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Key success factors of sustainable open source communities

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Introduction

At its inception, the Open Source Observatory (OSOR) initiative was part of the IDABC[1] and ISA programmes. At present, it is funded by the ISA[2] programme[2], under Sharing and Reuse (2016.31) Action[3]. OSOR aims to support the exchange of information, experiences and best practices around the use of open source software (OSS)[4] in public administrations. Over the years, OSOR's role has shifted from an open source observatory and repository (which was the case with the original stand-alone platform OSOR.eu) to the current open source observatory hosted on the Joinup[5] platform. Along with its role, OSOR also changed its name from *Open Source Observatory and Repository* to *Open Source Observatory*. Overall, OSOR aims to serve as a supporting tool for European public administrations that are in the process of adopting and working with OSS.

Recognising the different experiences of public administrations in adopting and maintaining open source software, OSOR has decided to put together Guidelines for Sustainable Open Source Communities in the Public Sector. The purpose of this study is to set the foundation for the Guidelines by analysing what determines the sustainability of public sector open source communities. More specifically, the objective of this study is to identify the key success and failure factors behind the establishment of sustainable open source communities in the public sector as well as to select and analyse relevant case studies of such communities.

The document is structured into the following chapters:

1. Methodological approach – detailing the approach taken to identify the key success and failure factors of sustainable open source communities in the public sector;
2. Literature review – a review of academic and other relevant literature to identify the most recurring factors and examples of sustainable open source communities;

[1] OSOR.EU: Open Source Observatory and Repository, Last update: August 2009.
[2] The ISA² programme supports the development of digital solutions that enable public administrations, businesses and citizens in Europe to benefit from interoperable cross-border and cross-sector public services.
[3] The sharing and reuse action provides the legal mandate for the Commission's activities in the domain of the reuse of IT Solutions; it also promotes best practices through user's communities.
[4] The term OSS is used in this report as an umbrella term that also includes Free and Open-Source Software (FOSS) and Free/Libre And Open-Source Software (FLOSS).
[5] Joinup is a collaboration platform created by the European Commission. It is funded by the European Union via its Interoperability solutions for public administrations, businesses and citizens (ISA²) programme.

3. Public sector open source software community survey – survey design, execution and findings with the objective of fine-tuning the key success and failure factors and further exploring specific examples of such community projects;
4. Case study analysis – an analysis of five case studies illustrating sustainable open source projects in the public sector;
5. Conclusion – summary of the key research findings;
6. Annex I: Public Sector Open Source Software community survey – contains the Community survey questions;
7. Annex II: Sustainability Case Studies – contains the five sustainability case studies.

1. Methodological approach

This chapter describes the methodological approach taken to conduct the study. Section 1.1 summarises the study objectives and scope, setting out the main research questions, while Section 1.2 introduces the overall methodological approach to address the research questions.

1.1 Study objectives

The overall objective of the study is to identify success factors behind sustainable open source communities in the public sector. The final list of success factors will serve as a basis for the Guidelines for Sustainable Open Source Communities in the Public Sector, which will be published separately.

The main objective of this study was made operational through the following research questions:

Table 1 Key research questions

Research Question	Corresponding Chapter
RQ1. What are the key success and failure factors of open source communities for code developers, private sector and public sector?	Chapter 2 Literature review Chapter 3 Public sector open source software community survey Chapter 4 Case study analysis
RQ2. What are some examples of failed and successful sustainable public sector open source community projects?	Chapter 4 Case study analysis

1.2 Overall methodological approach

The methodological approach taken to conduct this study was designed in such a way as to answer the research questions in a structured and rigorous manner. Several qualitative research methods were used, as outlined below.

Step 1 – Literature review

The study began with a literature review in order to identify the most recurring success and failure factors of sustainable open source communities. A combination of more than 30 academic papers and online resources focusing on open source communities were consulted. Given that the central focus of the Guidelines is on the sustainable open source communities in the public sector, reviewed literature looked at both private and public sector open source communities.

The outcome of this step is detailed in Chapter 2 Literature review

Step 2 – Survey addressed to the open source community

In line with the key findings from the literature review, the project team designed a survey targeting the open source community, including OSOR national contact points, specific initiative leaders, open source communities in Europe, and other relevant stakeholders. The main goal of the survey was to identify the best practices in creating sustainable open source communities in the public sector as well

as specific examples of such communities. The survey was also useful for mapping different success factors throughout Europe at the local, national, and supranational levels.

The outcome of this step is detailed in Chapter 3

Public sector open source software community survey.

Step 3 – Case study analysis

In order to further test and validate the identified success factors, a case study approach was taken to analyse successful open source communities. A total of five case studies were selected, which was validated by the Commission Project Officer.

Interviews with initiative leaders and/or members were carried out to complement desk research conducted on each individual case study.

The case studies were published on OSOR Knowledge Centre and served the joint purpose of illustrating success factors within specific contexts and raising awareness about public sector open source projects.

The outcome of this step is detailed in Chapter 4 Case study analysis.

2. Literature review

The purpose of this chapter is to present the analysis of academic literature and other relevant sources of information on the key factors determining the success of sustainable public sector open source communities, particularly as concerns the specificities of such communities. Due to the nature of open source software itself, the communities that develop around it are intrinsically different compared to other types of software communities. In this context, open source projects have been analysed through different lenses of collective organisation in order to better understand them, including: collective-invention (Allen, 1983), private-collective innovation (von Hippel and von Krogh, 2003), and community based innovation (Franke and Shah, 2003), to name a few. For the purpose of this paper, communities of open source software projects are understood as Internet-based communities of software developers who voluntarily collaborate to develop software that they or their organisations need (von Hippel and von Krogh, 2003). Given the online nature of such communities, it is normal for community members to not share the same workplace or even be based in the same country (O'Mahony, 2007). Furthermore, there tends to be no project or community 'owner' per se. Rather, on account of the principles of open source software itself, governance structures tend to develop heterogeneously. Analysing such communities is crucial to our understanding of how such structures emerge and under what conditions. Finally, the fact that membership in these communities is voluntary makes it even more important to examine and understand the factors and incentives that lead to their long-term sustainability.

The literature review consists of two main components – an analysis of the sustainability of open source communities in general and a narrowed focus on open source communities within the public sector.

2.1 Sustainability of open source communities

There is a wide range of literature examining the success of 'open innovation' communities. These can be defined as communities where collaborators and competitors join forces in the pursuit of co-developing technological innovations (Han et al, 2012). Openness, transparency, self-regulation, and self-monitoring are the defining characteristics and the operational norm upon which such communities are formed and sustained (ibid). Similarly, the concept of knowledge collaboration is a critical element of open communities' sustainability. This is because their driving factor is collaborating individuals who share and combine their knowledge in ways that benefit them personally while contributing to the community's greater worth (Faraj et al, 2011).

2.1.1 Analytical frameworks of the sustainability of open source communities

It is important to distinguish between the quality of OSS communities and the factors determining their success. We identified several sources dealing with the quality metrics of open source communities (e.g. QualOSS model). For example, Izquierdo-Cortazar and his colleagues (2010) analysed and applied the QualOSS model to the LibreOffice community and were able to determine the factors

indicating its quality: the time that developers spend working on a release, the time it takes to respond to a bug, the growth of code contributors, the number of events in issue tracking system, the number of events in mailing lists, the number of parties reporting bugs, and the number of parties committing to the community (Izquierdo-Cortazar et al, 2010). However, the community's quality can be seen as a principal factor contributing to its sustainability as a community that has developers working on releases, responding to bugs, reporting bugs and committing to the community will inherently be sustainable over time.

The early stages of our research focused on identifying general factors and characteristics of sustainable OSS communities. The works of Schweik (2013), Naparat et al (2015), and Soto & Ciolkowski (2009) were consulted as a starting point. Schweik investigated the key factors that lead to some open source projects being an ongoing collaborative success while many others were abandoned. He identified three factors that influence a community's success: technological maturity, community health, and institutional attributes. Each of them represents several community characteristics. For example, the technological factor is composed of software requirements, the modularity and granularity of the software, the software's perceived utility, and existing competition. Similarly, the community factor is determined by user involvement, leadership model, social capital, group homogeneity, financing, and marketing strategies. Finally, the institutional attributes are composed of several sets of rules and guiding documents in the communities at the operational level, collective-choice level and constitutional level.

Similar to Schweik, Naparat and his colleagues identified six factors that determine the sustainability of an open source (developer) community: positive member experience, trust in the leadership of the project leader, demonstration of reciprocity, marketing the community, enriching knowledge, and face-to-face meetings. We argue that a healthy open source developer community is one that has a significant number of participants (critical mass) to build software, upgrade it with new releases, and carry out maintenance activities. Having a leader(s) that the community can trust contributes to the quality of the community's output and interactions. Marketing the community is vital for the community's growth, for the visibility of its outputs, and to increase reputational reward for current participants. Enriching communities' knowledge with constant training opportunities and knowledge sharing among participants leads to better outputs from the community. Finally, face-to-face meetings help to foster the sense of belonging to a physical community, which contributes to long-term membership.

Soto and Cialkowski (2009) slightly diverged from these concepts. While they focused on the abovementioned QualOSS model, they extracted specific indicators related to the sustainability of open source developer communities. The authors identify three primary elements that contribute to a community's sustainability:

- Maintenance capacity - number of developers contributing to a project and the amount of time that they are willing to contribute to the development;
- Sustainability - composition of a community and its ability to grow;
- Process Maturity - existence of good practices, the documentation of processes and guidelines, and their level of implementation.

Other writers suggest that the sustainability of OSS projects is also dependent on the type of project that one is considering. Chang et al recognised five different open source community models. Despite

the difference in the operation of the analysed models, they still identify common success factors across all community types: adopting the relevant business models, securing funding or revenues, and reviewing the need to move from one operational model to another (Chang et al, 2007).

This research revealed that private firms have their own list of factors that help them to recognise successful open source communities. More specifically, Shaikh and Levina identified several aspects that managers focus on when assessing a community's viability: the vibrancy of the developer base (number and growth of active contributors), growth in the code base (lines of code), and attention paid to software quality improvements (number of bug reports, testers, and response to questions) (Shaikh and Levina, 2019).

Looking at these frameworks, several common factors that impact sustainability of open source communities emerge: the health of the community, its clear governance structure, technological maturity, and sustainable funding. The rest of this chapter will focus on each of these aspects in more detail.

2.1.2 Factors of sustainability of open source communities

Community vibrancy

The health of the OSS community appears to be one of the core factors that influences the sustainability of OSS projects and is composed of many different elements such as the motivation of core members, community growth, and community culture. The key finding of Gamalielsson and Lundell's research (2014) is that healthy communities are those which are supportive, diversified and independent.

Members' motivation: Given that open source communities normally comprise volunteer participants, maintaining member motivation is crucial for communities' long-term survival. This assumption is also echoed by Schweik (2013) who found that developer's motivation is a pivotal sustainability factor and is often driven by fulfilment of user-centric needs (developers and members *must* perceive value from being part of the project). Conversely, erosion of participants' motivation was found to threaten communities' sustainability (Naparat et al, 2015). Accordingly, the solution to limiting the erosion of participants' motivation lies in the timely delivery of software solutions and the existence of a good community culture, which helps all members see themselves as useful and enjoy smooth working relationships. Similarly, Shah (2006) shows that reciprocity is a crucial factor for motivating contributions to the community. Discussions on software-related developments should be conducted through the lens of the community rather than individual needs. This is to motivate developers to contribute their ideas.

Reputational benefits experienced by participants in the open source community appear to be another recurrent motivational factor in the literature (Von Hippel, 2003; Naparat et al, 2015; Baldwin et al, 2006). The more visible the outputs of the community and the more acknowledged the contributions of individual members are, the higher the reputational benefits experienced by community contributors. From an organisational perspective, member motivation is maintained when there are clearly defined

roles for members (Crowston et al, 2004). This is further elaborated on in the section on governance structures.

In their paper, von Krogh et al (2012) identified five dimensions associated with institutional and social practices that impact one's motivation to contribute source code, namely governance, community sponsorship, provision of rewards, licence restrictions, and social and technical exposure to the community. Governance refers to the contribution of individuals and/or organisations working on an OSS development project. Community sponsorship is the control exercised by organisations over the various stages of code development. The provision of rewards dimension applies to the incentive structure of rewarding participation. Licence restriction can be applied to proprietary software alone or in combination with OSS in order to sell a software solution. Finally, the social and technical exposure to the community dimension refers to the process of creating new opportunities and tasks for the community.

Community vibrancy: The community should be healthy and grow at a healthy pace over time by attracting and sustaining new members. OSS community members can be thought of and divided into two groups: core developers whose contribution to the project is vital and members who participate in the community but are arguably less invested than the core. The latter can be referred to as the *periphery* of the community (Crowston and Howison, 2006). The periphery of the community can be viewed as a "cloud", which "orbits" the core developers (Rullani and Haefliger, 2013). Despite not being core members, periphery members are of great value to the community. They submit bug reports, contribute to forums, and may bring ideas from other projects. In the end, they too can potentially become core members (Crowston and Shamshurin, 2017). Hence, an active and growing periphery is an important indicator of a community's vibrancy.

Shaikh and Levina found that the vibrancy of the developer base is associated with a healthy level of participant turnover and a realistic number of opportunities for new members to rise in influence and to become part of the core group (Shaikh and Levina, 2019). Barriers to community entry need to be appropriate, and new members should be well integrated by having suitable tasks or forums to contribute to. It has been proven that participants who contribute to forums and signal their level of knowledge to the community are more likely to be recognised as its new members and thus become active participants (Krogh et al, 2003). Therefore, such behaviours should be encouraged.

Community culture: A healthy culture within the community encourages member participation. Research conducted by Schweik (2013) found that social capital is built through regular open source communication channels (sessions, emails, websites, and bug tracking systems). This finding is confirmed by Crowston and his colleagues who found that coordination between developer teams is a key component of an open source community, which, by definition, is characterised by little or no face-to-face interaction among members (Crowston et al, 2004). The implementation of coordination practices and establishing project teams can contribute to the community's health. This is also echoed by Naparat's research on the importance of face-to-face meetings that were found to help foster a sense of belonging to a physical community, thus securing its long-term membership. Similarly, Crowston and his colleagues discovered that teams with higher levels of socialisation, conversation, and narration are more likely to develop shared mental goals (Crowston et al, 2004).

Clear governance structure

Clear and efficient governance appears to be another key element of sustainable OSS communities. The importance of a clear governance structure is recognised by the Linux Foundation, which states that 'almost every open source project has some structure, and the best projects will have the structure and project governance clearly described on the project website or in the documentation.'[6] To function efficiently, an open source community needs clear leadership, rules, and guidelines to organise itself as well as measures assuring efficient coordination between the developers and teams.

Leadership: Core leadership skills were found to play a significant role in open source communities: assertiveness, commitment, communicativeness, experience, helpfulness, personality, presence, vision, and responsibility (Sturmer, 2005). Furthermore, Schweik advises leaders of young OSS projects to administer the project well by clearly articulating its vision and goals through project communication channels and maintaining good documentation for potential new developers and the user community through these channels. For more mature projects, leaders focus their efforts on making sure that there are enough tasks that community members can contribute to (Schweik, 2013).

Rules and guidelines: Gamalielsson and Lundell show that sustainable OSS communities need to have clear leadership, congruence in terms of goals, and a clear governance structure (Gamalielsson and Lundell, 2014). More specifically, open source communities stand to benefit from the development and implementation of guidelines.

According to Gamalielsson and Lundell, there are three types of governance models in relation to rules. In young communities, governance is usually self-driven and happens spontaneously with rules and procedures based on needs. As communities become more mature, they implement formal internal control and coordination mechanisms. Finally, once communities start attracting outside attention, the need for appropriate rules on how to cooperate with these parties arises (Gamalielsson and Lundell, 2014). Schweik's findings further validate the importance of rules and guidelines (Schweik, 2013). In his opinion, it is necessary to differentiate between young and mature projects when implementing the community's governance structure. Young projects need strong efforts to structure the functioning of developer teams, set project goals and milestones, and build coordination mechanisms between participants. In contrast, rules governing a mature project's collaboration can be lean and more informal. The need for flexible organisation is underlined by the work of O'Mahony and Ferraro. While technical proficiency is an important criterion for leadership in open source communities, the writers' findings highlight a preference for 'hands-off leaders' who do not undermine the democratic characteristics of the community (O'Mahony and Ferraro, 2007).

Coordination: A vital aspect of an efficient open source community governance structure is being able to fully benefit from knowledge collaboration through successful coordination. Knowledge collaboration is critical to the sustainability of open source communities as individuals share and combine their knowledge in ways that benefit them personally while contributing to the community's greater worth (Faraj et al, 2011). In the authors' view, there is a need to strike a fine balance between active and less active participants. Whilst the former may bring great value to projects, they can tend to

[6] https://www.linuxfoundation.org/resources/open-source-guides/participating-open-source-communities/

overshadow other, less active community members. The authors encourage the flexible creation of roles, allowing for self-assigning of responsibilities where appropriate. Clear communication and a good level of engagement will also help to keep all participants well-informed and to avoid any conflicts. Crowston and his colleagues also recommend minimising dependencies by structuring and organising teams so that they have clear responsibilities and implementing coordination practices (Crowston et al, 2004).

Technological maturity

The sustainability of an open source community is also driven by its technological maturity. Both the quality of the outputs and the structure of the software itself are key factors in maintaining developers' motivation, building a community's reputation and attracting new members.

Output quality: According to Crowston and his colleagues, the success of an open source community can be evaluated with the following four output quality indicators: software creation and maintenance, code base quality, software use, and system consequences (Crowston et al, 2006). The community's work on software creation and maintenance is a good proxy indicator of a software's maturity, highlighting the levels of open source community's activity, the level of task completion, and programmers' productivity. The code base quality measurement is composed of the code quality, its manageability, and the quality of the supporting documentation. Software use quantifies user satisfaction, the number and interest of users as well as the effectiveness of community support when dealing with bugs and problems encountered by users. Finally, system consequences relate to the consequences of successful code base such as learning by developers, knowledge creation, future income, and removal of competitors.

Software structure: The technological maturity of an open source community also depends on the characteristics of the software's code base. For Baldwin and his colleagues, the OSS code architecture is a key factor in mitigating free-riding whereby developers only use the code but do not contribute to it (Baldwin et al, 2006). Their findings reveal that a modulated code base and the presence of option values increase the likelihood of developers' active participation. These characteristics must be taken into consideration when structuring the software architecture.

Sustainable funding

The final factor influencing the sustainability of an OSS community is its financing. The involvement of private companies in the development of open source solutions remains key to the viability of the sector.

Calculated private sector involvement: Butler and his colleagues discuss two main means of private sector contributions to OSS communities: technical and financial (Butler et al, 2019). Technical contributions can include bug reporting, feature requests, or technical support while financial contributions can include donations or employee placement. These findings are confirmed by Lakhani and Wolf (2005) who show that 40% of contributors to OSS projects are paid to participate. However, financial support for OSS projects is not as straightforward as one might assume. Whilst, on first

inspection, it might appear as though OSS communities benefit from large company support, both the communities and private companies make calculated decisions on their cooperation. For example, the Linux Foundation recognises that OSS communities can be wary of organisations that try to enforce direction and their own vision on the community[7]. From the company perspective, Shaikh and Levina identify four existing factors that companies consider when deciding to partner up with OSS communities: value offering, long-term reliance, compatibility of partnership, and health of the ecosystem (Shaikh and Levina, 2019).

Building a sustainable business model: In her paper, Krylov and her colleagues explore what constitutes sustainable financing of open source communities (Krylov et al, 2015). In their view, a sustainable approach to a community's financial model could involve selling of support, consulting services, or interfaces as well as 'bonus' products whilst the software source code itself remains free. The authors compared this business model to "giving away automobiles but charging for the mechanic". This is often referred to as the value-added services model (Fitzgerald, 2006). Krylov et al.'s findings are shared by the scholars Shaikh and Levina who claim that an open source community's commercial acceptance is a key criterion to assess the health of a community and possibilities of private partnerships (Shaikh and Levina, 2019). They find that a shift occurs in private organisations' assessment of partnerships with OSS communities: from value capture to value creation.

This section described several factors that influence the sustainability of open source communities, namely the health of the community, a clear governance structure, technological maturity, and sustainable financing. The abovementioned factors focus primarily on the open source developer communities.

2.2 Open source communities and public administrations

Having analysed the key aspects influencing the sustainability of OSS communities, the manner in which public administrations engage with such communities was examined in order to uncover whether OSS communities in the public sector are unique in any way or if the abovementioned factors determine their sustainability. This section presents a synopsis of existing literature on open source in the public sector, and it provides an overview of literature relevant to our study.

Literature on the subject looks at the adoption of open innovation (Lee et al, 2012), collaborative innovation (Sorensen and Torfing, 2011), changes brought about through implementing eGovernment-type innovation (Jun and Weare, 2011; Baldwin et al, 2012), and general discussions on the benefits and value of adopting OSS in the public sector (Laszlo, 2009; Schmidt, 2003; Simon, 2005). The majority of the research focuses on adopting OSS in the public sector and the value derived from it rather than the communities' role in the process or how to ensure their sustainability.

Nevertheless, some relevant inputs to OSS communities and the factors influencing the adoption of open source in the public sector did emerge from this research. Given the inherently change-resistant nature of the public sector, political willingness, external incentives, importance of good change

[7] https://www.linuxfoundation.org/resources/open-source-guides/participating-open-source-communities/

management, and knowledge on open source technologies were identified as largely contributing to the presence and sustainability of OSS communities in the public sector.

Following the structure of the analysis framework developed by Rossi (2012), the remainder of this section analyses incentives for the adoption of OSS in the public sector, understood as the key drivers and motivations for change. It also discusses the primary sustainability factors for the community-building phase of the open source project, understood as the core factors affecting its longevity.

2.2.1 Incentives for the adoption phase

The literature shows the existence of certain incentives for adopting open source solutions by public administrations, namely internal drivers and external incentives.

Internal drivers: It can be argued that proponents of OSS share a common ideology (Ven and Verelst, 2008a) that leads to employees encouraging and pushing for the adoption of OSS within their organisations. Adherents of the OSS philosophy, referred to as *boundary spanners*, can be understood as leaders who bring about innovation and change. The findings of Van Loon and Toshkov (2015) support the assumption that boundary spanners and political activism have a positive influence on the adoption of OSS in public organisations. However, public administrations are complex organisations, and the decision to adopt OSS is still influenced by factors such as cost, reliability, and functionality of the software. This is echoed by Shaikh (2016) who shows that 'goodwill' is not enough when trying to adopt OSS in the public sector. Similarly, Kyu-Nahm and Weare (2011) find significant support for the theory that OSS is often implemented in the public sector due to the competitive motivation of one public sector body to promote organisational legitimacy vis-à-vis other public organisations and the public.

External incentives: The adoption or development of OSS by public administrations can be incentivised using external factors, which may also nurture the boundary spanners' motivation. These factors can be of an economic or political nature.

Adopting OSS needs top-level support and encouragement to succeed (Oram, 2011). Jun and Weare's research showed that intergovernmental competition and the promotion of organisational legitimacy play a central role in the adoption of new software. These two incentives demonstrate the influence of high-level political support for open source solutions. This assumption is also shared by Rossi (2012) who believes that political support is key for innovation in the public sector. He also demonstrates that the governmental rules (top-down approach) need to push for adoption and a favourable attitude among the management towards change.

Similarly, Jun and Weare demonstrate that response to stakeholders' demands is a strong factor in innovation (Jun and Weare, 2011). Indeed, inputs from the industry, academia, and citizens are strong motivators of change (Lee et al, 2012).

Another external factor that can positively influence the adoption of open source is a negative economic environment. Sorensen and Torfing argue that in times of economic crisis, public budget cuts act as an incentive to adopt innovative solutions that help reduce public spending such as adopting OSS. (Sorensen and Torfing, 2011).

2.2.2 Sustainability factors for the community building phase

This research also looked at the factors that determine the successful building of an OSS community in the public sector.

Change management: Van Loon and Toshkov (2015) show that a lack of structure and organisation in a public administration body causes fragmentation and has a negative influence on the process of OSS adoption. Therefore, capacity for change at the managerial level contributes to the success of community building. According to Rossi (2012), a change-oriented management will "easily see the potential benefits and impacts of innovations" and can act as a facilitator during the implementation period, taking into account the necessary organisational changes. These findings are confirmed by Lee and his colleagues who argue that the implementation of open source solutions in the public sector has practical implications. Governments should develop an overarching strategic plan, demonstrating to civil servants that new changes are consistent with the needs of their workplace practices (Lee et al, 2012). A secure support base for the implementation of OSS is a must for its sustainability, and this can only be achieved through appropriate management.

Knowledge base: The existence of knowledgeable contributors is another vital element in building a successful community. Mergel (2015), while analysing an OSS community within the US government, found that the presence of in-house developers or people with coding knowledge was crucial to sustaining the community and its outputs. Rossi (2012) also underscored the value of regular training within the public administration in the context of community growth and sustainability because the change management process (as described earlier) is often more complex than in the private sector.

This section identified several additional factors that affect the public sector's decision to adopt OSS and to further implement it whilst fostering a community. Nevertheless, there are limitations to this research. Hence, a second research method, namely an online survey addressed to open source practitioners in public administrations across the globe, was employed to define a conclusive list of success factors.

2.3 Summary of the main findings

Table 2 Summary of identified success factors below presents a summary of the key success factors identified as influencing the sustainability of an OSS community in the public sector. For each factor, supporting literature is listed. This list served as the basis for the online survey addressed to the public sector OSS communities.

Table 2 Summary of identified success factors

Factor	Components	References
Community vibrancy	Member's motivation	• Baldwin, C.Y. and Clark, K.B., (2006). • Crowston, K., Annabi, H., Howison, J., and Masango, C., (2004). • Gamalielsson, J., and Lundell, B., (2014). • Naparat, D., Finnegan, P. and Cahalane, M., (2015). • Schweik, C. M., (2013). • Shah, S.K., (2006). • von Hippel, E. and von Krogh, G., (2003). • Von Krogh et al., (2012).

Factor	Components	References
	Community's vibrancy	• Crowston K. and Howison J., (2006). • Crowston, K. and Shamshurin, I., (2017). • Franke, N. and Shah, S., (2003). • Rullani, F. and Haefliger, S., (2013). • Shaikh, M. and Levina, N., (2019). • von Krogh, G., Spaeth, S. and Lakhani, K., (2003).
	Community culture	• Crowston, K., Annabi, H., Howison, J., and Masango, C., (2004). • Naparat, D., Finnegan, P. and Cahalane, M., (2015). • Schweik, C. M., (2013).
	Knowledge base	• Mergel, I., (2015). • Rossi, B., Russo, B. and Succi, G., (2012).
Clear governance structure	Leadership	• Schweik, C. M., (2013). • Sturmer, M., (2005).
	Rules & guidelines	• Gamalielsson, J. and Lundell, B., (2014). • O'Mahony, S. and Fabrizio F., (2007). • Schweik, C. M., (2013).
	Coordination	• Crowston, K., Annabi, H., Howison, J., and Masango, C., (2004). • Faraj, S., Jarvenpaa, S.L. and Majchrzak, A., (2011).
	Change management	• Lee, S., Hwang, T. and Choi, D., (2012). • Rossi, B., Russo, B. and Succi, G., (2012). • van Loon, A. and Toshkov, D., (2015).
Technological maturity	Output quality	• Crowston, K., Annabi, H., Howison, J., and Masango, C., (2004).
	Software structure	• Baldwin, C.Y. and Clark, K.B., (2006).
Sustainable funding	Calculated private sector involvement	• Butler, S. et al., (2019). • Lakhani, K. R. and Wolf, R. G., (2005). • Shaikh, M. and Levina, N., (2019).
	Sustainable business model	• Fitzgerald, B., (2006). • Krylov, A. I. et al., (2015). • Shaikh, M. and Levina, N., (2019).
Adoption incentives	Internal drivers	• Jun, K. and Weare, C., (2011). • Rossi, B., Russo, B. and Succi, G., (2012). • Shaikh, M. and Levina, N., (2019). • van Loon, A. and Toshkov, D., (2015). • Ven, K. and Verelst, J., (2008a).
	External factors	• Jun, K. and Weare, C., (2011). • Oram, A., (2011). • Rossi, B., Russo, B. and Succi, G., (2012). • Sorensen E. and Torfing, J., (2011).

3. Public sector open source software community survey

Having completed the literature review on the key success factors affecting sustainability of open source communities in the public sector, the next step involved testing the theoretical findings with the actual open source communities via an online survey. In addition to testing and furthering our initial findings, the survey also focused on identifying candidates for case studies to be explored in this research. The input was used to draft Guidelines for Sustainable Open Source Communities in the Public Sector.

3.1 Survey design

The survey focused on the five key factors affecting community's sustainability: community vibrancy, governance, technological maturity, sustainable funding, and public sector adoption incentives. IT contained 46 questions: 9 single choice questions, 13 multiple choice questions, and 23 open questions (see Annex I). EU Survey, an open source tool, was chosen to host the online survey. The survey was tested and validated by a Project Officer and an IT specialist, both from the European Commission.

The survey was advertised on Twitter, on the Joinup website, in several email campaigns sent to more than 300 individuals as well as at events organised or attended by the OSOR team. It was launched on 16 January 2020 and closed on 29 February 2020. Throughout the field period, a total of 74 complete responses were gathered.

3.2 Survey results

This section details the results of the online survey on the sustainability of open source communities in the public sector.

3.2.1 Community vibrancy

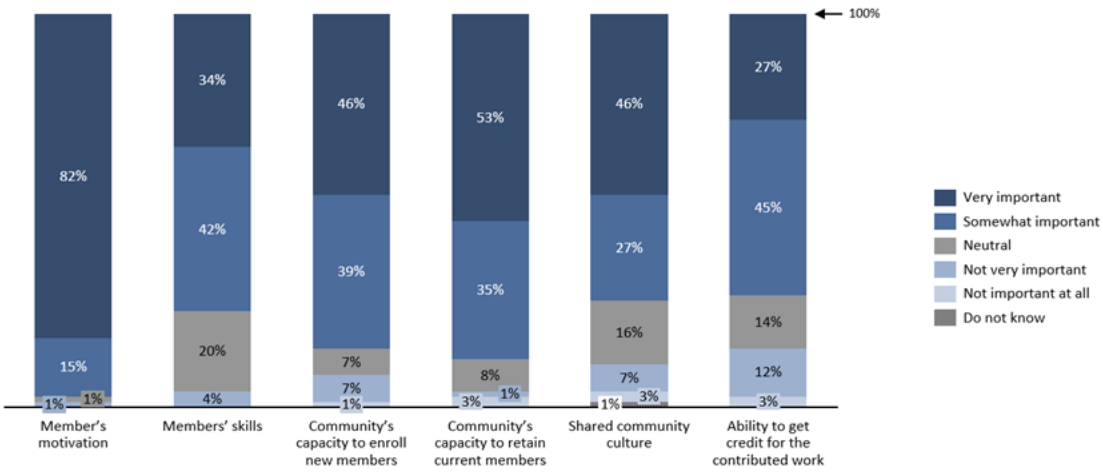
As outlined in the literature review, community vibrancy is a factor that determines the health of an open source community. The following key components were found to contribute to this factor:

- members' motivation
- members' skills
- community's capacity to enrol new members
- community's capacity to retain current members
- shared community culture
- ability to get credit for the contributed work.

Respondents regarded community vibrancy as a high-value aspect of a sustainable community. 62% of the respondents declared that they have experienced a situation where the lack of community vibrancy has undermined a project they were involved in. As shown in Graph 1 below, the respondents validated that members' motivation is an extremely important factor regarding community's vibrancy.

82% of respondents declared that members' motivation is 'very important' while 15% of respondents believe that member's motivation is 'somewhat important'.

Graph 1: Assessment of community vibrancy factors



Source: A survey conducted by Wavestone with members of open source communities in the public sector. Q5 Please indicate to which extent do you believe each of the factors below is important to the sustainability of a public sector open source community. N=74

Organic community growth and evolution appear to contribute to community vibrancy in a big way. The community's capacity to retain current members was seen as a 'very important' factor by 53% of the respondents and as 'somewhat important' by 35%. The community's capacity to enrol new members was considered very important by 46% and as 'somewhat important' by 39%.

The other sustainability factors identified through the literature review, namely members' skills, shared community culture, and the ability to get credit for contributed work were also validated by the respondents as being significant for the health of open source communities although the proportion of responses deeming them as 'somewhat important' appeared to be much higher than for the above-mentioned factors. The possibility for contributors to get credit was the least important factor, with only 27% deeming it 'very important'.

Finally, when asked if there were any other determinants of a community's vibrancy, the respondents insisted on the importance of having an open community that not only enrols new members but also trains them. The respondents also highlighted the importance of an inclusive and well-designed onboarding process that allows new members to rapidly develop the required skills and strengthen their motivation. Implementing collaborative working methods to avoid conflict between community members stood out as well. The ability to obtain credit for the work accomplished, in the absence of financial rewards, was also mentioned several times as a key factor to maintain contributors' motivation.

3.2.2 Clear governance structure

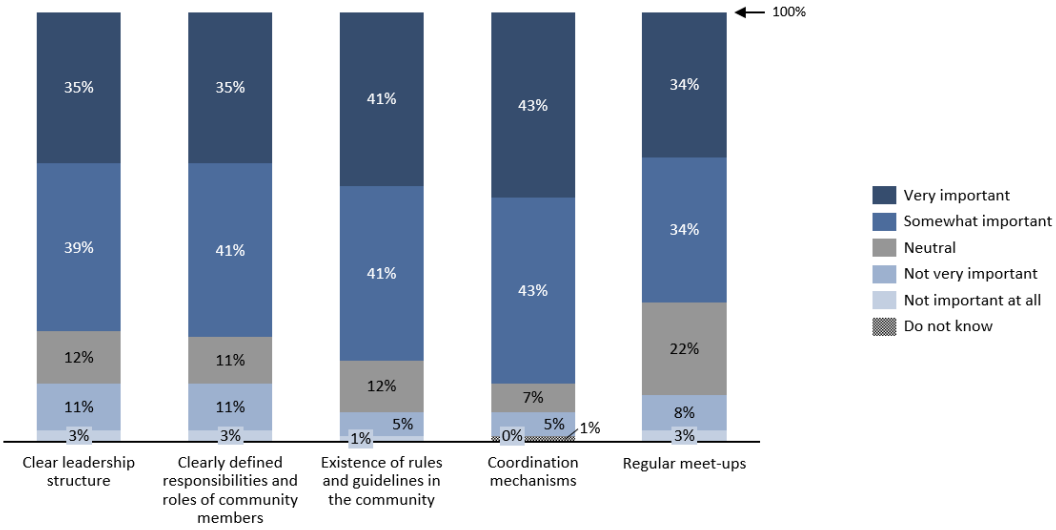
The literature review revealed that the following key components contribute to clear governance structure:

- clear leadership structure

- clearly defined responsibilities and roles of community members
- existence of rules and guidelines in the community
- coordination mechanisms
- regular meetups.

Survey respondents considered sound and efficient community governance significant to the community's sustainability, as illustrated in Graph 2 below. More specifically, the respondents identified the existence of coordination mechanisms (43%), rules and guidelines (41%), a clear leadership structure (35%), and clear definitions of roles and responsibilities of community members (35%) as 'very important'.

Graph 3: Assessment of governance factors



Source: A survey conducted by Wavestone with members of open source communities in the public sector. Q5 Please indicate to which extent do you believe each of the factors below is important to the sustainability of a public sector open source community. N=74

As for governance styles, many respondents regarded clear leadership, structured decision-making processes and role distribution in the community as crucial together with openness of the open source community where all contributions and ideas are welcome. It is clear that OSS communities must strike a fine a balance between openness and structure and between horizontal and hierarchical governance.

Finally, collaborative tools and processes vary depending on the size of the project. For larger projects, regular meetups and physical meetings are useful to maintain the sense of belonging and foster information exchange.

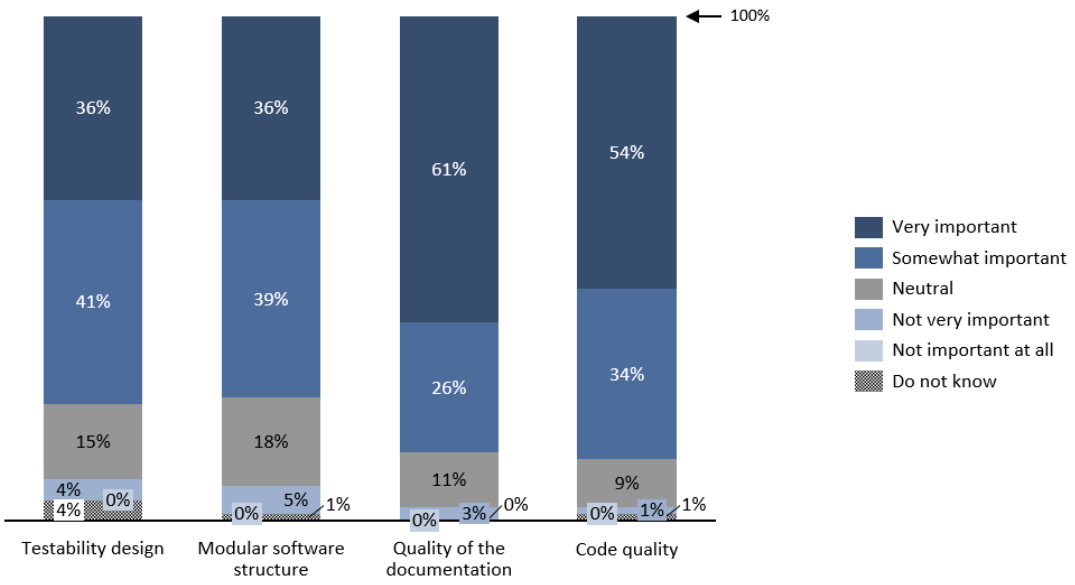
3.2.3 Software maturity

Software maturity is the third factor found to influence a community's sustainability and it comprises the following components:

- testability design
- modular software structure
- quality of the documentation
- code quality.

As shown in Graph 3 below, survey respondents validated that the quality of the documentation is an extremely important factor for the health of the community. 61% of respondents declared that documentation is 'very important' while 26% of respondents think that documentation is 'somewhat important'. The respondents believed that quality documentation is indispensable to recruiting new community members and users. It is also key to smooth collaboration between all the code contributors.

Graph 4: Assessment of technological factors



Source: A survey conducted by Wavestone with members of open source communities in the public sector. Q5 Please indicate to which extent do you believe each of the factors below is important to the sustainability of a public sector open source community. N=74

According to the survey participants, code quality is the second most important component when it comes to technological maturity. 54% of respondents saw it as a 'very important' factor. Regarding code quality, the respondents underlined that poor-quality code would inevitably result in the end of the project as contributions would be more difficult to share and the OSS would attract fewer users.

Respondents believed that a modular software structure and testability are other major indicators of the open source project's technological maturity as they are essential means of enforcing efficient collaboration amongst community members. Both elements allow contributors to work independently on some part of the code while ensuring code quality. Numerous respondents believe that code quality

is of the utmost importance: community members should not lose sight of the fact that the software is meant to be used and understood beyond the community.

Lastly, respondents underlined the importance of members' skills in order to sustain the quality and the reusability of the OSS. Members' skills are an asset that can be fostered through peer-to-peer support processes and efficient communication.

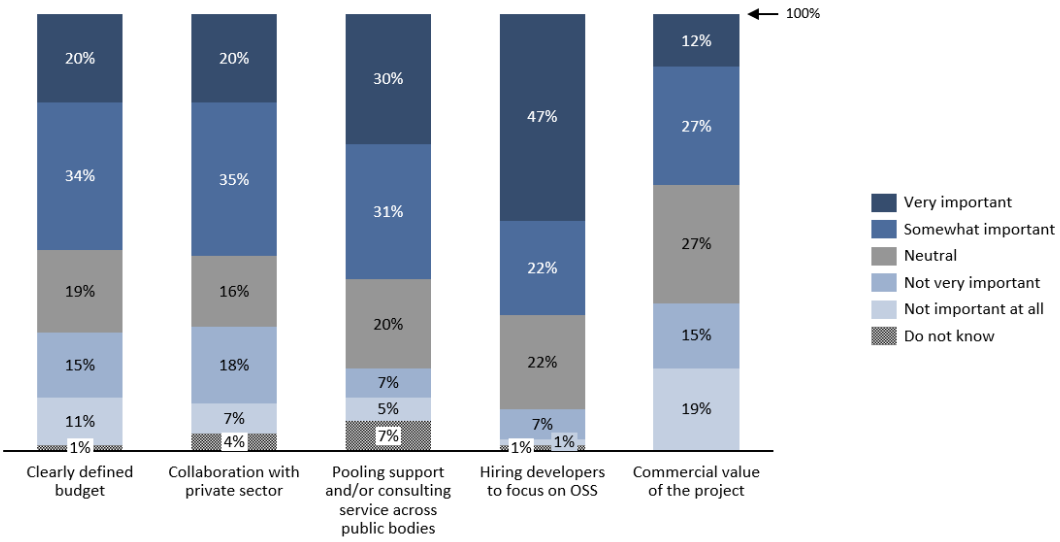
3.2.4 Sustainable funding

The fourth factor influencing community sustainability is sustainable funding, which consists of the following components:

- clearly defined budget
- collaboration with the private sector
- pooling support and/or consulting services across public bodies
- hiring developers focused on open source
- commercial value of the project.

Survey respondents highlighted the importance of sustainable funding in maintaining a sustainable community. However, their opinions diverged on the best means of ensuring sustainable financing of the open source community, as shown in Graph 4 below.

Graph 5: Assessment of sustainable funding factors



Source: A survey conducted by Wavestone with members of open source communities in the public sector. Q5 Please indicate to which extent do you believe each of the factors below is important to the sustainability of a public sector open source community. N=74

Except the recruitment of developers dedicated to open source, none of the sustainability factors identified in our literature review received positive responses. Only 20% of respondents believe that a clearly defined budget and collaboration with the private sector are 'very important' factors in the health of the community.

Regarding the private sector contribution, many respondents acknowledged that this is a key element of the financial sustainability of open source communities. However, some respondents also thought

that private contributions should not undermine the project's open source 'spirit'; open source communities and their private contributors should have aligned interests and share the same objective and vision for the OSS.

The project's commercial value is the sustainable funding component that received the least support from survey respondents, with only 12% viewing it as a 'very important' factor. A vast number of respondents were of the opinion that the open source community should ensure the reusability of the solution rather than focusing on its commercial value. The community would only then be able to attract new members and get funding from both the public and the private sector. Some respondents also highlighted the difficulty of existing communities in financing software maintenance; it is easier to get funding for the development of new projects.

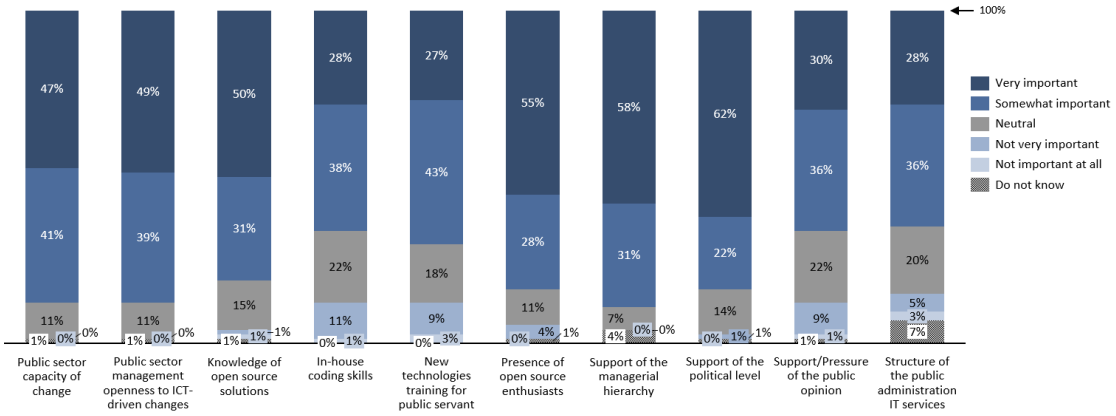
3.2.5 Public sector adoption incentives

This is the last factor of interest and is made up of the following components:

- public sector's capacity to change
- public sector management openness to ICT-driven change
- knowledge of OSS
- in-house coding skills
- new technologies training for public servants
- presence of open source enthusiasts
- support of the managerial hierarchy
- support at the political level
- support / pressure of the public opinion
- structure of the public administration IT services.

As shown in Graph 5 below, support from the different hierarchical levels of public administration was a key factor in the success of open source projects in the public sector. Political support for open source is the component that received the most validation from survey respondents, with 62% declaring that it is 'very important' and 22% deeming it 'somewhat important'. Similarly, 58% of respondents believe that managerial support is 'very important' whereas 31% believe it is 'somewhat important'. The respondents also considered the presence of open source enthusiasts an asset, with 55% deeming it 'very important' and 28% 'somewhat important'.

Graph 6: Assessment of public sector-related factors



Source: A survey conducted by Wavestone with members of open source communities in the public sector. Q5 Please indicate to which extent do you believe each of the factors below is important to the sustainability of a public sector open source community. N=74

The presence of open source enthusiasts in the public administration as well as support at the political and managerial levels were seen as key change-enablers by the respondents.

Opinions were more divided regarding the public administration's capacity to adopt changes. While some respondents were critical of the public sector capacity to adapt to new processes and change, others pointed to the need for IT skills in the public sector. According to them, the lack of experience with open source solutions and IT skills in general was slowing down the development of OSS in the public sector.

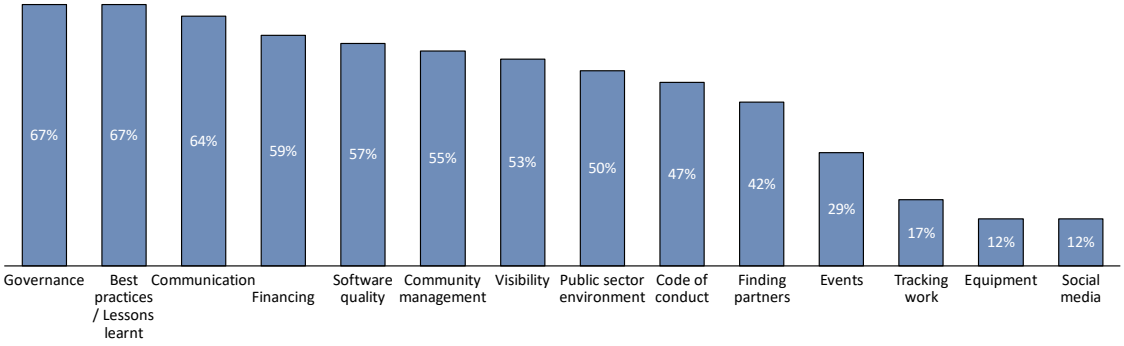
Finally, some respondents stated that the public sector encountered difficulties when adopting open source software due to proprietary software vendor lock-in and inadequate public procurement rules which discriminate against OSS.

3.2.6 Community guidelines

Survey respondents were also asked to provide their input on what should be included in the Guidelines for Sustainable Open Source Communities in the Public Sector.

Among the most mentioned items to be included in the guidelines (chosen by over 50% of respondents) are information on: the governance of the community (67%), communication (64%), financing (59%), software quality (57%), community management (55%), project visibility (53%), and how to develop a project in the public sector environment (50%). To a lesser extent, survey respondents would like the guidelines to contain elements about codes of conduct for the community (47%), the elaboration of partnerships (42%), and events (29%).

Graph 7: Elements to include in the Guidelines for Sustainable Open Source Communities in the Public Sector



Source: A survey conducted by Wavestone with members of open source communities in the public sector. Q40 What topics do you believe the OSOR guidelines should cover? N=74

Finally, 67% of survey respondents are particularly interested in learning more on best practices and lessons learnt from ongoing open source projects in the public sector.

The results of this survey and the literature review helped us develop five case studies looking at the sustainability of OSS projects in the public sector and allowed us to identify best practices and lessons learnt from these projects.

4. Case study analysis

In order to better understand the complexities that contribute to the sustainability of a public sector open source project, five case studies were analysed.

4.1 Case study selection and design

From the pool of respondents that completed the survey, a total of 45 agreed to their projects being considered for the development of the case studies. These projects exhibited a wide variety in terms of their geographic distribution and their core objectives. More specifically, 13 projects were international, 7 were located in the Netherlands, 5 in France, 5 in Italy, 4 in Germany, 2 in Denmark, 2 in the USA, 2 in Finland, and additional projects in several other countries. As for objectives, there were numerous projects focused on software and software migration, some were focused on designing a specific service for public administration (e.g. introducing secure authentication or building an eLearning platform) whilst others focused more on the policy side (e.g. facilitating participatory democracy and co-creation).

We had initially envisaged producing four case studies looking at sustainable public sector OSS projects and one looking at a failed project. However, it proved difficult to follow up with representatives of failed case studies and to receive consent to publish their input. For this reason, all five case studies focus on sustainable communities.

Below are the preliminary selection criteria:

- Geography – the selected case studies should exhibit geographical balance in terms of countries covered.
- Level of administration – the selected case studies should exhibit variance in the types of stakeholders (international, national, sub-national) involved in the project.
- Project objective – the selected case studies should exhibit variation in the type of projects.
- Level of complexity – the selected case studies should demonstrate a variety of factors contributing to the project's success.

Given these selection criteria and the availability of case study representatives to interview, the following five case studies were developed:

- the Developers Italia[8] community launched by the Italian government;
- the implementation of participatory democracy through the Voice of Groningen[9] platform in Groningen based on the CONSUL software;
- the Integreat[10] application used by municipalities across Germany for providing information to new arrivals;
- the geospatial OSKARI[11] software developed and used across Finland;

[8] https://developers.italia.it/en/
[9] https://stemvan.groningen.nl/
[10] https://integreat-app.de/en/
[11] https://oskari.org/

- the Lutece[12] software launched by the City of Paris and used across France.

Looking more closely at individual communities added a practical dimension to the main sustainability factors identified through the research. Each case study was designed in such a way as to provide insights into:

- community's launch and evolution
- community's main output
- key stakeholders involved in project development and execution
- factors behind the community's sustainability
- lessons learnt whilst building a sustainable community.

All five case studies are available in Annex II of this document and on the OSOR Knowledge Centre.

4.2 Key findings

The case studies confirmed and further complemented the initial research findings. For each identified success factor, additional insights were gained. Yet, the interviews with case study representatives also demonstrated that the identified success factors are exhaustive enough to illustrate what lies behind the sustainability of open source communities in the public sector. The rest of this section summarises the main findings for each of the five success factors.

4.2.1 Community vibrancy

The public sector OSS community survey demonstrated the vital importance of members' motivation in ensuring the longevity and sustainability of open source communities in the public sector. The case study interviews confirmed this finding and provided further insights. In both the Developers Italia and Integreat, regular physical or virtual meetups helped to sustain members' motivation. According to the interviewees, such meetups help to create a shared identity in the community, allow members to exchange ideas, and simply help community members to get to know each other.

Another finding regarding a community's ability to retain current members is the degree to which individuals can grow within the community. In the Developers Italia community, active community contributors can become managers of certain tracks or aspects of the community. According to the case study representative, this is the most sustainable way for the natural growth of the community and members' commitment to the project.

The interviews demonstrated that the community's longevity is dependent not only on the community being able to retain its current members but also on attracting new ones. CONSUL representatives stressed the importance of raising the community's visibility and promoting the software through external events and participation in conferences. Similarly, the team behind Integreat has a dedicated team member responsible for the community's international growth.

[12] https://dev.lutece.paris.fr/

4.2.2 Clear governance structure

Whilst our research pointed to the importance of a clear governance structure for the community's sustainability, a more complex picture emerged from the case studies. Firstly, they showed that there are generally two ways to create public sector open source communities. A public administration can either launch its own open source project (i.e. Lutece, OSKARI, Developers Italia) or join an already existing community (i.e. the use of CONSUL by the Groningen municipality, Integreat application used by municipalities across Germany).

Secondly, our case studies confirmed that all open source communities are slightly different and hence have designed governance mechanisms that are most appropriate for their size, membership, and structure. Generally, this research found that larger communities tend to be less centralised (e.g. CONSUL, Developers Italia), with contributors organising themselves into individual groups and working on different project streams. Meanwhile, more compact communities tend to be more centralised (e.g. Lutece, OSKARI and Integreat). They usually have a strong managerial team in charge of making the main strategic decisions.

Finally, another key finding is the difference between community contributors and users in open source communities. Both groups fall under the broad category of 'community members'; contributors are often made up of developers who contribute to the code while users are community members using the software as the final product. Case study representatives stressed the importance of not only the commitment of a community's contributors to the project but to also appropriate support and engagement for the software users (as is done in CONSUL or Integreat).

The strongest finding from our survey, namely the presence of coordination mechanisms, deemed 'very important' by 43% of the survey respondents, was also confirmed in the case study analysis. Both the OSKARI and the Voice of Groningen case studies highlighted the significance of community support channels and platforms where community members can interact and obtain useful resources. It was also apparent that, as communities grow in size, member coordination becomes even more crucial. In CONSUL, Slack[13] is the preferred medium of communication. Users from different countries can organise themselves in separate Slack channels to discuss matters of relevance. Additionally, the governance team behind OSKARI dedicates part of its resources to hire a Communication Manager responsible for handling internal communication flows.

4.2.3 Technological maturity

The sustainability of open source communities is primarily dependent on the quality of the software produced by said communities. This research underlined good documentation and code quality as factors contributing to the sustainability of open source communities. The significance of high quality, easily accessible documentation was confirmed by the case study representatives numerous times.

When it comes to code quality, the case studies revealed an additional insight. According to the interviews with the Voice of Groningen representatives, the software that the community is built on

[13] https://slack.com/

should be easily reusable and hence attractive to new members. This was also confirmed by our interviews with Lutece, OSKARI, and Integreat representatives. All of them perceived choosing an agile and user-friendly software as essential to the community's long-term growth and sustainability. Conversely, representatives of Lutece noted that, whilst the stability of the JAVA-based software used by the Lutece community helped to ensure longevity, it also made it difficult to attract new developers as young coders prefer to work with other programming languages.

4.2.4 Sustainable funding

Our research underscored the value of hiring developers to work on the software and pooling resources across public administrations to either kick-start the project or further develop the software. The case study findings confirm and further illustrate the importance of these two factors. The team behind the Lutece software at the City of Paris work with some 300 contributors, many of whom are externally contracted software developers. Similarly, the team at the Groningen municipality hired some contractors to help them start using the CONSUL software successfully. Finally, Developers Italia launched a public tender upon the inception of the community to develop some core products for the community to use and work on.

The pooling of resources emerged as a regular practice in the studied communities. The Groningen municipality actively collaborates with other Dutch municipalities to further develop and tailor the CONSUL platform to their own needs. In the case of OSKARI, the organisations working with the Steering Committee each contribute EUR 5 000 to the project on a yearly basis.

Furthermore, the case studies pointed to the fact that securing funding is vital at the start of a project. Funding is crucial for hiring developers, developing quality documentation, and promoting the community. As the software becomes more mature and the growth of the community more organic, the community becomes more self-sustaining and there is less of a need for funding.

At the same time, representatives of the Voice of Groningen noted that funding needs to be set aside not only for the initial software development but also software maintenance. As building an open source project is not a one-off investment but rather a continuous effort, the community's funding should reflect that.

Finally, the Lutece case study also provided an example of a sustainable collaboration with private sector organisations. Lutece received funding from the Bloomberg Philanthropies[14] in order to revamp their website and communication materials and to further promote its software.

4.2.5 Public sector adoption incentives

When answering questions on public sector adoption incentives, the survey respondents identified support of the political hierarchy as the most important factor (62% deemed it 'very important'). The case study representatives were of the same opinion. For example, the Lutece project was founded thanks to the initiative of the Mayor of Paris at the time. Similarly, the launch of the Voice of Groningen

[14] https://www.bloomberg.org/

platform was motivated by the *Proeftuin Digitale Democratie*[15] project launched by the Dutch Government, which also encouraged the use of open source software. The representatives of OSKARI also found cooperation from the political and managerial hierarchy essential to long-term sustainability.

Awareness of OSS and presence of OSS enthusiasts within public administrations was also confirmed as crucial. The representative of the Groningen municipality noted that being aware of the benefits of OSS and recognising its benefits for public administrations made it easier for the administration to launch the Voice of Groningen platform. On the other hand, representatives of Developers Italia shared that the lack of awareness about OSS within the Italian government made the launch and growth of the community more complicated; resources had to be directed into working with civil servants to demonstrate what OSS is about and why it is beneficial.

One challenge that was highlighted by the case study representatives is securing long-term commitment to the project. According to the representatives of OSKARI, the administration behind the community should view the project as a long-term engagement rather than a one-off investment. Public administrations are used to operating in accordance with short-term political cycles, and public sector open source projects should not fall prey to these cycles. The Developers Italia community seems to have overcome this challenge by acquiring legal standing. With the adoption of the *Guidelines on the acquisition and reuse of software for public administrations*[16], the community's 'reuse catalogue'[17] was recognised as the main hub for developing and sharing software.

Finally, transparency was a common theme in the conversations with case study representatives. Whether it is related to publishing quality documentation, communicating about key strategic decisions made in the community, or enabling the growth of community members, transparency is at the heart of open source communities, and it is something that should be guaranteed and strived toward.

[15] https://www.digitaleoverheid.nl/overzicht-van-alle-onderwerpen/democratie/proeftuin-digitale-democratie/
[16] https://docs.italia.it/italia/developers-italia/gl-acquisition-and-reuse-software-for-pa-docs/en/stabile/index.html
[17] https://developers.italia.it/it/software/

5. Conclusion

This research has shown that there are five key factors that influence the sustainability of OSS communities in the public sector:

- Community vibrancy – related to members' motivation, the community's capacity to retain current and attract new members. To this end, open source communities should provide opportunities for growth within the community and organise regular meetings to retain current members and attract new ones.
- Clear governance structure – related to the presence of clear and transparent processes and procedures within the community. Open source communities should have transparent guidelines and governance structures composed of community members.
- Technological maturity – related to the quality of the software's source code and its documentation. Open source communities should ensure that the source code and the supporting documentation are of a consistently high quality so as to promote the reusability and attractiveness of the software.
- Sustainable funding – related to funding and resource management within the community. Public sector open source communities should secure sufficient budget at the inception of the project and dedicate funds not only to development but also software maintenance, community growth, and visibility-raising activities.
- Public sector adoption incentives – related to the nuances of public administrations such as the support of the political and managerial hierarchy, awareness of OSS, openness to change, and transparency. Public administrations looking to start an open source project should become acquainted with the culture of OSS and actively work towards project longevity within the organisation.

The community survey and five case studies provided further insights into the factors that determine the longevity of public sector open source communities and those which might lead to their failure. Gathering information from public sector open source community representatives allowed us to identify different types of public sector communities and to discover some distinctions and nuances among various types of communities.

The main findings from the literature review, survey, and five case studies feed into the development of the Guidelines for Sustainable Open Source Software Communities in the Public Sector. The Guidelines aim to serve as a practical document that public sector representatives, project managers, and open source enthusiasts can use to learn more about what it takes to build sustainable open source communities in the public sector.

The Guidelines are available on OSOR's Knowledge Centre.

References

Allen, R. C. (1983). Collective invention. J.Econom.Behav. Organ. 41–24.

Baldwin, C.Y., Clark, K.B., (2006). "The architecture of participation: does code architecture mitigate free riding in the open source development model?,". Manage. Sci. 52:7, 1116–1127.

Butler, S., Gamalielsson, J., Lundell, B., Brax, C. Sjöberg, J., Mattsson, A., Gustavsson, T., Feist, J., and Lönroth, E., (2019). On Company Contributions to Community Open Source Software Projects, IEEE Transactions on Software Engineering (to appear). https://doi.org/10.1109/TSE.2019.2919305

Chang. W, Mills, H., Newhouse. S., (2007). From Open Source to long-term sustainability: Review of Business Models and Case studies

Crowston, K., Annabi, H., Howison, J., & Masango, C., (2004). Effective work practices for Software Engineering: Free/Libre Open Source Software Development. Paper presented at the WISER Workshop on Interdisciplinary Software Engineering Research, SIGSOFT 2004/FSE-12 Conference, Newport Beach, CA.

Crowston, K., Howison, J., Annabi, H., (2006). "Information systems success in free and open source software development: theory and measures,". Softw. Process. Improv. Pract. 11:2, 123–148.

Crowston K, Howison J., (2006). Assessing the health of open source communities. IEEE Comput. 39(5):89–91. doi:10.1109/MC.2006.152.

Crowston, K., Shamshurin, I. (2017). Core-periphery communication and the success of free/libre open source software projects. J Internet Serv Appl 8, 10 doi:10.1186/s13174-017-0061-4

Gamalielsson, J., and Lundell, B., (2014). “Sustainability of Open Source Software Communities beyond a Fork: How and Why Has the LibreOffice Project Evolved?” Journal of Systems and Software 89: 128–45. https://doi.org/10.1016/j.jss.2013.11.1077.

Faraj, S., Jarvenpaa, S.L., Majchrzak, A., (2011). "Knowledge collaboration in online communities,". Organ. Sci. 22:5, 1224–1239.

Fitzgerald, B. (2006). The transformation of open source software. MIS quarterly, 587-598.

Franke, N., S. Shah., (2003). How communities support innovative activities: An exploration of assistance and sharing among endusers. Res.Policy 32 157–178.

Han, K., Oh, W., Im, K.S., Chang, R.M., Oh, H., Pinsonneault, A., (2012). "Value cocreation and wealth spillover in open innovation alliances,". MIS Q. 36:1, 291–325.

Izquierdo-Cortazar, D., Gonzalez-Barahona, J.M., Duenas, S., Robles, G., (2010). "Towards automated quality models for software development communities: the qualoss and floss metrics case". Quality of Information and Communications Technology (Quatic), Seventh International Conference on the: IEEE. pp. 364–369.

Jun, K., Weare, C. (2011). “Institutional Motivations in the Adoption of Innovations: The Case of E-Government”. Journal of Public Administration Research and Theory. 21:3, 495–519. https://doi.org/10.1093/jopart/muq020

Krogh, Georg Von, Sebastian Spaeth, and Karim Lakhani (2003). “Community, Joining, and Specialization in Open Source Software Innovation: A Case Study.” SSRN Electronic Journal. https://doi.org/10.2139/ssrn.387500.

Krylov, A. I. et al. (2015). “What Is the Price of Open-Source Software?”. The Journal of Physical Chemistry Letters. 6:14, 2751-2754.

Lakhani, K. R., & Wolf, R. G. (2005). Why Hackers Do What They Do. Perspectives on Free and Open Source Software. doi: 10.7551/mitpress/5326.003.0005

Lee, S., Hwang, T., Choi, D. (2012). Open innovation in the public sector of leading countries. Management Decision. 50. 147-162. 10.1108/00251741211194921.

Mergel, I. (2015). “Open collaboration in the public sector: The case of social coding on GitHub”. Government Information Quaterly. 32:4, 464-472.

Naparat, D., Finnegan, P., Cahalane, M., (2015). "Healthy community and healthy commons:‘Open sourcing as a sustainable model of software production,". Australas. J. Inf. Syst. 19.

O’Mahony, S., Fabrizio F. (2007). “The Emergence of Governance in an Open Source Community.” Academy of Management Journal 50, no.: 1079–1106. https://doi.org/10.5465/amj.2007.27169153.

Oram, A. (2011). Promoting Open Source Software in Government: The Challenges of Motivation and Follow-Through. Journal of Information Technology & Politics, 8:3, 240–252. doi: 10.1080/19331681.2011.592059

Rossi, B., Russo, B., Succi, G. (2012). “Adoption of free/libre open source software in public organizations: factors of impact”. Information Technology & People. Emerald Publishing Limited.

Rullani F, Haefliger S. (2013). The periphery on stage: the intra-organizational dynamics in online communities of creation. Res Policy.42(4):941–53. doi:10.1016/j.respol.2012.10.008.

Schweik, C. M. (2013). Sustainability in Open Source Software Commons. Technology Innovation Management Review

Shah, S.K., (2006). "Motivation, governance, and the viability of hybrid forms in open source software development,". Manag. Sci. 52:7, 1000–1014.

Shaikh, M. Levina, N. (2019). Selecting an open innovation community as an alliance partner: Looking for healthy communities and ecosystems.

Sorensen E., Torfing, J. (2011). “Enhancing Collaborative Innovation in the Public Sector”. Administration and Society. 43:8, 842-868. https://journals.sagepub.com/doi/abs/10.1177/0095399711418768

Soto, M., Ciolkowski, M., (2009). "The qualOSS open source assessment model measuring the performance of open source communities,". Proceedings of the 2009 3rd International Symposium on Empirical Software Engineering and Measurement: IEEE Computer Society. pp. 498–501.

Sturmer, M. (2005). Open Source Community Building, Licensiate at the Facultu of Economics and Social Science at the University of Bern

van Loon, A., Toshkov, D. (2015). “Adopting open source software in public administration: The importance of boundary spanners and political commitment”, Government Information Quarterly. 32:2, 207-215.

Ven, K., Verelst, J. (2008a). The impact of ideology on the organizational adoption of open source software. Journal of Database Management, 19:2, 58–72.

von Hippel, E., von Krogh, G., (2003). "Open source software and the “Private-Collective” innovation model: issues for organization science,". Organ. Sci. 14:2, 209–223.

Annex I: Public Sector Open Source Software community survey

Introduction

Thank you for agreeing to take part in our survey on the sustainability of public sector open source projects.

Your feedback to this survey will help us to better understand what determines the sustainability of open source projects and collaboration in the public sector. Our objective is to put together **practical Guidelines for Building Sustainable OSS Communities in the Public Sector**. We will share the developed guidelines with the entire open source community by publishing them in the Open Source Observatory (OSOR). By contributing to this survey you will help us to ensure that our guidelines are reflective of the needs of public sector Open Source Software (OSS) community representatives.

OSOR is a European Commission initiative funded by the ISA^2 programme. It aims to support the distribution and reuse of software developed by or for public sector administrations across Europe, connecting EU services and the Member States. OSOR allows the open source community to access the best practices on OSS, find reusable solutions, discover events, and explore in-depth case studies.

The survey takes around 15 minutes to complete. We would be grateful if you could submit your feedback by 29 February 2020.

The survey is being executed by Wavestone European Services on behalf of the European Commission, Directorate-General for Informatics – DG DIGIT Interoperability Unit.

For more information on how we handle your data, please read our specific privacy statement before answering the questionnaire.

Should you have any queries, please contact Wavestone by email at osor@wavestone.com.

1 About you and your community

The purpose of this section is to learn more about your personal involvement in any public sector open source communities. *For the purposes of this survey, "a public sector open source community" has been defined as a community for a specific OSS created and designed specifically for the public sector or a community around a general purpose OSS but focusing on its use in a public sector context.*

1. Are you or have you ever been part of a public sector open source community? (e.g. you contributed to development of software for the public sector, your community provides support to the public sector users of your software, etc.) Please tick those options most applicable to you*
   - ☐ Yes, I am/have been a member of an open source community managed by the public sector
   - ☐ Yes, I am/have been a member of an open source community with a significant number of members coming from the public sector
   - ☐ No [If selected, jump to 'End of Survey']
2. [If answered 'Yes' in Q1] What is/has been your role in the community/ies? * *Please tick all that apply.*
   - ☐ Core member of the project, contributing to the strategical decision process
   - ☐ (Subsystem) maintainer, responsible for a large part of the codebase
   - ☐ Regular contributor
   - ☐ Contributing fixes when I encounter them in work
   - ☐ Other, please specify:
3. [If answered 'Yes' in Q1] What is/has been your type of contribution to the community/ies? * *Please tick all that apply.*
   - ☐ All of my contributions to the project are/have been paid for by my employer or clients
   - ☐ Some of my contributions to the project are/have been paid for by my employer or clients
   - ☐ My contributions are/have been on a voluntary basis
   - ☐ Other, please specify: [ ]
4. [If answered 'Yes' in Q1] How often would you say you contribute/has contributed to the community in terms of contributing code, participating to forums, reporting bugs, among other things. *
   - ☐ Daily
   - ☐ Weekly
   - ☐ Bi-weekly
   - ☐ Monthly
   - ☐ Quarterly
   - ☐ Bi-annually
   - ☐ Other, please specify: [ ]

2 Sustainable community's success factors

5. Please indicate to which extent do you believe each of the factors below is important to the sustainability of a public sector open source community. *

COMMUNITY VIBRANCY

Sustainability factors	Not important at all	Not very important	Neutral	Somewhat important	Very important	Don't know
Members' motivation	☐	☐	☐	☐	☐	☐
Ability to get credit for the contributed work	☐	☐	☐	☐	☐	☐
Members' skills	☐	☐	☐	☐	☐	☐
Community's capacity to enroll new members	☐	☐	☐	☐	☐	☐
Community's capacity to retain current members	☐	☐	☐	☐	☐	☐
Shared community culture	☐	☐	☐	☐	☐	☐

6. [If any 'Very important' or 'Somewhat Important' answer(s) in Q5] Could you please elaborate on your reasoning behind the assessment of the most important factors?

7. Have you ever experienced a situation where the lack of one of the abovementioned factors undermined an open source project that you were involved with? *

☐ Yes

☐ No

8. [If 'Yes' selected in Q7] Please elaborate on this experience. *

9. In your opinion, are there any other factors influencing community vibrancy?

10. Please indicate to which extent do you believe each of the factors below is important to the sustainability of a public sector open source community. *

GOVERNANCE OF THE COMMUNITY

Governance of the community	Not important at all	Not very important	Neutral	Somewhat important	Very important	Don't know
Clear leadership structure	☐	☐	☐	☐	☐	☐

Governance of the community	Not important at all	Not very important	Neutral	Somewhat important	Very important	Don't know
Clearly defined responsibilities and roles of community members	☐	☐	☐	☐	☐	☐
Existence of rules & guidelines in the community	☐	☐	☐	☐	☐	☐
Coordination mechanisms	☐	☐	☐	☐	☐	☐
Regular meet-ups	☐	☐	☐	☐	☐	☐
Exchange tools (forums, emails lists…)	☐	☐	☐	☐	☐	☐

11. [If any 'Very Important' or 'Somewhat Important' answer(s) in Q10] Could you please elaborate on your reasoning behind the assessment of the most important factors?

12. Have you ever experienced a situation where the lack of one of the abovementioned factors undermined an open source project that you have been involved with? *
    - ☐ Yes
    - ☐ No

13. [If 'Yes' selected in Q12] Please elaborate on this experience. *

14. In your opinion, are there any other factors influencing the good governance of a community?

15. Please indicate to which extent you believe each of the factors below is important to the sustainability of a public sector open source community. *

TECHNOLOGICAL MATURITY

Technological features	Not important at all	Not very important	Neutral	Somewhat important	Very important	Don't know
Code quality (i.e. manageability)	☐	☐	☐	☐	☐	☐
Quality of the documentation	☐	☐	☐	☐	☐	☐
Modular software structure	☐	☐	☐	☐	☐	☐
Testability design	☐	☐	☐	☐	☐	☐

16. [If any 'Very Important' or 'Somewhat Important' answer(s) in Q15] Could you please elaborate

on your reasoning behind the assessment of the most important factors?

17. Have you ever experienced a situation where the lack of one of the abovementioned factors undermined an open source project that you have been involved with? *
    - ☐ Yes
    - ☐ No

18. [If 'Yes' selected in Q17] Please elaborate on this experience. *

19. In your opinion, are there any other technical factors influencing the sustainability of open source communities?

20. Please indicate to which extent do you believe each of the factors below is important to the sustainability of a public sector open source community. *

SUSTAINABLE FINANCE

Financing	Not important at all	Not very important	Neutral	Somewhat important	Very important	Don't know
Cooperation with the private sector	☐	☐	☐	☐	☐	☐
Commercial value of the project	☐	☐	☐	☐	☐	☐
Clearly defined funding	☐	☐	☐	☐	☐	☐
Pooling support and/or consulting service across public bodies	☐	☐	☐	☐	☐	☐
Hiring developers to focus on OSS	☐	☐	☐	☐	☐	☐

21. [If any 'Very important' or 'Somewhat Important' answer(s) in Q20] Could you please elaborate on your reasoning behind the assessment of the most important factors?

22. Have you ever experienced a situation where the lack of one of the abovementioned factors undermined an open source project that you have been involved with? *
    - ☐ Yes
    - ☐ No

23. [If 'Yes' selected in Q22] Please elaborate on this experience. *

24. In your opinion, are there any other financing opportunities influencing the sustainability of open source communities?

25. Please indicate to which extent do you believe each of the factors below is important to the sustainability of an open source community. *

PUBLIC SECTOR ADOPTION INCENTIVES

Change drivers in the public sector	Not important at all	Not very important	*Neutral*	Somewhat important	Very important	Don't know
Public sector capacity of change	☐	☐	☐	☐	☐	☐
Public sector management openness to ICT-driven changes	☐	☐	☐	☐	☐	☐
Knowledge of open source solutions	☐	☐	☐	☐	☐	☐
In-house coding skills	☐	☐	☐	☐	☐	☐
New technologies training for public servants	☐	☐	☐	☐	☐	☐
Presence of open source enthusiasts	☐	☐	☐	☐	☐	☐
Support of the managerial hierarchy	☐	☐	☐	☐	☐	☐
Support of the political level	☐	☐	☐	☐	☐	☐
Support/Pressure of the public opinion	☐	☐	☐	☐	☐	☐
Structure of the public administration IT services	☐	☐	☐	☐	☐	☐

26. [If any 'Very important' or 'Somewhat Important' answer(s) in Q25] Could you please elaborate on your reasoning behind the assessment of the individual factors?

27. In your opinion, are there any other factors influencing the adoption and implementation of open source solutions in the public sector?

28. Is there anything else you believe might be missing from the above detailed factors?

3 Case studies of successful and failed projects

For the purpose of this project, we will be developing several case studies of successful and failed public sector OSS initiatives. The purpose of this section is to learn more about your involvement in such projects and your evaluation of their success or failure. With your consent, we might highlight some of them on our OSOR community space.

29. [If Answered 'Yes' in Q**Error! Reference source not found.**] You indicated as having participated or currently participating in a public sector OSS project. Could you please briefly describe its main objectives, stakeholders involved and the timeline? *

Objectives	
Stakeholders involved	
Location	
Geographical scope (international, national, sub-national)	
Start date	
End date	
Other relevant information	

30. Is your OSS project still ongoing? *

- ☐ Yes
- ☐ No

31. [If 'No' selected in Q30] Which of these factors contributed to the fact that the open source project ended? *Please tick all that apply.**

- ☐ Community vibrancy
- ☐ Community governance
- ☐ Technological maturity
- ☐ Sustainable finance
- ☐ Public sector adoption incentives

32. [If 'No' selected in Q30] Could you please elaborate how the above-mentioned, or any other factors contributed to the fact that the project ended??

33. [If 'Yes' selected in Q30] Based on your opinion, could you please evaluate the level of sustainability of this OSS project? *

- ☐ Sustainable
- ☐ Somewhat sustainable

- ☐ Neither sustainable nor unsustainable
- ☐ Somewhat unsustainable
- ☐ Unsustainable
- ☐ Do not know

34. [If 'Yes' selected in Q30] Which of these factors do you believe contribute to the sustainability of your OSS project? *Please tick all that apply.**
    - ☐ Community vibrancy
    - ☐ Community governance
    - ☐ Technological maturity
    - ☐ Sustainable finance
    - ☐ Public sector adoption incentives

35. [If 'Yes' selected in Q30] Could you please elaborate how the above-mentioned or any other factors contribute to the project's sustainability?

36. For the purpose of our guidelines we will be developing case studies focusing on successful and failed examples of public sector OSS initiatives. For the purpose of the case studies, we might get in touch with project stakeholders to learn more about the project. *

Would you be willing to participate to an interview focused on your experience in public sector OSS initiatives?

- ☐ Yes
- ☐ No

37. [If 'Yes' selected in Q36] Could you please provide your contact details? *

38. Are you aware of any other public sector communities that you believe we should contact for the purposes of our guidelines?
    - ☐ Yes
    - ☐ No

39. [If 'Yes' Selected in Q38] Please briefly describe the community and provide the best way to get in touch with them:

4 Toward ‘Community Driven OSS Guidelines’

One of the objectives of this project is to ensure that our Guidelines for Building Sustainable OSS Communities in the Public Sector are truly community driven. If this topic is of importance to you, please complete this section.

40. What topics do you believe the OSOR guidelines should cover? *Please tick all that apply.*

- ☐ Communication
- ☐ Visibility
- ☐ Financing
- ☐ Equipment
- ☐ Social Media
- ☐ Code of Conduct
- ☐ Events
- ☐ Governance
- ☐ Community management
- ☐ Tracking work
- ☐ Software quality
- ☐ Finding partners
- ☐ Public sector environment
- ☐ Best practices/lessons learnt
- ☐ Other, please specify:

41. What type of content in the guidelines for creating sustainable open source communities in the public sector would be most useful to you?

5 Data collection consent

42. The European Commission may use your personal information to follow up on the survey results, production of our guidelines, to invite you to a webinar on this topic, to share our guidelines with you, and for other research purposes. By giving your consent below, you are agreeing to the use of your personal data (name, surname, organisation and email address). For more information on our data policies, please visit our privacy statement.

- ☐ I confirm that I consent to the collection of the above data
- ☐ I do not consent to the collection of the above data

43. First Name

44. Last Name

45. Email Address

46. Do you agree to be contacted for evaluation purposes, namely to share your feedback on specific ISA^2 solutions and actions as well as on the ISA^2 programme in general?
    - ☐ I agree
    - ☐ I do not agree

Annex II: Sustainability Case Studies

1. Developers Italia

Introduction

Developers Italia is the name of both a community of Italian software developers and the central open source software platform designed for the delivery of public services in Italy. Developers Italia is a vibrant community made up of citizens, civil servants, public administrations, and enterprises. Community members have the opportunity to meet on the platform and discuss ongoing or future projects, share ideas, and upload source code.

Developers Italia was launched by the Digital Transformation Team and Agency for Digital Italy (AgID) in 2017. The community initially received government funding to cover the costs of building the platform and the various tools (such as communication channels and portals), running events, creating calls for tender to develop open source software, and launching initial projects. Over time, the funding allocated to some projects has decreased due to the abundance of volunteer developers, thus reducing the need to create paid government positions. More than 260 software solutions developed by the community are hosted and further developed by volunteer community members on GitHub. Then, the solutions are uploaded to an online catalogue maintained by governmental bodies.

One of the key factors behind the community's sustainability is recognising members' contribution, with each member having the potential to become a project leader. This governance structure empowers community members, in turn contributing to the community's sustainable growth.

To learn more about Developers Italia's sustainability, OSOR spoke to the community's OSS Project Leader, Leonardo Favario.

Community at a glance

Name	Developers Italia
Brief description	Open source code and community of developers working with the Italian government
Starting date of the project	2017
User community	4680 users in the Slack Channel and 6493 users in the Forum
Developer community	131 software maintainers invited on the Developers Italia GitHub
Software output	Developer's Italia Software Catalogue GitHub Repository

Licensing	OSI-compliant licenses
Funding	The initial funding of Developers Italia was part of the governmental budget dedicated to the Digital Transformation Team

Project output

Developers Italia is a vibrant community that originated within the Italian government. It was established in response to an ongoing issue that the government was attempting to tackle: public administrations were increasingly carrying out their work in small silos and closed communities rather than striving to foster collaboration on projects that were of mutual interest. According to Leonardo Favario, there were four aims that guided the creation of Developers Italia:

- **Source code**: creation of a catalogue where the source code of Italian digital services can be easily indexed, reviewed, and maintained. When source code is easy to find, sustainable communities are more likely to build around it.
- **Documentation**: creation of a centralised open source platform where legal and technical documentation is stored, publicly available, and easy to understand.
- **Discussion**: establishment of a forum for both synchronised (live chats) and unsynchronised (forum) conversations.
- **Testing and validation**: provision of a software testing space for experimentation. The Developers Italia platform contains a selection of APIs and tools that allow developers to test their applications.

The community is continuously growing and developing. Nowadays, Developers Italia is no longer simply focused on maintaining source code. Rather, the community now works to enhance the delivery of digital public services in Italy. For example, the community shares technical and administrative documents that citizens can comment on, organises public events such as hackathons and community engagement activities, and calls upon citizens to collaborate on coding, sharing software, and reporting new APIs. The GitHub repository currently contains 264 free and open source software repositories (*as of April 2020*).

Timeline

In 2017, the then-called Digital Transformation Team, together with the Agency for Digital Italy, joined forces to establish the Developers Italia community.

The Digital Transformation Team launched several initiatives to place the community on the radar of Italian developers. Firstly, they launched a public tender inviting developers to contribute to some core public services that would be integrated with the community, such as electronic identification and the population registry. The time constraints were quite tight to provide these public services: by launching a tender, the Digital Transformation Team could guarantee the developers' full-time commitment to this particular phase rather than relying on voluntary contributions. Secondly, the community organised a successful and widely attended international hackathon in October 2017 to brainstorm the innovative

delivery of public services. The Developers Italia's operations were kicked off successfully in part because it is a government-led initiative enjoying sufficient funding and investment.

The community grew in stature in 2019 when the legal Guidelines for Code Acquisition and Reuse of Software aimed at public administration were adopted. These Guidelines mandate that all software developed or owned by Italian public administrations must be released with an OSI compliant licence and made available in a public repository. Most importantly, the Guidelines contributed to the community's success as the "reuse catalogue" hosted on Developers Italia became the main place for developing and sharing code for the delivery of public services. This gave the community recognition and a legal standing. Due to its decentralised structure, the catalogue collects and displays information on all the source code hosted by the different Italian public administrations, independently of where it is hosted. At present, source code is hosted on GitHub. The catalogue currently contains 93 solutions *(as of April 2020).* Given that the use of the catalogue is a legal obligation, it is actively maintained and monitored by governmental bodies.

When the mandate of the Digital Transformation Team ceased at the end of 2019, Developers Italia was incorporated into the Department of Digital Transformation within the Ministry for Innovation and Technology.

Community's sustainability

According to Leonardo, Developers Italia can be deemed as being a sustainable and healthy open source software community on account of the following four factors:

- **Governance:** A community is functioning optimally when its members are empowered and allowed to continuously take on further responsibilities. It is also important for community members to have defined roles. In the case of Developers Italia, dedicated community managers (community developers) can see when members are inactive and provide them with new discussion points or topics to explore further. Generally, members are entrusted with more responsibilities over time; therefore, communication and engagement tend to increase naturally without nudges from community managers.
- **Community vibrancy:** A community is sustainable when its members act upon queries, carry out updates, and notice bugs without being called upon to do so. Many volunteers quickly develop into active and crucial community members over time. The Developers Italia team also highlighted the importance of events and physical gatherings to boost motivation and increase the sense of community belonging. Despite being sometimes costly, it is necessary to bring community members together and increase their visibility to the wider public.
- **Technological maturity**: Codes put forward by the community are well-tested and of a high quality supplemented with documentation. There is a common recognition in the community that code is only valuable once it has been well-documented and written out. In addition, if members are entrusted with increased leadership capabilities, it often leads to higher quality code.
- **Public sector adoption incentives**: Developers Italia is a community that was created by the public sector for the public sector. However, the way an open source software community

works is different to the methods of public administrations. Developers Italia has shown that, despite public sector hierarchical structures, it is possible to have a non-hierarchical and vibrant open source software community in the public sector. The community overcame this challenge by introducing the public sector to the digital realm where, together, the two partners figured out how to engage with each other. The public sector and the community also collaborate with regional and local administrations.

Lessons learned

Despite Developers Italia being a sustainable community, Leonardo stressed that its growth did not occur in a linear fashion.

The community encountered certain challenges when introducing the world of open source software to the Italian public sector. The latter did not have a thorough understanding of open source software and how open source software communities work. The community therefore dedicated resources to educating the public sector and raising awareness about how they operate. The community also convinced some public officials to get involved and learn for themselves how the community operates and how tasks are shared among members.

In light of this, Leonardo stressed that agility from both the community and the public sector itself were necessary to achieve sustainability. The community has to be able to re-define itself and adapt to the needs of the public sector when necessary. Projects originate based on the needs of the public sector and the additional unforeseen input that a project may demand often means that other ongoing projects need to be put on hold. A community also has to find an organic way to balance different needs, without jeopardising the motivation of its members.

Within the community, it is also important to implement an appropriate leadership style. In the case of Developers Italia, the leadership structure is decentralised, with every active contributor having the potential to become a manager. It is important to create an environment where community contributors are encouraged to continue creating code because they can bring valuable knowledge and expertise to the table.

According to Developers Italia, an open source software community looking to develop a public sector project similar to that of Developers Italia should thus focus on the four following points:

- **Agility**: it is important to be able to re-define priorities.
- **Code**: quality over quantity.
- **Governance**: the right style of leadership is important.
- **Mission**: build a strong and clear objective recognised by all members.

Initially, Developers Italia was a project of the Digital Transformation Team that started with an investment of money, time, and resources. Today, a large number of projects are maintained and curated by volunteer community members. Therefore, the community continuously grows and prospers.

Policy context

For information regarding the policy context of the use of open source software in the public sector in Italy, please consult the respective Country Intelligence Report and its corresponding factsheet. You will find a detailed overview of the political actors, strategic players, political and legislative initiatives, and general public sector open source software initiatives in Italy.

2. Integreat

Introduction

Integreat is an open source digital integration platform designed to reduce information poverty for new arrivals in and within Germany. With the aid of an interactive website, smartphone application and PDF brochure in their native language, Integreat helps refugees integrate into their new communities by increasing their social inclusion and keeping them informed about the support services that are available to them. Launched in 2015, Integreat has proved to be a highly successful open source project in the public sector, with plans to further expand throughout Germany and abroad. While the Integreat community was not started from within a public administration, it has helped over 60 municipalities in Germany with their project. The project's success can be attributed to its sustainability, largely due to the revenue model of its associated non-profit organisation *Tür an Tür* and Integreat's focus on ensuring continuity and communication within its open source community at all stages.

To learn more about the sustainability of Integreat, OSOR spoke to Integreat Project Manager, Fritjof Knier, and an Integreat software developer working in the public administration of the Hersfeld-Rotenburg district, Alexander Hacker.

Community at a glance

Name	Integreat
Brief description	Open source digital integration platform used by German municipalities to reduce information poverty for new arrivals in and within Germany.
Starting date of the project	2015
User community	Over 60 municipalities and counties with 400 content creators
Developer community	20 active code contributors
Software output	Repository on Git Hub
Licensing	Content within Integreat is published under Creative Commons (CC BY 4.0). The Content Management System is available under a GNU General Public Licence. The smartphone application and web application are both published under an MIT licence.
Funding	Originally public funding coordinated by their associated non-profit organisation *Tür an Tür* and prize money. Now funded by municipalities who pay a fee for the service depending on the number of inhabitants.

Project Output

In 2015, Germany was trying to grapple with the increasing number of refugees seeking asylum. At the same time, many public administrations were ill-equipped to provide asylum seekers with the information that they needed to ease their transition to life in Germany, thus creating a situation whereby many refugees were suffering from information poverty. The situation in Augsburg, the hometown of one of the founders of Integreat, was no different. Project manager Fritjof Knier, who was a student at the time, highlighted how newly arrived asylum seekers in Augsburg were provided with a printed guide designed to help them, however, the guide had been designed in 1999, meaning that the contents and the design were somewhat out of date. Fritjof and other students working in *Tür an Tür*, a local refugee association that generally works to improve the living conditions and social integration of refugees and asylum seekers in Germany by strengthening their participation in society, set about redesigning the 1999 guide using the tools of the 21st century. They worked to gather all the relevant information that an asylum seeker could possibly need upon their arrival to Augsburg and make it available in their native language and in a new format based on open source software.

Following Integreat's initial launch and some national press coverage, other cities in Germany began reaching out to the project team. Now, Integreat is used in over 60 municipalities throughout the country, and the team works closely with several municipal governments and other experts in this field to further expand the use of the software. Following the success of the platform, the focus of Integreat shifted from asylum seekers and refugees to anyone arriving in Germany and moving across the country.

Integreat's digital integration platform helps cities, counties and federal states to centralise their information, increase their digital visibility and accessibility, reduce language barriers and create information transparency. Integreat also helps local integration officers to carry out their work efficiently and municipalities to carry out their digital integration work in a cost-effective manner. The package version of the software can be further developed by software technicians, and all the informative content contained within the platform is managed by the municipalities. Fritjof estimates that there are around 400 active content contributors to the Integreat platform, scattered across various municipalities, who populate the software with relevant information without contributing to the source code itself. According to him, some municipalities choose to have a few system users, with the rest of the municipalities' staff sharing information with them. Other municipalities choose to have some 20 user accounts, all uploading their information directly onto the platform. Alexander Hacker, a software developer working for the public administration of the district of Hersfeld-Rotenburg, worked to launch Integreat in his municipality. By gathering information from his colleagues and other institutions, and also developing additional features for the platform, he tailored Integreat with their community in mind, using new technical customisations that he developed.

The complete programme and source code of the Integreat app is freely available under an open source license (MIT). The Content Management System is available under a GNU General Public Licence. Integreat expressly supports the Public Money, Public Code campaign, which works to ensure that software developed with public funds for public administrations is published under a free software and open source license. In addition, all content from the different cities and municipalities using

Integreat is licensed under Creative Commons (CC BY 4.0), meaning that the software and content can be reused to the benefit of new and existing districts and cities.

Timeline

Project Integreat was launched in Augsburg in 2015. While working on the initial launch of Integreat, the project team began to collaborate with Prof. Helmut Krcmar, the Chair for Information Systems at the Technical University of Munich. Given his experience working on public sector projects for refugees and asylum seekers, he not only encouraged fellow staff members to join the project in an operating role and students to help with the software development, but he also helped to direct the project team to other cities and municipalities that might be interested in using Integreat. This collaboration, combined with national press coverage following a successful launch in Augsburg, led other cities and countries to reach out to the project team regarding potential expansion opportunities. Since then, Integreat has successfully launched in larger cities, including Dortmund, Munich, and Nuremburg, among others.

Initially, Integreat relied on public funding that their associated non-profit organisation *Tür an Tür* coordinated from their large network of people supporting asylum seekers trying to enter the German labour market. This funding helped to support two part-time positions from the summer of 2016 to the end of 2018.

In 2016, a municipality approached Integreat about signing a contract for a collaborative cooperation agreement whereby Integreat would support the municipality through the implementation and operation phase of the project. In order to be able to sign this contract, Integreat had to establish itself as a non-profit public sector project, and they did so under the umbrella of *Tür an Tür*, thus allowing them to proceed with the contract and expand their project in other municipalities.

Since 2019, Integreat has continued to grow in strength. The software has been implemented in over 60 public administrations throughout Germany, the majority of which opt for collaborative cooperation agreements and pay Integreat for their assistance in implementing the software. Municipalities pay 3,500 EUR, 5,000 EUR or 7,000 EUR per year depending on their number of inhabitants. Integreat's revenue (160,000 EUR) covers 80% of the necessary budget (200,000 EUR) per year. This budget includes technical maintenance, further development, support and scaling efforts. Integreat is now largely independent from external funding, and in a stable position to consider expanding their service throughout the public sector on a global basis.

Community's Sustainability

The widespread usage of Integreat and the array of awards it has received since its inception in 2016, including the 2018 Google Impact Challenge Award for Germany, are testament to the astonishing success of this public sector open source software project. Fritjof attributes this success to the sustainability of the project, the vibrancy of the project, and the unique nature of the platform. With regards to ensuring sustainability, Integreat believes that an OSS community looking to develop a similar public sector project should focus on the following five points:

- **Partnership**: Treat public sector actors as partners in order to foster trust and a collaborative working relationship. By treating municipalities as partners, municipalities often reach out to Integreat when they have ideas for new projects, and they help to put other interested municipalities in contact with Integreat. This helps to ensure the continuous funding and sustainability of the Integreat project.
- **Continuous funding**: The partnership model that Integreat maintains with public administrations helps to not only encourage new projects, but also to ensure the continuous funding and sustainability of Integreat.
- **Code**: There should be designated team members who update the software, conduct peer-reviews, and follow up on any bug reports to ensure that the application does not become digitally irrelevant over time.
- **Teamwork**: Ensure that the project team is sustainable in and of itself, and that the onboarding procedure is fine-tuned so as to increase staff and volunteer retention. In Integreat, new team members receive some initial supervision, smaller projects, and guidelines about operating within the team, thus ensuring continuity and a sense of community.
- **Mission**: Once a community has a clear vision of what it wants to achieve, understands why decisions are taken, and is involved in these decision-making procedures, then that community is likely to be vibrant and sustainable.
- **Uniqueness**: Monopolise the standard of the service that you provide, both in terms of uniqueness and quality, in order to ensure that you are irreplaceable. While other services exist, only Integreat has been able to successfully do what they do and demonstrate that it works as an open source software project that is suitable for the public sector by helping public administrations in their efforts to work independently.

Lessons learned

Aside from the aforementioned importance of maintaining a vibrant open source community and ensuring a smooth onboarding procedure for new team members, both Fritjof Knier and Alexander Hacker had insights to share regarding the lessons they have learned in relation to the development and implementation of open source software in the public sector.

Firstly, Fritjof highlights the importance of **understanding how the public sector operates** and exercising patience when working with them. Public sector contracts can take some time to be drawn up and the general tempo of work within public administrations can vary, meaning that open source software communities seeking to work with public sector actors must be able to adapt their work to this tempo. It is also crucial to work as closely with public sector representatives as possible and to learn about their work processes and IT systems. By adjusting to the infrastructure that they use, understanding the community that they work with, knowing how their decision-making processes function, and understanding their software capabilities, it will be easier for open source software project communities to engage and work with the public sector in a sustainable manner. This was reaffirmed by Alexander, who experienced varied enthusiasm among local stakeholders involved in the project,

particularly when supplying the district administration with the information necessary to populate the platform. By understanding that the stakeholders were all generally willing to help, but that their pace of work is a bit different, Hacker knew to simply follow up with them over time in order to collect the necessary information that had been promised.

Secondly, it is best to **start small and think big**. A key takeaway from the project team was that it is best to launch an open source software project in a smaller public administration. Augsburg is the third largest city in Bavaria and the 23rd largest in Germany. While decision-making procedures within its public administration can be lengthy and challenging, they are by no means comparable to those in larger cities such as Berlin or Munich. For example, initial contact regarding the use of Integreat in Munich was made in early 2016, and the official launch of the platform took place in early 2020, four years after the first round of discussions. Working with a smaller public administration and successfully implementing the software there will enable project teams to demonstrate their successes and lessons learned to larger public administrations.

Finally, Fritjof stressed the importance of **operating in a transparent and horizontal manner**. The project team for Integreat has a horizontal structure, which helps to foster a sense of trust not only within the project team itself, but also with other community members. By involving young people and treating everyone equally with regards to their involvement, not only does this foster a positive working environment, but also it ensures the sustainability of the project, given that it will not depend entirely on one individual. This was further reinforced by Alexander Hacker, who stressed the importance of **giving all community members control over the product and the means to participate**. Integreat survives on willing cooperation, and Alexander is confident that the community will continue to cooperate and drive the project following the completion of the Hersfeld-Rotenburg Integreat platform in June.

Policy context

For information regarding the policy context of the use of open source software in the public sector in Germany, please consult the respective Country Intelligence Report and its corresponding factsheet. You will find a detailed overview of the political actors, strategic players, political and legislative initiatives, and general public sector open source software initiatives in Germany.

3. Lutece

Introduction

Lutece is a free and open source portal engine that allows users to quickly create a dynamic website or web application. Part operating system and part content management system (CMS), the source code helps users to easily create and maintain custom websites and applications, which can then be further enhanced with additional functional modules (*plug-ins)* to add supplementary features adapted to the needs of the users.

Lutece was launched in 2001 as an initiative of the City of Paris with the aim of supplying each Parisian district with a tailored CMS too to manage their own websites. As a project launched by the public sector, the software is maintained and developed within the municipal government of Paris. Over time, the use of Lutece has increased. It is now used by national organisations and for the provision of multiple digital services in the city. The two decade-long success of Lutece can be partly attributed to the stability of the JAVA-based structure that the software was built on, thus ensuring its sustainability of the years.

To learn more about the sustainability of Lutece, OSOR spoke to the Head of Software Engineering and Development for the City of Paris, Pierre Levy, who has overseen Lutece's development since its inception, as well as Lutece's Technical Project Manager, Philippe Bareille.

Community at a glance

Name	Lutece
Brief description	Open source portal engine designed by the City of Paris that allows users to quickly create a dynamic website or web application
Starting date of the project	2001
User community	The main user is the City of Paris, with dozens of websites built on Lutece. The software has also been adopted in the cities of Lyon, Marseille and Mont-de-Marsan as well as in over 50 medium and large French organisations.
Developer community	300 contributors in Paris since the inception 100 active contributors currently
Software output	Repository on GitHub
Licensing	BSD 3-Clause licence
Funding	Municipal budget from the City of Paris

Project Output

In the early 2000's, the City of Paris wanted to leverage Information and Communication Technology (ICT) to provide its citizens with a set of website and online applications supporting public services. In 2001, a portal engine that allows users to quickly create a dynamic website or web application was developed and thus, Lutece was born. Lutece was built using JAVA and relies on various databases in MySQL, MaraDB, and PostgreSQL. The core CMS of Lutece helps public administrations to easily set up a website with a built-in search engine, workflows and dynamic content. It can then be complemented with any of the numerous ready-to-use plug-ins in order to deliver more complex services to meet users' needs. In 2002, Lutece expanded its functionalities on newly launched websites for all the Parisian districts. These new websites allowed the districts to share information with local residents through a user-friendly interface that didn't require administrators to have strong technical skills. Over time, the focus of Lutece has shifted from content management to the development of applications and digital services fostering interactions with citizens. Today, the City of Paris and its districts have deployed dozens of websites and applications using Lutece to provide digital public services, such as;

- **Democratic Participation**: Lutece has enabled the launch of a participatory budgeting platform to allocate 5% of the City of Paris' budget. It also released a dedicated plug-in for public consultations.
- **Information and communication**: As a CMS, Lutece allows municipalities to publish information for citizens on topics of interest, such as urban planning, voting or distance learning.
- **Reporting urban issues**: Lutece makes it easier for citizens to report issues in their neighbourhoods, such as an abnormal street disturbance, or requests for disposal of bulky items.
- **Appointments and applications**: Multiple websites have been launched, powered by Lutece, to digitalize appointment scheduling and application submissions, such as registering for day-care or to book an appointment to get a parking vignette.

Despite the successful adoption of Lutece in Paris, it has been used only in a few other cities across France, including Lyon, Marseille and Mont-de-Marsan. Pierre explained that the slow dissemination of Lutece stems from the difficulty of adapting it to existing IT infrastructures, which are often built on different programming languages that makes them reluctant to engage such work of combining many technologies. Additionally, software dissemination in other cities is not the core focus of the Lutece team; any growth that has occurred in the Lutece user base over the last two decades has been fully organic.

Since its inception, Lutece has been a project of the City of Paris. The funding stems exclusively from the city budget, however, Pierre and Philippe expressed their wish to attract external sources of funding in the future. Over the years, there have been approximately 300 contributors to Lutece, including the team working for the City of Paris but also private contractors from several IT companies. The City of Lyon is a notable contributor, having developed an additional plug-in that will be reused in Paris.

Timeline

In 2001, the newly elected mayor of the City of Paris outlined his wish for the creation of dedicated websites for every district of the city and recommended that their code be made available as open source. At the time, the City of Paris' development team was working on a separate Apache-based open source software project. The building blocks of this project helped the team in the development of a specific software for Paris that would meet the mayor's criteria: Lutece.

The software was launched in January 2002 for the 3rd district of Paris. By June, 18 out of 20 districts were equipped with their own Lutece-powered websites. Following the launch in Paris, the source code for Lutece was published as open source in September 2002 to allow other municipalities to gain access to the software. To comply with French regulations, Lutece was published under a BSD License.

Since its launch, Lutece has been used within the municipality to build websites and applications for many services. In 2008, several large French organisations chose Lutece for their website, including the French Weather Forecast and the national notaries. The same year, the city of Marseille, the second largest French city after Paris, launched their website based on Lutece. Furthermore, the City of Lyon has been using Lutece for approximately a decade and has 20 digital services based on the software. Aside from public administrations, Lutece has also been implemented by over 50 medium and large French organisations.

Lutece joined the OW2 consortium, an independent European community fostering open source projects, and the French April association in 2015. The following year, Lutece was recognised by the OW2 consortium as one of its few mature projects and received the OW2con'16 Quality Award in 2016.

In 2018, Lutece partnered with the Johns Hopkins University for its hackathon, HopHacks, involving over 300 students from American universities. The goal of the event was for these young developers to work on Lutece plug-ins that could potentially help solve real community issues encountered in the city of Baltimore. Since then, Lutece has been collaborating with the Johns Hopkins University with the goal of adapting the software for non-profit organisations in the Baltimore area.

Community's Sustainability

The continued usage and development of Lutece in French administrations and organisations since its inception in 2001 are testament to the success of this public sector open source project. Over the years, the software has been developed to include additional plugins and functionalities to respond to any need that public administrations might have. According to Pierre and Philippe, Lutece has been sustainable for many years now and this sustainability can be attributed to three key elements:

- **Technological Maturity**: The stable JAVA-based structure on which Lutece is developed has proven to be long-lasting and reliable. The sustainability of open source software in public administrations is dependent on mature and long-lasting technologies that do not require extensive revision and reworking of the source code when new technological trends emerge.
- **Community Governance**: With regards to the governance, two key aspects are highlighted as being crucial for sustainability. First, the size of the team needs to remain stable in order

to ensure the sustainability of a community. For Lutece, most contributors are paid, either in the role of public servants or as private contractors. Second, motivated and inspiring leaders with a strong belief in the purpose of the project are essential. Technical management should not be handled by privately-contracted systems integrators, who may have a narrow, short-term vision of the project's development. While Lutece's inception stems from a political initiative, the team in charge of its technical development has remained a constant since its inception.

- **External Contributions**: The final element that has helped Lutece remain sustainable is the contribution and help that the community receives. Lutece is being assisted by the Bloomberg Philanthropies in order to promote their software and communicate more effectively. They are also members of the OW2 consortium, the Adullact association, and the April association.

Lessons learned

Aside from the aforementioned importance of technological maturity and stable community governance, Pierre and Philippe had additional insights to share regarding the lessons they have learned in relation to the development and implementation of open source software in the public sector.

The first insight is directly linked to the importance of community governance and relates to the need to **build an inspired and motivated community**. The community of developers who contributed to Lutece throughout the years are mainly paid contractors from private IT companies. It has proven difficult to inspire these contractors to work towards long-term goals, even if the core team from the municipality has been motivated since the beginning. Attracting new developers to join the Lutece community has also been difficult. Pierre and Philippe identified two key elements negatively impacting Lutece's attractiveness: (1) the JAVA framework is not as appealing to the younger generation of developers as trendy technologies learnt in schools and (2) they believe that the public sector is less attractive to developers (part of it because less paid and technology is chosen for sustainability reasons rather than its wow-effect) than the private sector where the goal is mainly focused on making profit.

Secondly, Pierre highlights the need for the software to be built on a **long lasting and adaptable technology**. Indeed, the JAVA-based structure that allowed Lutece to remain sustainable for almost 20 years has also proven to be a challenge for the developers. As new plug-ins and websites were developed, it became necessary to follow leading technologies and adapt to market evolutions while simultaneously ensuring compatibility with the existing JAVA framework.

Finally, Pierre and Philippe stressed the importance for developers interested in open source to **look for existing project they can contribute to before launching a new one**. As many new projects are launched and end up failing, it would be more beneficial to have a smaller number of projects, but more people involved in each of them. Their advice to developers looking to launch a new software is to look for existing communities with similar objectives and contribute to the code. In line with this idea, Pierre and Philippe call on political officials to look more favourably on open source solutions by giving municipalities the necessary capabilities and funding to develop and implement reusable solutions themselves. Public administrations should have dedicated development teams and a good budget to foster the reuse of technological tools. Political change is essential to foster the use of open source software in public administrations.

Policy context

For information regarding the policy context of the use of open source software in the public sector in France, please consult the respective Country Intelligence Report and its corresponding factsheet. You will find a detailed overview of the political actors, strategic players, political and legislative initiatives, and general public sector open source software initiatives in France.

4. Voice of Groningen

Introduction

In 2019, the City of Groningen started a new participatory democracy project following the successful launch of the Stem van Groningen (Voice of Groningen) platform. The new project was designed with the aim of giving citizens more decision-making power in relation to their locality. On the advice of the Dutch Ministry of Interior's Digital Democracy Lab, the city of Groningen decided to use open source software. To host the platform, the municipality considered three open source online participatory solutions: CONSUL, YourPriorities, and OpenStad. Ultimately, the municipality chose CONSUL as it had the most relevant functionalities. CONSUL offers an open source digital platform and an app for participative democracy used by local governments and organisations. While Voice of Groningen is an independent public sector-led initiative in its own right, over time, the City of Groningen began to contribute to the existing open source community that had already been built around the CONSUL software.

CONSUL was initially designed by the Madrid City Council in 2015. The platform had the primary objective of allowing public institutions to carry out democratic participatory processes and make them accessible at different levels, including among local authorities, and regional and national governments. Now used by 140 institutions in 35 countries around the globe, CONSUL is one of the most advanced solutions for participative democracy.

To learn more about the sustainability of Voice of Groningen platform, OSOR spoke to the City of Groningen's Digital Democracy Project Officer, Nephtis Brandsma, and the former City of Madrid's CONSUL Project Leader, Miguel Arana Catania.

Community at a glance

Name	Voice of Groningen
Brief description	Online platform for participative democracy developed by the municipality of Groningen (the Netherlands). The solution was forked from the open source software CONSUL.
Starting date of the project	2019
User community	*Groningen*: 1200 users *CONSUL*: 140 institutions in 35 countries.
Developer community	*Groningen*: 3 developers hired by the municipality. *CONSUL*: 100 developers have contributed to the main source code. The CONSUL software has been forked more than 550 times.

Software output	Repository on Git Hub
Licensing	GNU Affero General Public License v3.0
Funding	Public funding from the Groningen municipality and the Dutch Ministry of Interior.

Project Output

Based on the CONSUL open source software, the Voice of Groningen platform and app has an 'area-oriented' approach, in the sense that it aims to give citizens more decision-making power in their locality. The digital platform is meant to serve as a complementary tool to the physical municipality meetings, rather than a replacement. According to Nephtis Brandsma, this initiative allowed the municipality to broaden its outreach, especially among disabled citizens and young adults. Local residents can submit ideas and vote on which projects should be implemented. Between October and December 2019, Groningen citizens had the opportunity to distribute a neighbourhood budget of EUR 25,000 on projects that they deemed to be most important. The city of Groningen is currently working on a similar project in the southern part of the municipality, with a budget of EUR 35,000.

Like the CONSUL software, the Voice from Groningen fork is freely available under a GNU Affero General Public License v3.0, in a GitHub repository. Developed in Ruby, the solution is easily customisable while the risks of damaging the core part of the software are limited. CONSUL is also a secure solution as it features a registration system that protects the privacy of users in line with the General Data Protection Regulation. The Groningen fork allows users to make proposals for participatory budgeting, vote for their preferred options, directly decide how to spend part of the budget, contribute to collaborative decision-making, share informative documents, and comment on such documents.

To develop and maintain the platform, the municipality of Groningen can seek support from the responsive CONSUL open source community through Slack and consult the extensive documentation available both on the CONSUL website and on GitHub.

Timeline

The adoption of CONSUL by the City of Groningen

In 2017, the city of Groningen participated in the 'Local Digital Democracy Lab' (henceforth: the Lab) initiative organised by the Dutch Ministry of the Interior. The Ministry developed a sandbox approach whereby new participatory democratic tools, preferably based on open source software, would be tested at the local level. In the framework of this governmental initiative, municipalities were able to work together to experiment with online participation and exchange lessons learned. Thanks to the Lab, Groningen reached out and began collaborating with other municipalities using CONSUL. As mentioned in the Digital Democracy guide published by the Ministry of Interior in April 2020, functional managers across the municipalities helped each other with questions, and project leaders advised one another on different participation processes. As part of this collaborative effort, the municipalities have

also applied for funding to work together on the further development and improvement of the fork of CONSUL.

In October 2017, the City of Groningen created the Coöperatieve Wijkraad (Cooperative Neighbourhood Council). The Cooperative Neighbourhood Council is a participatory democratic initiative that invites 11 randomly selected local residents to sit with the six elected councillors at the Oosterpark District's neighbourhood council. Together, they make decisions for and with the neighbourhood. To support the neighbourhood council, a panel of 400 residents were selected through sortition. This panel is regularly asked to give their opinion through online surveys.

In light of the Cooperation Neighbourhood Council's success, the Municipality of Groningen decided to launch a larger-scale participatory democratic initiative on the *Stem van Groningen* platform in October 2019. For the first large-scale action of the Voice of Groningen platform, citizens were presented with the opportunity to allocate a EUR 25,000 budget for the improvement of their neighbourhood. Between October and December 2019, citizens could submit ideas and/or vote for their preferred projects to be implemented in the area. The municipality also organised a series of physical meetings where citizens could exchange and develop their ideas. The consultation resulted in the adoption of 11 proposals, following a vote on the Voice of Groningen platform. The proposals are now being implemented by the City of Groningen in close collaboration with the citizens.

The work carried out by the City of Groningen is gradually being picked up on across the globe, partly due to the City's partnership with the European Union's Like! project, which allows them to disseminate the lessons learned from the Cooperative Neighbourhood Council and the Voice of Groningen initiatives. The Cooperative Neighbourhood Council initiative gained further international recognition after being awarded the European Innovation in Politics Award 2019.

The origins and growth of the CONSUL software

The CONSUL project was launched in Madrid in 2015 by the newly elected Ahora Madrid party. A core tenet of their political ideology centres on participatory democracy. The project materialised with the launch of the Decide Madrid platform based on CONSUL software. It allows citizens of Madrid to voice their opinion on various matters, ranging from the City budget to proposals for new regulation.

The popularity of CONSUL has spread rapidly across Spain and consequently around the globe. There are now more than 100 programmers across the world producing code for the initial version of CONSUL and 550 different forks of the software. The working community currently consists globally of more than 580 programmers and citizen participation public servants. According to Miguel Arana Catania, the CONSUL software is currently being used by more than 140 public administrations or organisations in 35 different countries. Since 2018, the project has been widely recognised internationally It won the United Nations Public Service Award 2018 and the 2nd prize in the Open Source Software with the Biggest Impact on Businesses and Citizens category of the European Commission's 2019 Sharing and Reuse Awards. For Nephtis Brandsma, these awards were the sign that CONSUL was a mature tool to reuse.

In April 2019, the CONSUL community established the CONSUL Democracy Foundation, a non-profit organisation whose mission is to 'reinforce the quality, neutrality and credibility of citizen participation worldwide in democratic process embodying the principles of democracy, independence, open source

and free software and knowledge, neutrality, transparency, rule of law and inclusion; as well as manage and contribute to the improvement, development and worldwide expansion of the open source free software CONSUL'.

Community's Sustainability

The successful implementation of CONSUL in Groningen is a testament to the success of this public sector open source software project. With regard to ensuring sustainability, our interviewees believe that an open source community looking to develop a similar public sector project should focus on the following five points:

- **Funding**: stable funding was key to the implementation of the CONSUL platform in Groningen. The municipality received funding from the Ministry of Interior and from the cities of Emmen and Enschede at the beginning of the project, meaning that they could hire additional developers to evaluate the code components and contribute to the improvement of the platform's user interface. According to Nephtis Brandsma, the long-term allocation of funding to both the development of the CONSUL fork and to its maintenance is a key sustainability factor.
- **Technological maturity**: the software needs to be properly maintained by the open source community, including regular updates and bug-fixing. For Nephtis Brandsma, the adoption of the CONSUL software by the City of Groningen was facilitated by the the positive feedback provided by other public organisations and administrations.
- **Feedback from the community**: in order to ensure the abovementioned technological maturity of the software, the CONSUL community pays particular attention to feedback from the user community. For Miguel Arana Catania, this is essential to maintain quality and attractiveness of the solution. The CONSUL team recommends the implementation of easy-to-use communication channels to encourage communication between developers and the user base in order to ensure that any bugs can be resolved quickly and users' feel supported in their implementation of the software.
- **Community vibrancy**: for the Nephtis Brandsma, the vibrancy of the CONSUL community had a positive effect on the Groningen's participatory democracy project. Being part of an open source community allowed the Voice of Groningen team to get technical support when needed. Beyond technical help, the community also shared advice on the design of online participatory process. Additionally, being part of a bigger project fostered exchanges with other public administrations around the globe. The vibrancy of the community is also a crucial factor for sustainability. Considering that the departure of some contributors over time is expected in any project, it is essential to ensure a steady stream of newcomers to replace them and to keep the community healthy.
- **Reusability of the solution:** according to our interviewees, merely publishing the source code of open source software is not sufficient to ensure the reusability of the solution. To foster the reusability of the software, the open source community needs to provide well-developed documentation and user support, especially regarding the installation of the

software. All of these elements contribute to the attractiveness of the open source software as compared to similar solutions simply publishing the source code.

Lessons learned

Aside from the aforementioned importance of keeping the software up-to-date, fostering the vibrancy of the community and focusing on the reusability of the solution, both Nephtis Brandsma and Miguel Arana Catania had insights to share regarding the lessons they have learned in relation to the development and implementation of open source software in the public sector.

Firstly, the most important sustainability factor mentioned by our interviewees was **promoting the solution** to ensure constant **growth of the user base**. The CONSUL team adopted an active strategy, directly contacting other public administrations that could potentially be interested in using the software. Not only does this ensure the growth of the user base, but it also allows the community to decrease its dependency on a sole contributor.

Secondly, the interviewees believe that **positivity and collaboration** are important elements that contribute to the sustainability of an open source project. This is something that made the implementation of CONSUL in Groningen particularly smooth. Collaboration in the framework of an open source community is different than working with another company – it is important to foster a horizontal and cooperative environment. By the very nature of open source software, individuals are doing things for other people, therefore one needs a collaborative mindset and a general sense of willingness from the involved actors.

Thirdly, the CONSUL team underlined the importance of getting the **support of decision-makers** in order to enlarge the software's user base and involve new public administrations. For that purpose, open source communities' representatives need to explain the advantages of using open source software to decision-makers in terms of transparency, price, and prevention of vendor lock-in, among other benefits. Most importantly, it is essential to make sure that decision-makers are aware of the specificities of open source software, in comparison with proprietary software, as it would allow them to take into account the long-term benefits of an open source project.

Additionally, Nephtis Brandsma underlined that civil servants involved in an open source project could benefit from **additional technical expertise** either from an in-house developer or by subcontracting an external expert, as was the case with the Voice of Groningen platform. The support from professional developers would help the public sector project leaders understand the technical aspects of open source software. A best practice shared by the interviewee is to communicate with the open source community and make the most of its expertise. It is therefore essential to ask questions and share any problems that may arise when installing and using the software.

Finally, on the developer side, Miguel Arana Catania shared the importance of **publishing the source code early** to maximise its open source characteristic and encourage as many developers as possible to contribute to the project.

Policy context

For information regarding the policy context of the use of open source software in the public sector in the Netherlands, please consult the Country Intelligence Report and its corresponding factsheet. The policy context of the use of open source software in the public sector in Spain where CONSUL was created, is provided in the respective Country Intelligence Report and its corresponding factsheet. There you will find an overview of the political actors, strategic players, political and legislative initiatives, and general public sector open source software initiatives in Spain and in the Netherlands.

5. OSKARI

Introduction

Oskari is an open source software designed as a framework that can be used to easily build web mapping applications, showcase geospatial data, and further analyse such data. The distributed Spatial Data Infrastructures used in Oskari enable public administrations and other bodies to share their spatial data and work collaboratively. Additionally, Oskari supports the Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) and OGC standards.

The INSPIRE Directive aims to create a European spatial data infrastructure for environmental policies by enabling the sharing of spatial data related to environmental impacts between public organisations. Following its adoption in 2007, Oskari was launched by the Finnish National Land Survey (NLS) in 2009 to establish a geoportal to host information about the Directive and various required datasets, showcase existing tools and provide documentation to support public sector bodies in implementing the Directive. The establishment of Oskari can be understood as a direct response to the implementation of the INSPIRE Directive.

Today, the Oskari open source software solution provides a user-friendly solution for web mapping to help public organisations offer better digital services to their citizens. Currently, about 40 organisations are involved in Oskari's development. Although the project originated from within the public sector, the solution is now used in several public and private organisations in Finland and abroad to support geospatial projects.

To learn more about the sustainability of Oskari, OSOR spoke to the Geographic Information System Expert at the National Land Survey of Finland, Timo Aarnio who has been working for the NLS since 2012 and is in charge of the technical coordination of Oskari.

Community at a glance

Name	Oskari
Brief description	Open source software for easily building multipurpose web mapping applications designed by the Finnish National Land Survey.
Starting date of the project	2009
User community	Not available
Developer community	The Oskari Network of over 40 organisations contributing to Oskari. 10 staff members within the National Land Survey of Finland.

Software output	Repository on GitHub
Licensing	MIT and EUPL Licenses
Funding	Initial funding came from the Finnish Ministry of Agriculture's budget. Gradually, other public administrations contributed to Oskari. At present, the yearly fee is set at EUR 5000 for the 9 organisations working with Oskari.

Project Output

Initially, Oskari was designed as a geoportal to host information about the INSPIRE Directive, datasets and documentation to support public administrations in the implementation of the Directive. As existing market tools were deemed insufficient to meet the requirements of the Directive, the NLS of Finland decided to develop software in-house using innovative development methods, such as Agile and SCRUM methodologies, and existing open source resources.

The development model incorporated the use of external consultants as part of the development team, working alongside internal employees of the NLS. However, the coordination of these efforts remained internal. Oskari was built with Java and Javascript on top of existing open source tools such as GeoTools, GeoServer, OpenLayers and PostgreSQL, among others. The software tools and production servers are run on Linux and all of the source code was released in 2011 under MIT and EUPL Licenses on GitHub.

Currently, Oskari provides user-friendly, browser-based tools to access and reuse spatial data from various sources such as governmental applications. The main components of Oskari allow users to:

- create embedded maps through the user-friendly wizard, including map layers from multiple data sources;
- easily customise map user interfaces with limited programming skills; and
- create thematic maps based on geospatial statistics and run an analysis based on spatial data.

Oskari supports multiple languages for the full version, including English, Finnish and Swedish, and almost a dozen more for a limited set of functionalities. Oskari is compatible with all major web browsers such as Firefox, Chrome, or Safari.

The architecture of Oskari is built on two main components: a frontend, the user interface, and a backend, the server-side components. The user interface is built as a single-page app that users can customise with various modules in order to tailor the features to their needs. The modules can be used together or individually, and additional ones can be created. The server-side provides deployable web components for managing and launching the user interface in applications relying on Oskari, thus enabling a higher level of customisation.

Today, over 40 organisations from both the public and private sector are involved in Oskari. Some of the main contributors include the Finnish Transport Agency, the City of Tampere, Statistics Finland, the City of Joensuu, the National Land Survey of Iceland, and the National Land Survey of Moldova. The municipalities that use Oskari rely on the solution mainly for spatial data and city planning. Larger cities, such as Tampere, actively contribute to the development and sustainability of Oskari by developing new features as they need them. There is no one body with responsibility for spreading the word about Oskari – the entire community takes responsibility for stakeholder engagement and promotion activities, thus helping to ensure that Oskari can reach a wider, diversified audience.

Initially, the funding required to develop Oskari came from the budget of the Ministry of Agriculture - the funding entity of the National Land Survey. However, once other public administrations became interested in using Oskari, they started contributing to the budget. Currently, the yearly fee is set at EUR 5,000 for each of the organisations working with the Project Steering Committee. Additional funding has come from the private sector. As Oskari continued to progress, private companies expressed an interest in the software and eventually contributed financially to its development. However, the continued development of Oskari solutions and provision of support for public sector actors proved to be a highly contentious issue for private sector companies as they felt that the NLS was generating unwanted competition in the public sector. As a result, the NLS no longer develops projects specifically for the public sector; rather, they simply provide support and software maintenance when it comes to Oskari. In addition to private sector funding, a couple of projects were funded by a grant that Oskari received from Eurostat.

Timeline

The INSPIRE Directive entered into force in 2007. It aims to establish a spatial data infrastructure in Europe to ensure interoperability between databases and to facilitate the dissemination, availability, use and reuse of spatial data. This Directive is the driving force behind the Oskari project, which was launched in 2009 by the National Land Survey of Finland. The initial goal of Oskari was to provide a geoportal with information, datasets and documentation to support public bodies in the implementation of the INSPIRE Directive. Considering that market tools didn't fully address the needs of the Directive, the NLS decided to develop an in-house tool.

Following the launch of the software, other governmental organisations showed interest in having a geoportal on their websites. This interest led to the release of Oskari as an open source software solution in 2011.

Timo Aarnio joined Oskari in 2012 as a product owner for one of the software's features. Over time, his role evolved to that of a lead product owner and community coordinator for the network of 40 organisations involved in the project. In 2014, approximately 10 more members joined the Oskari community, mostly from the public sector. That same year, larger projects involving the use of Oskari were launched. They included dynamic thematic mapping in order to rapidly build shareable thematic maps, further development of the basic Oskari functionality, and Remote Procedure Call (RPC) APIs to provide support for integrations to existing systems.

As Oskari began to grow, there was a need to define clearer roles and responsibilities for developers working within the community and to establish a governance structure. In 2014, the Collaborative

Oskari Network was founded, and in 2016, a Project Steering Committee was created for technical discussions, consisting of nine organisations working at the core of the project. The Project Steering Committee formed part of the Oskari team's application for an OSGeo membership, which is ongoing. OSGeo, the Open Source Geospatial Foundation is a non-governmental organisation founded in 2006 to support and build an open source software offer in geomatics.

In 2017, Oskari began retailing software support to private companies and selling hosting, services and development. Since 2019, users looking to gain more expertise about Oskari have been able to access training courses delivered by a private company.

Community's Sustainability

The Collaborative Oskari Network has been growing at a steady pace over the past few years. From 10 members in 2014, it has evolved to include 40 organisations today. The spread and development of Oskari in public and private organisations is testament to its success. Having started as the Finnish Geoportal for the INSPIRE Directive, Oskari can today be considered as a global solution for enabling multipurpose web mapping applications. According to Timo Aarnio, Oskari has met and surpassed its initial objectives and can be viewed as a sustainable open source project. This sustainability can be attributed to four key elements:

- **Sustainable Funding:** A stable source of funding is a prerequisite for the sustainable development of any public sector open source project. For Oskari, the initial budget came from the Finnish Ministry of Agriculture, the funding entity of the National Land Survey. The continued use of Oskari in several services provided by the NLS has ensured a steady source of public sector funding to maintain the existing services. As the project grew, however, funding became more challenging as not all organisations that use Oskari are committed to providing financial contributions. The nine organisations of the core Project Steering Committee each contribute a fee of EUR 5,000 per year. However, now that Oskari is used in several organisations, funding has become steadier and Timo Aarnio doesn't anticipate any financial difficulties in the near future.
- **Public sector adoption incentives:** Linked with funding needs, the sustainability of open source projects such as Oskari is dependent on the support they gain within public administrations. Timo Aarnio highlights the need to gather support and encourage the involvement of high-level officials and directors in order to strategically leverage dependencies on the project within the organisation and ensure that the project lifecycle is sustainable.
- **Technological Maturity:** In projects with numerous stakeholders such as Oskari, the software architecture needs to be modular and foster agility so that developers can respond to all of the organisations' needs. The more flexible the software, the more sustainable it is. Additionally, if various contributors are to manage the code, it must be built in such a way as to ensure that it is clear and can be revised and reviewed easily. Similarly, high-quality, up-to-date documentation is very important and should always be available to users. Processes need to be put in place to ensure quality and consistency in the software development and the maintenance of the documentation.

- **Effective Communication:** For a large-scale open source project involving several organisations, effective communication is key to ensure stakeholder involvement. Oskari used some of the fees collected from the Project Steering Committee to hire a community manager responsible for handling internal communication flows and external communication, i.e. on blogs or social media platforms. This community manager helps to facilitate operations and ensure smooth communication between all stakeholders.

Lessons learned

Aside from the importance of funding, technological maturity and communication, Timo Aarnio had additional insights to share regarding the lessons learned in relation to the sustainability of open source software in the public sector.

Firstly, Oskari is a project born within a public organisation, but over time, it **branched out to the private sector**. This diversification brought challenges in 2014 as some private companies felt that Oskari was using their work and contributions to develop new services for public administrations. This issue was resolved by adapting the services provided to public sector bodies. Oskari now simply supports the implementation of Oskari-based solutions in public bodies rather than developing code specifically for them.

Secondly, **community building** has been a challenge for Oskari. Timo Aarnio reports that commitment of both individuals and organisations has been unequal over time. The management of these varying levels of commitment in a long-term project has proven difficult. Timo Aarnio suggests that administrations should launch longer-term projects that focus on ensuring steady contributions and funding rather than planning one- or two-year-long engagements. Shorter projects are more likely to struggle with sustainability over time.

Finally, Timo Aarnio highlights the importance of the **project lifecycle** in the development of a new open source project in the public sector. It must be clearly disclosed to all stakeholders that such projects are long-term commitments. According to Timo Aarnio, in the public sector, people are used to projects that are shorter in length. However, developing an open source software solution is not solely about achieving a complete version in a couple of years but also about maintenance, continuous upgrading, and the development of the software. Therefore, it is crucial to have high-level commitment within public organisations in order to foster the long-term benefits of using open source software.

Policy context

For information regarding the policy context of the use of open source software in the public sector in Finland, please consult the respective Country Intelligence Report and its corresponding factsheet. It includes a detailed overview of the political actors, strategic players, political and legislative initiatives, and general public sector open source software initiatives in Finland.