[666]. Given some of the other challenges in creating a maintainable 'core' for Consul, these communities have been vital for sustaining the project and supporting the diverse needs of global users, proving to be one of the engines of its reach and success as a global open source project and community.

Development and maintenance

After its initial launch, Consul's development was heavily driven by the Madrid City Council, which had initiated its development[667]. The open source approach in the City of Madrid was adopted in large part due to a mandate and pragmatism about choice of tooling, which was made possible by a surprising and generous political mandate from the recent elections, as well as a strong leader in the form of Mayor Manuela Carmena[668]. The use of open source in Decide Madrid was influential and got the attention of many other cities and regions in Spain, including the City of Barcelona[669].

After just 6-12 months, other cities became interested in Consul and its use spread, with active contributions from various stakeholders, including the City of Barcelona[670], and eventually actors from outside Spain[671]. As early as late 2015 or early 2016, there was rapid adoption by various cities and regions. In 2016-2017, the City of Barcelona forked Consul and developed its own open source platform, which came to be known as Decidim. This was partly due to a need for greater oversight of the architecture and customisation options, to meet local needs in Barcelona[672].

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[662] Interview with Former City of Madrid Employee
[663] Ibid.
[664] Ibid.
[665] Interview with Consul Democracy Foundation; Interview with Former City of Madrid Employee; Interview with Convention of Scottish Local Authorities (COSLA)
[666] Consul Democracy Foundation. (2024, June 10). *Consul Conference 2025: Gran Canaria.* Available: https://consuldemocracy.org/2024/06/consulcon25/
[667] Interview with Consul Democracy Foundation; Interview with Former City of Madrid Employee
[668] Interview with Former City of Madrid Employee
[669] Interview with Decidim Association
[670] Ibid.
[671] Interview with Former City of Madrid Employee, Interview with Consul Democracy Foundation
[672] Interview with Decidim Association

Political shifts in Madrid, beginning in 2019 when a more conservative and technology-sceptic government was elected, led to reduced official support for the Consul software, which declined further with the onset of the COVID-19 pandemic in 2020. According to one interviewee: *'[T]his citizen's party that was in the government lost elections, [...] and that happened also in many of the other cities all over the country [as well]. [...] In the case of Madrid, the government was quite right-wing, a coalition with much more extreme right-wing parties. And they started basically going back with a lot of the political decisions that were done during the previous years. But they decided to keep the tool open, which is good.'* [673]

These shifts in political support for Consul Madrid created some uncertainty in how Consul was being developed and maintained in the city, with additional uncertainty caused by elections in other cities. Noted one interviewee of the changes in 2019 in Madrid: *'Then [in 2019] there was a local change in the government. There was a new election. [...] They stopped taking responsibility for the Consul project. So that meant that there was a huge cut in the team. There was no longer responsibility for updating the code, doing security updates, doing new version releases, doing everything that it takes to keep a software viable, usable and safe.'* [674]

A challenge for the long-term adoption and maintenance of Consul in the period after 2019 was the small community of service suppliers supporting the project[675]. In particular, many of the service suppliers emerged in Spain and had direct or indirect connections to the Consul project, allowing them to build up knowledge and understanding of the project that would be hard for other service suppliers to replicate, giving them soft control of the market[676]. That said, the lack of in-house technical expertise in many local governments led to a form of dependency on external service suppliers and NGOs, for better or worse.[677]

Speaking to one of these service suppliers and their relationship, an interviewee noted how: *'I can definitely say that again the most helpful part of the community has been still the collaboration, even before it was a contracted collaboration with the team at [the service supplier] Rock&Ror. They seemed, at least at that moment in time, [that] they were the most actively engaged people, and that was supporting everybody who was trying to deploy Consul. They really helped us.'* [678]

Fortunately, the set-up of the Consul Democracy Foundation had begun in 2018, in large part a proactive measure to anticipate risk should the City of Madrid withdraw support. In a case of fortuitous timing, it was finalised in 2019 as the new government came into power, which helped to ensure the platform's continued maintenance, although only in part[679]. Over time, the role of the Consul Democracy Foundation became focused on community development

[673] Interview with Miguel Arana-Catania
[674] Ibid.
[675] Interview with Decidim Association
[676] Ibid.
[677] Interview with Commit Global / Code for Romania; Interview with City of Munich
[678] Interview with Commit Global / Code for Romania
[679] Interview with Consul Democracy Foundation

and expanding the use of Consul. To this day, they do not have their own developers to maintain it[680].

Partly as a result, but also due to natural changes in any large open source community, additional challenges in development and maintenance persist. These include reliance on a small pool of maintainers, difficulty in securing funding for maintenance over feature development, and adoption challenges wherein local governments face challenges integrating Consul with existing IT infrastructure[681]. Finally, political changes affect long-term adoption and funding commitments, and bureaucratic hurdles in integrating open source software into government workflows remain as well[682].

Funding and sustainability

Initially funded by the Madrid City Council, Consul expanded naturally and freely – in the way many open source projects do – in the period between 2016 and 2019. By maintaining their installation of Consul, the City of Madrid provided a sort of de facto, upfront subsidy to the development of a citizen participation platform for local governments adopting Consul[683]. Further development of Consul, including new features or architecture, was funded largely by participating local governments, and most of it seems not to have made its way back to the core codebase[684].

Since the emergence of the Consul Democracy Foundation in 2019 – an idea from even earlier than that, which was intended to promote the software's technical and financial sustainability – Consul has since transitioned to a model reliant on external contributions, with attempts at diversified funding through grants and sponsorship. For example, as part of a new model for supporting Consul, the City of Munich contributes €20.000 annually to the project via the Consul Democracy Foundation, which is also seeking to get other cities to do so as well[685]. Additionally, European Union grants and private donations supplement local government contributions, and there are financial contributions – whether direct or indirect – from service suppliers implementing Consul for local governments[686]. Nevertheless, the total effect of all this fundraising seems to be insufficient.

The Consul Democracy Foundation itself is circumspect about these challenges, which are often equated with a focus on what's new. As one interviewee pointed out: *'... there's a lot of emphasis always on new features and doing new stuff and innovations and adding [more]. Now you can get funds for adding AI to the platform or something like that. You need to have [these things] if you want to get funded, you need to come up with some fancy new*

[680] Interview with Consul Democracy Foundation
[681] Extrapolated from: Interview with Consul Democracy Foundation; Interview with Former City of Madrid Employee; Interview with Decidim Association
[682] Ibid.
[683] Interview with Former City of Madrid Employee
[684] Interview with City of Munich; Interview with City of Groningen
[685] Interview with City of Munich
[686] Ibid.

feature every time, even if you want to get the funding that you need to just maintain the platform.' [687]

There have been attempts at a diversified funding model, which have helped to sustain the platform. Namely, the Consul Democracy Foundation has developed a certification program with service suppliers with criteria for participation that motivated them to contribute back actively and donate a small percentage of revenue to the project[688]. Despite this, and the money from Munich, long-term financial stability remains a key concern for Consul, as there is (for now) a dependency on ad-hoc funding from a patchwork of sources and in-kind contributions from service suppliers and local governments[689]. That said, both paths offer potentially fruitful and sustainable funding models for the project, if the Foundation can convince more people to come on board and be recurring sponsors or supporters.

The struggles Consul has had in attracting and retaining funding sources stand in stark contrast to the Decidim Association. While Decidim also reported struggles to fundraise, it has been more successful in diversifying its funding and bringing together a patchwork of different sources into better core funding and support for the Decidim codebase and those local governments and actors dependent on it[690]. This may partly be attributed to the amount of time it had to get up and running before the pandemic, whereas the Consul Democracy Foundation was severely constrained during the COVID-19 period[691].

Governance and organisation

During the period from 2016 to 2019, governance of Consul was loosely structured, with contributions from various local governments coming in a fragmented and ad-hoc way[692]. While the City of Madrid was the primary maintainer of Consul, it did so largely by default, as it had initiated the project and invested so many resources into it, though not necessarily because of a conscious choice regarding its governance[693]. There was a lot of collaboration around Consul and sharing of knowledge and information, but it was also true that most cities had their own installations, and new features and code were developed on an ad-hoc basis, with little contributed upstream to a single, maintainable core[694].

Since 2019, when political change happened in the City of Madrid and the Consul Democracy Foundation emerged, the governance of Consul has remained relatively informal. The Consul Democracy Foundation serves as the primary coordinating organisation, but it cannot be regarded as the maintainer, and decision-making is highly decentralised, with most local governments

[687] Interview with Consul Democracy Foundation
[688] Ibid.
[689] Extrapolated from: Interview with Consul Democracy Foundation; Interview with Former City of Madrid Employee; Interview with City of Munich
[690] Interview with Decidim Association
[691] Discussion with Consul Democracy Foundation
[692] Interview with Former City of Madrid Employee
[693] Ibid.
[694] Interview with Former City of Madrid Employee; Interview with Consul Democracy Foundation

maintaining Consul in separate repositories with quasi-forks of the original codebase (there remains a lot of collaboration between cities and through online fora)[695]. This stands in contrast to Decidim, which has adopted a more modular but centralised architecture, and for which the Decidim Association has taken responsibility for coordinating maintenance and contributions with service suppliers and local governments[696].

Despite efforts to maintain the platform, challenges remain in ensuring continuous technical development and central governance due to the change in government in Madrid and the corresponding decline in investment in Consul, which happened in other local governments across Spain, too[697]. The governance of Consul, which had been driven primarily by the largesse of those governments in Spain, was unable to adapt easily. A lack of a clear governance structure has led to fragmented development wherein cities and service suppliers contribute separately, often without merging features back to the core codebase. Noted one interviewee: *'The service providers, some of these providers also are now providing a bit more core development services of the tool. So in that sense now, for example, the developers of the city of Madrid or the big cities are not anymore really taking all the work of the development.'* [698]

As a result, today's contributions to Consul come largely from certified service suppliers, with fewer contributions from local governments and NGOs. Each group plays a different role in shaping the project's development, but at the moment, the governance of the core project is centred on a technical core group with mainly representatives from service suppliers, many of whom date back to the 'Madrid era' of Consul's development[699]. In terms of the active local government contributors, right now it is largely the City of Munich which has played an outsized role in contributing to and requesting features of Consul, though the Scottish Association COSLA has also played a big role in adapting Consul to the unique needs of Scotland[700]. Now, the technical core group (e.g. the service suppliers) takes the main decisions, while ventilating the roadmap with the overall community.

The absence of a strong centralised governance structure has reinforced challenges in governing a unified community – let alone a single codebase – ultimately leading to a degree of fragmentation in community governance between the local governments and the service suppliers. For example, a key concern for sustainability has been the increased distance from cities like Groningen; if there had been a more inclusive/open governance, they might have stayed[701]. This centralisation of power in the hands of the service suppliers is one of the reasons for the continued fragmentation of development on the local government level. Over time, the Consul Democracy Foundation intends to

[695] Extrapolated from Interview with City of Munich; Interview with Commit Global / Code for Romania; Interview with City of Groningen
[696] Interview with Decidim Association
[697] Interview with Former City of Madrid Employee; Interview with Decidim Association
[698] Interview with Former City of Madrid Employee
[699] Interview with Consul Democracy Foundation
[700] Interview with Convention of Scottish Local Authorities (COSLA); Interview with City of Munich
[701] Interview with City of Groningen

involve local governments more long-term[702] and bring the Consul codebase 'back together' to make it less fragmented[703].

Lessons Learnt

1. **Diverse funding and support – e.g., in terms of funders and type of funding (grants, sponsorships, resources) – improves resilience of the project and overdependence on any single actor, particularly as a project scales up internationally.**

The Consul case study illustrates how insufficient funding diversification can fragment communities and create problematic dependencies on service suppliers or systems integrators for both customisation and financial support. Notably, Consul experienced a risk in funding in the aftermath of the 2019 elections when the City of Madrid retracted its support[704]. Furthermore, the Consul Democracy Foundation has struggled to diversify funding since the onset of Covid-19 – with the City of Munich being the only sponsor from the public sector[705] and some funding from the philanthropic arm (foundation) of Bosch[706] – and it often relies on service suppliers to do much needed maintenance work[707], defaulting to more of a community than technical role. This risk and uncertainty reinforce the fact that if a main funder of a project were to pivot, e.g. due to a change in government, projects would risk going unmaintained and 'soft forks' in the codebase might become 'hard forks'[708].

While public sector organisations provide valuable support, relying solely on local government or single-source funding can lead to long-term instability, as can a lack of funding diversification once a project goes into a foundation. In the medium- to long-term, this can compromise the independence of PSOs adopting the software. More diverse models that include community contribution fees, revolving funds, EU grants, and even private donations can help warn against the risks of overdependence on one actor[709]. These additions, while hard to implement in practice for small foundations, illustrate practical pathways to financial sustainability. Core development and maintenance require centralised fundraising to ensure the software remains implementable and maintainable by local governments, and to ensure that it is flexible and scalable for the actors adopting it, many of whom have common needs and use cases.

2. **For an international project to function freely, collaboration across the overarching (cross-border) community must be maintained.**

Structured and inclusive governance is critical when open source product or collaboration gets used increasingly internationally, but it also requires

[702] Ibid.
[703] Discussions with Consul Democracy Foundation
[704] Interview with Consul Democracy Foundation; Interview with Former City of Madrid Employee; Interview with Decidim Association
[705] Interview with Consul Democracy Foundation; Interview with City of Munich
[706] Interview with Consul Democracy Foundation
[707] Interview with Decidim Association; Interview with City of Munich; Interview with City of Groningen
[708] Extrapolated from Interview with City of Munich
[709] Extrapolated from: Interview with Decidim Association; Interview with City of Munich

subcommunities to be built up and fed into the larger community that supports the ‘core’ project. This is true even in cases where there is no single maintainer. In the case of Consul, it became clear that the modular architecture and decentralised community made it challenging for local governments to contribute back and work together around shared feature development or needs[710]. Some expressed the belief that Consul felt like it was being forked by each local government – even if it was not a ‘hard fork’ but a re-configuration according to each local government – with little getting contributed back upstream.

In this way, the Consul case study demonstrates how a steering committee model – with clear roles for local government representatives and product development teams – could help coordinate diverse contributions while preventing fragmentation in the codebase. While this could have, in theory, been the role the Consul Democracy Foundation took, they chose to instead work more on advocacy and diversifying the contribution base for Consul, and have now become more reliant on a group of largely Spanish service suppliers that have been active since the project’s inception. While the intent of the Foundation seems to be to change this, the current centralisation of power in the hands of service suppliers likely means governance needs to change before technical decisions can change, not the other way around.

Open knowledge sharing and community interaction with users from similar contexts and with similar requirements for the solutions is critical for sustainability.

Digital communication channels and online communities are crucial for platform growth in open source projects, particularly in their early stages. Consul's success stemmed largely from its diverse user community of local government and other PSOs sharing knowledge and best practices across (city) borders, which happened organically in its early days as a community. Online collaboration modalities supported the expansion and ultimate consolidation of the Consul community, even as formal fundraising stagnated and governance structures weakened. Yet, as communities grow larger, a risk is that diversity and distance grows between the users. If underpinning needs and ways of communicating grow too large, community members may be forced to look to alternative options, as happened with the City of Groeningen.

The City of Groeningen was missing the ability to share knowledge with peers who have similar requirements and needs from the solution, and discuss and implement the necessary customisations accordingly. Different languages and cultures also posed a barrier to the knowledge sharing of the international community. The city instead opted for an open source alternative solution emerging from other Dutch local governments where they could communicate on a closer level.

[710] Extrapolated from: Interview with Decidim Association; Interview with Commit Global / Code for Romania; Interview with City of Munich

3. **Without more defined governance structures, service suppliers can begin to play an outsized role in technical decision-making, and cities can become reliant on them over time.**

Consul's experience demonstrates how trade-offs in technical choices – e.g. a lack of modularity or centralisation in maintenance – can lead to service supplier dependence and ad-hoc collaboration, with minimal upstream contributions resulting from architectural constraints and a community culture that has been built around that architecture. Compared to Decidim, an open source civic participation platform like Consul, which was forked from Consul by the City of Barcelona in 2016, Consul relies on a highly centralised architecture, which is harder to customise[711]. Another aspect of the challenge comes from the fact that it is programmed in the Ruby on Rails framework, a programming language that fewer developers may be familiar with[712].

Global open source solutions require technical adaptability by modular development, facilitating updates and customisation while accommodating the needs of diverse local government IT environments. That said, this was not always common for Consul, and many cities worked on Consul in silos, partially reinforced by the fact that it was harder to program for without a lot of historical expertise and knowledge, and partially because its architecture made it difficult to commit new features or customisations back upstream[713]. This was made clear in the example of Code for Romania, which worked to adapt Consul to the needs of the City of Brasov and other smaller local governments, eventually developing capacity-building efforts to help train local officials and encourage them to take over ownership of the platform[714]. This was also done in the case of COSLA, the association in Scotland[715].

In this way, a platform's continued adoption depends on its flexibility to meet evolving needs across different social and political contexts. Maintaining a unified codebase serves as a ‘single source of truth’ even as jurisdictions implement unique features. Modular development and a unified yet flexible codebase can help local governments adapt the platform to their local IT environments, as well as reduce dependency on any single supplier. This is not currently the case for Consul, which is dependent more on contributions from service suppliers than local governments, though there is some degree of awareness that this needs to change[716].

4. **With open source projects steered by a foundation, it is important to balance centralisation of governance with the modularity and adaptability of the project.**

Governance structures impact technical decisions, as seen in the challenges Consul faced in maintaining a unified codebase. The lack of a formal

[711] Interview with Decidim Association
[712] Interview with Commit Global / Code for Romania
[713] Extrapolated from: Interview with Convention of Scottish Local Authorities (COSLA); Interview with Commit Global / Code for Romania; Interview with City of Munich
[714] Interview with Commit Global / Code for Romania
[715] Interview with Convention of Scottish Local Authorities (COSLA)
[716] Interview with Consul Democracy Foundation

governance procedure and the reliance on trust-based collaboration led to fragmented development, with multiple forks adapted to different local needs. This decentralised approach has made it difficult to synchronise updates and maintain security across installations. In contrast, Decidim's governance, characterised by democratic elections within the Coordination Committee, helped guide its technical roadmap, reflecting community needs and ensuring more cohesive development across its international community[717].

Initially, the choice to fork Decidim from Consul was driven by architectural constraints that limited customisation and flexibility. The decision to adopt a more modular architecture in Decidim allowed for greater adaptability to local needs, influencing governance by empowering local implementers to contribute to the development and decision-making processes[718]. This modularity also facilitated a more diverse and robust community, enabling decentralised governance structures where cities and regional governments could maintain their versions while still contributing to the core project[719].

In Consul's case, the interplay between governance and technical decisions is also evident in how funding and organisational models influenced project sustainability. Consul's reliance on local NGOs and certified service suppliers for implementation shaped its technical evolution, as these organisations prioritised features relevant to their clients. Conversely, Decidim's funding from PSOs, combined with its community-led governance model, supported a long-term vision that prioritised security and maintainability[720]. These examples illustrate how governance structures and technical decisions co-evolve, shaping both community dynamics and the long-term sustainability of open source projects like Consul and Decidim.

In this view, it becomes clear that there is a need to adopt more balanced approaches. Comparing Consul to Decidim reveals how early architectural and governance decisions can create different outcomes, and how different types of governance may indeed be required in different contexts. In the case of Consul, it could potentially have benefited from a more decentralised, open, and inclusive governance where the key stakeholders – like COSLA or the City of Munich – could be invited and engaged. This could have promoted a better synchronisation across their needs and defragmentation of the various 'forks'. While there is a recognition that this needs to happen, it is hard to change because of decisions made early in the project's lifecycle.

5. **Exit strategies should be defined before adopting an open source project.**

Practitioners and policymakers need to ensure that the adoption of solutions enables migration (e.g. an 'exit strategy') if the project's governance changes, or it is no longer maintainable. Exit strategies can be defined both in terms of getting out of relationships with a service supplier and the ability of an open

[717] Interview with Decidim Association
[718] Ibid.
[719] Ibid.
[720] Ibid.

source project and its data to be taken over by another actor, including a service supplier[721]. This was demonstrated by COSLA's experience with Consul. COSLA recognised the importance of having an exit strategy due to the inherent uncertainty of open source projects, where future development and support are not guaranteed[722].

In particular, COSLA understood that without a clear exit strategy, local governments risked becoming locked into a system that could become obsolete or unsupported, affecting their ability to continue providing public services effectively[723]. COSLA's approach involved ensuring that councils did not perceive open source software solutions like Consul as dead ends. They emphasised the importance of data portability and system interoperability, ensuring that local governments could extract their data and transition to other platforms if needed[724]. COSLA communicated these exit strategies upfront, making the transition to being more open source more persuasive by alleviating concerns about service supplier lock-in and long-term sustainability[725]. This strategic foresight mitigated the risks associated with open source adoption by providing local governments with flexibility and security.

The necessity for exit strategies was also influenced by COSLA's organisational role and funding structure. As an organisation funded by the Scottish government and representing local governments, COSLA aimed to simplify digital transformation for local governments while maintaining a degree of control over future developments[726]. By proactively planning exit strategies, COSLA not only reduced the perceived risks of open source but also supported a more resilient and adaptable governance model[727]. Unlike proprietary software, which often comes with contracts ensuring long-term maintenance and accountability, open source software relies on community contributions and voluntary maintenance. By proactively planning exit strategies, COSLA not only reduced the perceived risks of open source but also enabled resilience and flexibility in the community it supported.

[721] Focus Group #2
[722] Interview with Convention of Scottish Local Authorities (COSLA)
[723] Ibid.
[724] Interview with Convention of Scottish Local Authorities (COSLA); Focus Group #2
[725] Interview with Convention of Scottish Local Authorities (COSLA)
[726] Ibid.
[727] Ibid.