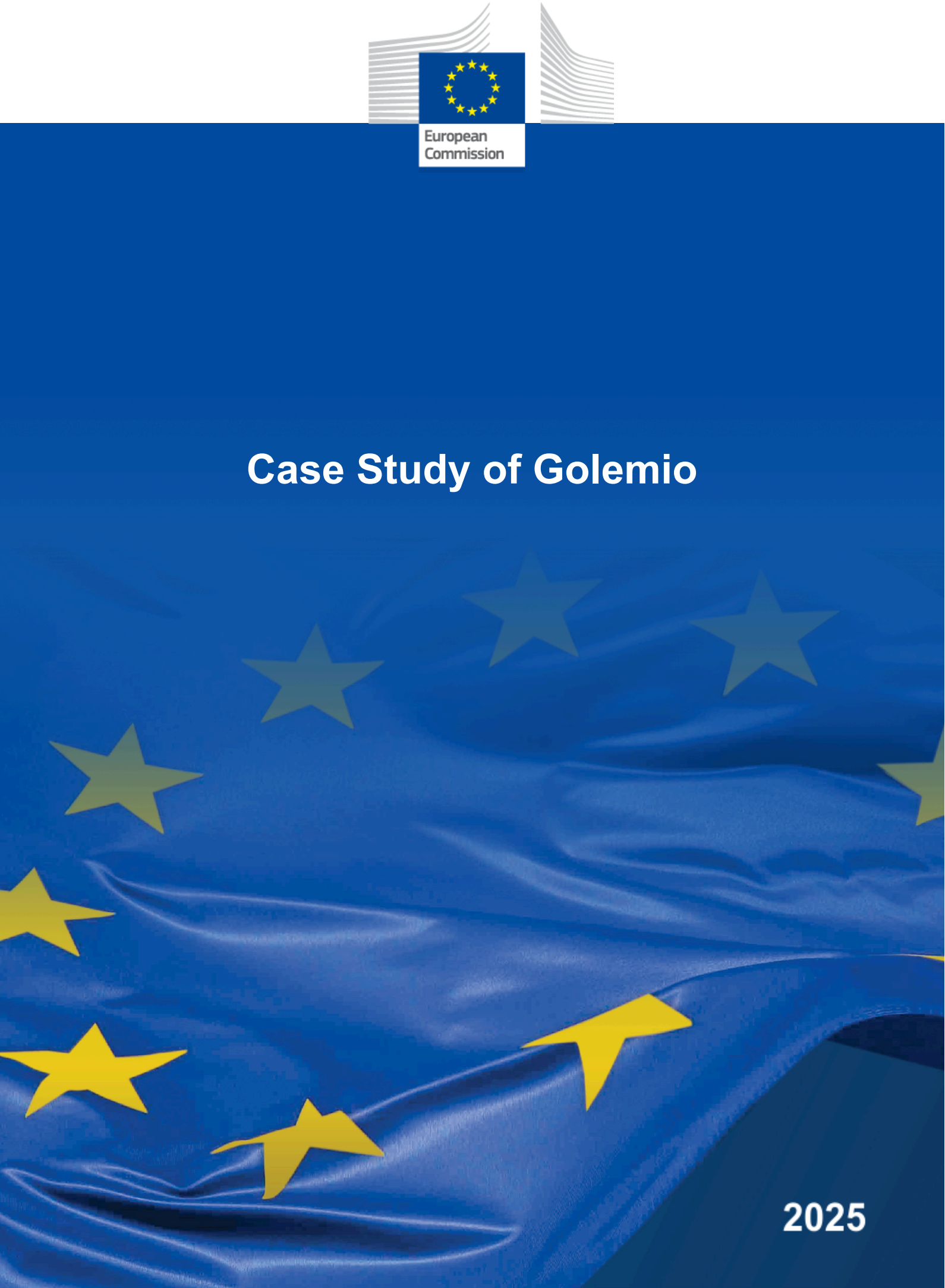

Case Study of Golemio

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Disclaimer

Case Study of Golemio

1. Abstract

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.

2. Introduction

Golemio is a smart city data platform developed and maintained by Operator ICT[1], 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[2], Golemio is heavily customised for Prague's specific needs and context[3]. The decision to open source the code of Golemio was done largely for developer satisfaction and transparency (more on this later)[4], and it is governed like a single service supplier open source solution, albeit one owned by a public organisation[5].

Developed with a focus on creating value through data services rather than merely collecting information[6], 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[7]. 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[8]. 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[9]. 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[10].

This realisation led Operator ICT to make a pivotal decision: develop Golemio entirely in-house using an agile development approach[11]. This transition involved not only organising an internal team using Scrum methodology but also teaching city stakeholders to embrace agile, incremental thinking – moving

[1] Operátor ICT a.s. (n.d.). *We are creating a new Prague.* Available: https://operatorict.cz/en
[2] Open Source Initiative. (2025). *Introducing the new API for OSI Approved Licenses®.* Available: https://opensource.org/licenses
[3] Interview with Operátor ICT (Operational)
[4] Ibid.
[5] Ibid.
[6] Interview with Operátor ICT (Operational)
[7] Ibid.
[8] Interview with Operátor ICT (Operational); Interview with City of Prague
[9] Interview with Operátor ICT (Operational)
[10] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[11] Interview with Operátor ICT (Technical)

away from long-term roadmaps toward building team capacity and delivering solutions in short iterations[12]. 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[13].

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[14]. 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[15]. Central Bohemia contributes approximately one-quarter of the funding for running the platform, with Prague covering the remainder[16].

Beyond public transit, Golemio supports various smart city applications, including waste management, energy monitoring and environmental sensing[17]. The platform serves approximately 500 users, and Operator ICT provides open APIs that allow external developers and organisations to access and utilise city data[18]. This has enabled various integrations, from Google using the public transit data to students leveraging it for analysis projects[19]. 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[20].

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.

[12] Ibid.
[13] Ibid.
[14] Interview with Operátor ICT (Operational)
[15] Interview with Prague Integrated Transport
[16] Ibid.
[17] Interview with Operátor ICT (Operational)
[18] Ibid.
[19] Interview with Prague Integrated Transport
[20] Interview with Operátor ICT (Operational)

3. 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[21]. 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[22].

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[23]. 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[24]. 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[25].

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[26]. 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[27].

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[28]. 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[29].

[21] Interview with Operátor ICT (Operational)
[22] Ibid.
[23] Interview with Prague Integrated Transport
[24] Ibid.
[25] Interview with Operátor ICT (Technical); Interview with Prague Integrated Transport
[26] Interview with City of Prague
[27] Interview with Operátor ICT (Operational); Interview with City of Prague
[28] Interview with Prague Integrated Transport
[29] Interview with Operátor ICT (Technical); Interview with Prague Integrated Transport

4. Detailed Findings

4.1. 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[30], with the team deliberately taking a data-first approach focused on addressing specific local government needs rather than adhering to predetermined standards[31]. This pragmatic strategy has resulted in approximately 500 users across various city departments and affiliated organisations utilising the platform's business intelligence capabilities[32].

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[33]. As part of their mandate, ROPID sets priorities quarterly and collaborates with the Golemio team to define requirements and specifications[34]. 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[35]. 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[36].

When it comes to encouraging other PSOs to use the platform, there is a necessary element of upskilling that needs to take place[37]. 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[38]. 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.'* [39]

[30] Interview with City of Prague
[31] Interview with Operátor ICT (Operational)
[32] Ibid.
[33] Interview with Operátor ICT (Technical)
[34] Interview with Prague Integrated Transport
[35] Ibid.
[36] Ibid.
[37] Interview with Operátor ICT (Technical)
[38] Ibid.
[39] Ibid.

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[40]. 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[41]. 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[42].

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[43]. 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[44]. 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[45], 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 code of Golemio.’* [46] 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[47].

4.2. 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[48]. The platform was released as open source software under an MIT license, though not primarily to encourage code reuse or external

[40] Interview with Prague Integrated Transport
[41] Interview with Operátor ICT (Technical)
[42] Interview with Prague Integrated Transport
[43] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[44] Interview with City of Prague
[45] Interview with Operátor ICT (Operational)
[46] Interview with Operátor ICT (Technical)
[47] Interview with City of Prague
[48] Interview with Operátor ICT (Operational)

contributions[49]. 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[50].

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[51]. 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.'* [52]

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[53]. 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[54].

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 feedback on data so we can enhance the sensors to deliver better products.'* [55] 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.'* [56]

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[57]. While this collaboration took time to establish effective meeting

[49] Ibid.
[50] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[51] Interview with City of Prague
[52] Interview with Operátor ICT (Operational)
[53] Ibid.
[54] Ibid.
[55] Ibid.
[56] Ibid.
[57] Interview with Operátor ICT (Technical); Interview with Prague Integrated Transport

cadences and working practices, it has resulted in a more responsive and effective development process tailored to city needs[58].

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.'* [59]

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[60]. 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[61], an integrated approach which helps to maintain consistency in development practices and culture.

4.3. 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[62]. 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[63]. This funding arrangement is formalised through a three-sided contract involving the City of Prague, Central Bohemia Region, and Operator ICT[64]. 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[65]. Beyond the core city funding, the team has established standard business arrangements with various local government companies for

[58] Ibid.
[59] Interview with Prague Integrated Transport
[60] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[61] Interview with Operátor ICT (Technical)
[62] Ibid.
[63] Interview with City of Prague
[64] Interview with Operátor ICT (Operational); Interview with Prague Integrated Transport
[65] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)

specific development work[66]. 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.'* [67] 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[68].

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[69]. 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[70]. '*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.*' [71]

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[72]. Many stakeholders in the city government initially expected a one-time investment to suffice, not fully appreciating the ongoing resources required[73]. 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 continuously working and working with business owners and creating and helping them to generate the added value.'* [74]

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[75].

[66] Interview with Operátor ICT (Operational); Interview with City of Prague
[67] Interview with Operátor ICT (Operational)
[68] Interview with City of Prague
[69] Interview with Operátor ICT (Technical)
[70] Interview with Operátor ICT (Operational)
[71] Ibid.
[72] Interview with Operátor ICT (Operational); Interview with City of Prague
[73] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[74] Interview with Operátor ICT (Operational)
[75] Ibid.

4.4. 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[76]. 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[77]. 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.'* [78]

The transit sector has emerged as a particular success story, with strong partnerships enabling sophisticated data integration and service delivery[79]. 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[80]. 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[81]. This variability has led to the development of different engagement models, from highly structured collaboration in areas like public transit to more flexible, advisory relationships in less technically mature departments[82].

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[83]. 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[84]. Part of the reason for this is the lack of political buy-in needed for a

[76] Interview with Prague Integrated Transport
[77] Ibid.
[78] Interview with Operátor ICT (Technical)
[79] Ibid.
[80] Interview with City of Prague
[81] Interview with Operátor ICT (Operational); Interview with City of Prague
[82] Interview with Operátor ICT (Operational)
[83] Ibid.
[84] Ibid.

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.'*[85]

[85] Ibid.

5. 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 – 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[86]. 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[87].

[86] Extrapolated from: Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[87] Extrapolated from: All Golemio Interviews

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[88]. 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[89].

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[90]. For example, an open source license allowed them to demonstrate the connection between the transparency of building in the open and agile methods[91]. 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[92].

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[93]. 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[94]. 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[95].

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[96]. The public nature of the code encouraged higher quality standards among the development team, because

[88] Interview with Operátor ICT (Technical)
[89] Interview with Operátor ICT (Technical); Interview with Prague Integrated Transport
[90] Interview with Operátor ICT (Technical); Interview with Prague Integrated Transport
[91] Extrapolated from: Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[92] Interview with Operátor ICT (Technical)
[93] Interview with Operátor ICT (Technical)
[94] Ibid.
[95] Ibid.
[96] Extrapolated from: Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)

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[97].

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[98]. 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[99]. The team had to prove their value over time and build trust through delivering results[100]. This process involved learning to communicate 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[101].

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[102]. 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[103]. This would streamline the process and foster greater collaboration between the city and external organisations. Another way they built trust was related to recruitment[104]. 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[105]. The open source approach offered the potential for external collaborators to contribute, especially in identifying and resolving vulnerabilities[106]. 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,

[97] Ibid.
[98] Extrapolated from: Interview with Operátor ICT (Operational); Interview with Prague Integrated Transport
[99] Interview with Operátor ICT (Operational)
[100] Interview with Operátor ICT (Technical)
[101] Interview with Operátor ICT (Operational)
[102] Interview with Operátor ICT (Technical)
[103] Ibid.
[104] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[105] Interview with Operátor ICT (Technical)
[106] Interview with Operátor ICT (Operational)

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[107]. They found that trust was built incrementally through successful delivery of smaller projects, which then enabled them to take on larger, more complex initiatives[108]. 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[109]. The horizontal collaboration between city departments and Operator ICT allowed for more flexible, iterative development processes that would have been difficult under traditional public procurement rules requiring detailed upfront specifications[110].

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[111]. 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[112]. 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[113].

Their status as a local government-owned organisation provided other administrative advantages which enabled them to deliver on their work[114]. 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

[107] Ibid.
[108] Extrapolated from: All Golemio Interviews
[109] Interview with City of Prague
[110] Extrapolate from: All Golemio Interviews
[111] Interview with Operátor ICT (Operational); Interview with Operátor ICT (Technical)
[112] Interview with Operátor ICT (Operational)
[113] Interview with Operátor ICT (Technical)
[114] Interview with City of Prague

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[115]. 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[116].

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[117]. 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[118].

Thus, standards are important for interoperability, just like open licensing and open APIs, but their value is not universally applicable[119]. 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[120]. 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[121]. This balanced approach proved particularly valuable in maintaining flexibility while still enabling interoperability where it mattered most.

[115] Interview with Operátor ICT (Technical)
[116] Ibid.
[117] Ibid.
[118] Workshop #2
[119] Ibid.
[120] Interview with Operátor ICT (Technical)
[121] Ibid.