Roadwork ahead

Evaluating the needs of FOSS communities working on digital infrastructure in the public interest

JUNE 2020

I Executive Summary

This report explores the unique nature of the community that builds and maintains free and open-source software (FOSS) and its role in shaping an open Internet. It draws on interviews with contributors to FOSS projects to highlight the community's strengths as well as its challenges. It finds that, while the community runs on trust-based relationships, self-organization and self-motivation, these foster a lack of organizational structure and low diversity among contributors. This results in a lack of different skills and perspectives that are necessary for running successful, sustainable projects, and lost opportunities to receive funding and other, non-monetary support. Based on these insights, this report proposes recommendations of how funders can support the FOSS community more effectively.

II Introduction

BACKGROUND

THE IMPORTANCE OF OPEN INFRASTRUCTURE

Open digital infrastructure forms the groundwork of the digital world. At a time when personal and professional activity increasingly takes place digitally, the security, reliability and trustworthiness of this infrastructure is of crucial importance. The Internet, which runs on this infrastructure, has long provided the public space for the development of a digital society. It is therefore imperative that its foundations are maintained and developed in the public interest.

Although individuals, companies and governments depend upon this foundation of free and public code (or free and open-source software, or FOSS), the way digital infrastructure is developed and maintained has not fundamentally changed since the early 1990s. The development and maintenance of digital infrastructure is still overwhelmingly the work of contributors whose lone efforts can suddenly become fundamental to the successful operation of hundreds of new projects.

In her 2016 report, Roads and Bridges: The Unseen Labor Behind Our Digital Infrastructure, Nadia Eghbal writes:

> "Digital infrastructure projects [...] are conceived of and built from the bottom up. It is akin to a group of citizens getting together and deciding they want to build a bridge or create their own sewage system. There is no authoritative body whose formal permission is required to create new digital infrastructure." [1]

> "Many useful projects will come from independent developers who suddenly find themselves at the helm of a successful project, facing critical decisions about its future." [2]

1 https://www.fordfoundation.org/media/2976/roads-and-bridges-the-unseen-labor-behind-our-digital-infrastructure.pdf p.43

2 https://www.fordfoundation.org/media/2976/roads-and-bridges-the-unseen-labor-behind-our-digital-infrastructure.pdf p.52

This report looks into the kinds of support needed by individuals and groups involved in the development of digital infrastructure, and examines why existing support such as project-based fellowships and development grants are rarely used. It builds on the work of others, in particular Nadia Eghbal, whose Roads and Bridges formed the basis of for the call for research on digital infrastructure[3] by the Ford Foundation. This report was produced by Implicit Development Environments (IDE)[4], a project supported by the Ford Foundation in the context of that call.

PROBLEM STATEMENT

RELIANCE WITHOUT GOVERNANCE?

Open digital infrastructure is not just part of the digital ecosystem; it forms the very foundations of the technology industry. Nadia Eghbal writes:

> "Thanks to permissive licenses, companies like Facebook or Instagram are not obligated to pay for this code [i.e. free, public software], but are free to profit handsomely from it. This is not unlike a trucking company (Instagram) using a highway (public code) to transport goods for commercial services (Instagram's app)." [5]

Like roads and highways, digital infrastructure is more than a backbone for the economy. – Like market squares and other public spaces, it also serves as an arbiter of society. Digital infrastructure grants access to information, makes and shapes personal and professional digital environments, and enables the formation of communities (or, conversely, when it is not built with the public interest in mind, doesn't).

Contributors to public infrastructure include public institutions (e.g. public wireless networks), businesses (e.g. IBM-owned RedHat's platform and cloud services[6]), non-profits (e.g. the Internet Security Research Group[7] service Let's encrypt[8]), and often a combination of all three (e.g. DNS root servers[9]). Where open infrastructure is absent, privatized and often exploitative business models predominate. These commodify people, harming those communities that are most vulnerable, both in the physical and the

3 https://www.fordfoundation.org/ideas/equals-change-blog/posts/a-call-for-research-on-digital-infrastructure/

4 https://implicit-development.org/

5 https://www.fordfoundation.org/media/2976/roads-and-bridges-the-unseen-labor-behind-our-digital-infrastructure.pdf p.20

6 https://www.redhat.com/en

7 https://www.abetterinternet.org/

8 https://letsencrypt.org/

9 https://www.iana.org/domains/root/servers

digital world.[10] While the existence of public infrastructure does not automatically make the world a more just and equitable place, it is an essential prerequisite. Nadia Eghbal classifies the development of digital infrastructure according to three main categories, each of which is differently organized and financed: within companies, as a new business, or by an individual or community of developers.[11] This report focuses on the third group for the following reasons:

- Representatives of this group are comparatively hard to identify because organizational structure, public image and branding are often absent. Characteristically, their working methods are decentralized, with a focus on individual contributions and self-organization rather than shared strategies or missions.

- While many of the projects produced by this third group are well known in the tech industry, the people and communities behind them often fly under the radar of investors, funders and other non-technical supporters. As a result, they receive less support.

- Even though we currently do not have the data to quantify how many digital infrastructure projects rest mainly or solely on the shoulders of individuals or developer communities, anecdotal evidence suggests they make up a sizeable share of these projects. This is to some degree supported by a 2015 study[12] by Guilherme Avelino, Marco Tulio Valente and Andre Hora which showed that of the 133 most widely used projects on GitHub, 64% are maintained by one or two contributors.[13]

For this report, we chose to incorporate an additional actor missing from Eghbal's classification into this third group: not-for-profits. A great deal of infrastructure is developed by communities made up partly by paid staff, but mostly volunteers and freelancers, under the umbrella of not-for-profit organizations. Compared to for-profits, not-for-profits find it easier to rally these communities, who will frequently volunteer their time and expertise. Even though not-for-profits constitute an organizational structure that is otherwise absent from the cited developer communities, our research has found

10 https://www.theguardian.com/technology/2017/jul/27/facebook-free-basics-developing-markets

11 Roads and Bridges, p.46

12 https://doi.org/10.7287/peerj.preprints.1233v3

13 Existing studies evaluate contributor numbers on projects on GitHub. This provides valuable insight into the FOSS ecosystem, but doesn't cover two points that are of interest to this report – namely, projects that work with tools other than GitHub, and whether or not the projects under scrutiny receive institutional support or not.

them to play a vital role both in the digital infrastructure ecosystem and as a counterweight to businesses and commercial interests.

To continue the metaphor of digital infrastructure as roads and highways, this means that road workers carry out their jobs in the absence of any form of central governance. They proactively maintain old roads and continuously extend the road network on which not only trucks carrying companies' loads travel, but along which public transport is conducted – allowing people to go about their lives and reach their places of work and study.

This infrastructure is of increasing social and economic importance, and it deserves support. Major donors to public-interest digital infrastructure include private foundations (e.g. Mozilla Foundation[14], NLnet Foundation[15], Knight Foundation[16]), public funders (e.g. the Open Technology Fund[17], the Prototype Fund[18], the Next Generation Internet grants of the EU[19]), and multi-stakeholder initiatives (e.g. the Core Infrastructure Initiative[20]). Private individuals contribute via direct donation and crowd funding platforms (e.g. Liberapay[21], Open Collective[22]) or platforms like Bountysource[23], on which donors can sign up to support individual features under development.

Yet it is doubtful that these sums are enough. Whether public infrastructure should be supported by philanthropy is another subject for debate. The fact is however, that infrastructure projects developed by individuals or developer communities continuously face the challenge of how to support themselves.

GOALS

HOW TO SUSTAIN OPEN INFRASTRUCTURE

> "Developing effective support strategies requires a nuanced understanding of the open source culture that characterizes so much of our digital infrastructure, as well as recognizing that much has changed in the past five years, including the very definition of 'open source' itself."[24]

14 https://foundation.mozilla.org/en/

15 https://nlnet.nl/

16 https://knightfoundation.org/prototype/

17 https://www.opentech.fund/

18 https://prototypefund.de/en

19 https://www.ngi.eu/opencalls/

20 https://www.coreinfrastructure.org/

21 https://liberapay.com/

22 https://opencollective.com/

23 https://www.bountysource.com/

24 https://www.fordfoundation.org/media/2976/roads-and-bridges-the-unseen-labor-behind-our-digital-infrastructure.pdf p.125

In order to better understand the culture from which open digital infrastructure emerges and the obstacles faced by different projects, we sought to identify similarities and differences between FOSS projects. Through a series of qualitative interviews, our goal was to determine the social norms and practices that influence contributors to infrastructure projects, and thereby understand the effects of these values on open source communities – particularly with regards to funding. The goals of our research were to:

- identify the preconditions and needs specific to infrastructure projects which set them apart from projects at the application layer,

- examine in what way these needs are rooted in the social values underlying free and open-source software (FOSS) communities,

- outline how funders can support open digital infrastructure in the future.

III Methodology

As we have noted, open digital infrastructure projects tend to be organized from the bottom up by their contributors. We therefore started our research right where the work is done – with those individuals. We conducted a total of 26 interviews, 15 of which focused on the interviewee's relationship to a particular project (across 12 projects), while the remaining 11 focused on the relationship between the interviewee and communities within FOSS.

We opted for a qualitative, human-centered research (HCR) approach. HCR, which has been described as the "active consultation of people"[1] can be especially valuable in cases where the factors at play are unknown or not well understood, as it helps with mapping the field and allows any further research, qualitative or quantitative, to build on an accurate understanding of the context. For our research, HCR helped us to dive into the subject matter early, adjust our strategy on the go and remain flexible in the paths we pursued, while remaining anchored in the communities we aimed to study.

Together with project partner Simply Secure, we formulated a large set of questions to assist interviewers in navigating interviews. In turn, interviewees chose for themselves which aspects of their work they wanted to emphasize and fed back to interviewers with suggestions of questions to add to the list.

The questions fell into 7 broad categories:

- Trajectories and positions in FOSS: What are you working on, and how did you end up there?
- Outlook on FOSS: What do you like about your work?
- Values: What does your work on open infrastructure mean to you?
- Governance: How do people on a project collaborate? Who does what, and why?

1 Bruce Hannington, Relevant and Rigorous: Human-Centered Research and Design Education. Design Issues 26.3, 2010, pp. 18–26.

- Support: From what sources do projects receive funding or sponsorship?

- Project state and outlook: Is your project sustainable? What makes it so?

- Standards: How do standards affect your work, and how does your work affect them?

In their 2019 report On Trust and Transparency[2], which was also based on a series of interviews, Simply Secure[3] highlighted how the power differential between funders and grantees may have unknown, and sometimes undesirable, effects on funding and the relationships between parties. Following the example of Simply Secure, we placed great emphasis on confidentiality and trust in the course of conducting and evaluating interviews. Part of this effort consisted in running our own open-source and GDPR-compliant digital research infrastructure.[4] No individual interview partner or project will be named in this report without their explicit consent.

2 https://ontrustandtransparency.report/

3 cf. "On Trust and Transparency", p 9. https://simplysecure.org/resources/ott/On_Trust_and_Transparency.pdf

4 cf. our blogpost: https://implicit-development.org/2019/09/25/walking-the-walk/

DEFINITION

WHAT IS (OPEN) DIGITAL INFRASTRUCTURE?

What qualifies as digital infrastructure is open to interpretation. Definitions range from the formulation and implementation of information technology standards, to the tools and services that enable developers to do their work. For us, neither definition by itself seemed promising. Standards laid down by organizations such as the Internet Engineering Task Force (IETF) do not always get accepted in the wilder space of open-source software development, where quasi-standards may rule over official ones. And to single out specific tools, frameworks and services seemed arbitrary: why would we assume that special rules apply to them that do not apply to other examples of free or open-source software?

Instead, we formed our own working definition to match our research question. **Digital infrastructure provides services essential to the operation of digital activity.** It is the result of processes that take place in different fields and are shaped by many different people in varying capacities. We identified three core spheres of activity and the actors within them:

- **Standard creators** People and organizations who decide upon and write IT standards.

- **Standard implementors** People who implement these standards in their software and create digital tools and services around them.

- **Service providers and maintainers** People and organizations who run these tools and services, and can directly observe how these standards affect users.

If we want to assess how open digital infrastructure is best developed and how funders can support it better, we needed to address these three groups equally, viewing them as an interconnected ecosystem.

From the vast number of existing infrastructure projects, we intentionally focused on developers with strong ties to infrastructure security or resilience. Though they make up a sizable community, they tend to set themselves apart from more public groups working on frameworks and languages. Even when their work is publicly known, they are therefore less visible, despite their work playing a vital role in making digital systems – the network of roads and highways – more secure. Since most of these projects value privacy and decentralization, they tend not to share their code on GitHub, but through other, decentralized channels such as GitLab[5], Bitbucket[6] and Sourceforge[7]. Most research has focused on GitHub because its centralized structure enables researchers to query data on large numbers of projects. However, this has led to projects present on other channels not being represented in studies into open digital infrastructure.

5 https://about.gitlab.com/

6 https://bitbucket.org/

7 https://sourceforge.net/

IV Interviews

SCOPE
WHO DID WE TALK TO?

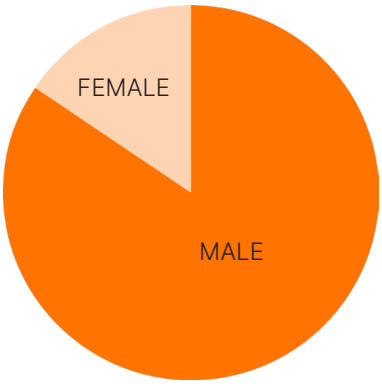
For our interviews, we contacted people contributing to different kinds of open digital infrastructure projects through a variety of roles and tasks. Most of the time, we contacted them directly or were introduced by a former interviewee. We also attended different communities' events in order to schedule interviews in person; this proved more effective. The demographic of our interviewees was rather homogenous – mostly male-presenting and overwhelming white or white-passing. This was in line with our observations at events as well as an empirical study on the geographic locations of open-source software developers on GitHub conducted by Yuri Takhteyev and Andrew Hilts.[1] In an effort to counter this homogeneity, we invited additional projects with ties to under-represented groups and world regions to participate in this research, but received no responses.

1 https://pdfs.semanticscholar.org/9ba2/9373aac78aa592f3cbf932fbd2d14d6fcb53.pdf

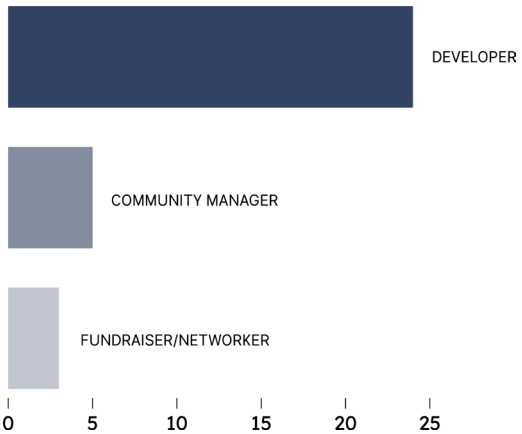
STATISTICS

INTERVIEWS IN NUMBERS

We conducted 26 interviews in total, 25 of them in person, one via telephone. 15 were in-depth interviews with people from 12 different projects, 11 focused especially on the relationship between individual and community.

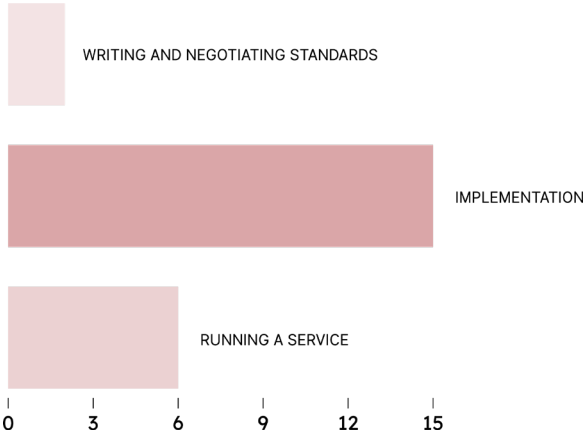


22 participants were male-presenting, 4 female-presenting



They contribute to their projects as developer (24), community manager (5), fundraiser/networker (3) (multiple answers allowed).

They hold a position as an employee (11), are freelancers (8) or volunteers (14) (multiple answers allowed).



The projects they work on center around writing and negotiating standards (2), implementation (15), or running a service (6) (multiple answers allowed). Data only from in-depth interviews.

DEMOGRAPHICS

CHALLENGES AND LIMITATIONS

A few challenges we faced during our research are worth noting. Because our target communities value security and privacy highly, we mostly reached people close to our own network or to whom we were introduced to by a trusted person. We tried mitigating this by sending out a public call for interviews and requesting interviews on public mailing lists, but received few responses.

For trust and privacy reasons, we limited our set of demographic questions to a minimum. Nevertheless, most opted out of stating even basic information like gender. There may be several reasons that led to this question going unanswered, but one interviewee stated that they perceived it as "politically loaded". The only vaguely-reliable numbers about women in Open Source (female representation to comprise 5.4%) are based on GitHub profiles, a platform that many in our target audience shun for different reasons (e.g. it is a centralized, closed-source service belonging to the Microsoft corporation). Even more, the GitHub numbers are likely to be skewed, since pull requests by observably female profiles are more often rejected.[1] This compounds the problem of finding reliable statistics with which to compare the demographics of our interview group.

1 https://phys.org/news/2017-05-gender-bias-open-source.html

V Project Types

We matched statements from each individual interviewee to the actual infrastructure project. Since many interviewees were involved in more than one project, we asked them to choose the one in which they were then most involved, since they would have a thorough understanding of how the community works. To make the commonalities and differences between the projects more tangible, we formulated “project types” similar to personas in human-centered design. These project types help provide an overview of the landscape, helping us keep the full breadth of the field in mind as we analyze our interviews. The types are of course simplified – by no means do all infrastructure projects fit neatly into one category, nor do they check all the boxes. Mainly, they serve as a tool for differentiating insights and recommendations that might otherwise seem conflicting or contradictory.

THE “ONE-PERSON SHOP”

The “one-person shop”, as one interview partner described it, is the smallest unit: individual people who work on an independent project for which they are solely responsible.

- **Who is involved** A freelancer or volunteer.
- **Longevity** A one-person shop can exist for decades.
- **Pipeline** More likely to work on standards or implementation than running services.
- **Funding** No first-hand experience.
- **Resources** The limiting factor is time. A one-person shop is often cross-financed through contracts or regular employment (e.g. a position in academia).
- **Governance** No structure needed.
- **Note** Even though they function independently, the one-person shop is very well connected within the wider sector. The willingness to collaborate varies.

THE COLLECTIVE

Collectives are grassroots communities whose contributor numbers fluctuate. Consensus on general issues is generated through conversations on IRC channels, mailing lists or, less often, a platform like Slack or Matrix; smaller decisions can be taken by those who work on the specific issue.

- **Who is involved** Freelancers who usually offer services connected to the project, and volunteers.
- **Longevity** Collectives are persistent, even though contributor numbers fluctuate and the original founders may no longer be involved.
- **Pipeline** Implementation and services.
- **Funding** Little to no first-hand experience, often with a critical attitude towards funding.
- **Resources** The project has no funds; if it does, distributing them is seen as a challenge.
- **Governance** Consent-based decision making, meritocratic; often anti-structure and/or anti-hierarchical. No set roles apart from core developer and contributor.
- **Size** Anything from two contributors to dozens or even hundreds.
- **Note** Personal and political values tend to be more explicit in collectives' work than the other types. Despite producing a lot of work, there is usually is no identifiable spokesperson (e.g. for companies who are looking for someone to address in order to collaborate; for funders looking for a contact person).

THE EMBEDDED

Embedded projects typically evolve out of an older or larger project (quite possibly a collective) and specialize on developing a set of features within that project – for instance a product or a service. Embedded projects have strong ties to the projects from which they sprang as well as other specialized projects, and often share resources and distribute tasks between them. Embedded projects function within a network.

- **Who is involved** From an initial group of freelancers, a core of paid staff is formed who push development forward; freelancers who offer services connected to the project; volunteers.
- **Longevity** An embedded project

can evolve out of older, larger tech projects (quite possibly a collective) and can specialize on a set of features or a product.

- **Pipeline** Standards, implementation, and services.
- **Funding** Embedded projects often have first-hand experience applying for support from different sources (e.g. paid contributions from companies, FOSS foundations, philanthropic or public funders), but less often with handling larger grants.
- **Resources** Embedded projects have modest to mid-size funds at their disposal which mostly go towards supporting coding work, but can also fund travel, community events etc...
- **Governance** A light-weight governance structure is in place, but mostly to coordinate with external partners. Internal roles, such as fundraisers and community managers, are vaguely defined, if at all.
- **Size** Small team of 3-10 people.
- **Legal status** An embedded project starts without a legal entity, but soon adopts a low-cost model to suit its needs, which might include writing bills, handling money and partner contracts, insurance reasons, and so as to be taken seriously by companies and potential funders.
- **Note** Embedded projects are constantly evolving and flexible, which sets them apart from organizations.

THE ORGANIZATION

Organizations have transformed their product into a brand with which they are inseparably connected.

- **Who is involved** Paid staff with clear job descriptions. Usually a community of freelancers and volunteers who contribute a lot to the product forms around the core staff, though often they only play a minor role.
- **Longevity** The organization is established.
- **Pipeline** More likely to work on implementation and services than standards.
- **Funding** The organization has received funding from different donors and other sources. They usually have a mixed funding model consisting of contracts, services and grants.

- **Resources** A significant level of resources goes into maintaining the organization itself, i.e. in management, marketing and overheads.

- **Governance** Organizations have typical structures with clearly defined internal (community management, team lead, CEO) and external roles (marketing, fundraising).

- **Size** Small to medium-sized team of 5 –30 people.

- **Legal status** The organization often has, or tries to achieve, a more sophisticated legal status, such as an LLC, or a fiscal status that allows for tax-exemption. Depending on the country or region in which the organization is based, the latter can take very different forms and have very different strings attached.

- **Note** It is possible for an organization to take other projects (e.g. young embedded projects) under its umbrella, providing them with legal and fiscal status. However, there needs to be some sort of logical connection between the two – organizations do not usually serve as a fiscal sponsor in the classical sense.

Insights

1 There is a uniform path into open digital infrastructure projects.

2 Projects lack structure because of the values of project contributors.

3 Diversity is understood and valued differently.

4 A lot of non-coding work is done by people who would rather just be coding.

5 Trust runs deep.

6 Effective funding means understanding unusual needs.

7 Adoption is a double-edged sword.

8 Funders and infrastructure projects communicate differently.

9 A variety of factors prevent infrastructure projects from applying for funding.

10 Accepting funding can be a risk.

VI Key Insights and Recommendations

From the interviews we conducted we selected those insights that we believe can help funders to better understand digital infrastructure projects, especially those that are less visible. For clarity, we classified these insights according to four overarching topics:

- **Portrait** Who are the people behind the projects? What social values do they bring to their work?
- **Technology** What are the technological specificities that set infrastructure projects apart from other tech projects? What are the key challenges that arise out of their work?
- **Community** Who takes up which roles within a community? Which dynamics make a community work well, and which threaten their stability?
- **Funding** How do the peculiarities of digital infrastructure projects influence the relationship between funders and grantees?

1

There is a uniform path into open digital infrastructure projects.

“We expect them [newcomers to the project] to know their stuff.”

“The first days are most critical [for newcomers to stay with a project].”

People‘s paths into FOSS projects usually follow the same route. Individuals often spend more than a year passively reading mailing lists and trying to make sense of the code on their own before actively taking part in discussions and committing to code. That people need to put in so much time and work is seen as necessary for newcomers to prove their commitment and be taken seriously. Our interviewees were aware that this status quo strongly favors people privileged to have access to computers in their youth, but the prevailing sentiment is that this is necessary to guarantee independence and quality of work. Clear onboarding mechanisms are the exception, not the rule.

PORTRAIT & COMMUNITY

Insights

> “It all [the FOSS ecosystem] works quite well once you understand it.”

This rather arbitrary pre-selection affects the lack of diversity in infrastructure projects in several ways:

- **Limits skill sets** If people join a community by contributing code, the result is that only developers join the community. People with other, non-technical skills who might be sorely needed have no way of entering the community.

- **Selects for financial background** People without a steady income or the backing of a financially stable environment have a hard time working their way into a project to the point where they are accepted as a contributor. There is no guarantee that the time they spend will at some point pay off financially, whether that be in the form of contracts or job opportunities.

- **Preserves unbalanced demographics around race, region, and gender** Though there is awareness of large race and gender imbalances, there are few examples of communities or projects actively trying to diversify, since such efforts would go against the established way of joining projects.

Recommendations

- Understand that the path into FOSS is perceived as formative, and people often identify strongly with the path they themselves took; criticizing it can lead to developers taking the criticism personally. Instead of arguing for greater diversity, approach the issue by first helping the project work out which people, skills or perspectives the project needs to be successful – and where these could be found – and work from there.

- Reach out to people who dropped out of a project in order to learn what factors contributed to them leaving.

- The provision of free-to-access resources and examples of good practice about onboarding could help those who are willing to change the process, but do not know where or how to start.

- Explicitly funding non-technical positions within tech projects can enhance their standing in the eyes of the FOSS community.

Recommendations

- Our data on women is scarce, but there are indications that projects with community management and team leadership roles can help to keep women on board. Financially supporting these roles could help tackle the lack of diversity. However, especially for one-person-shops or collectives, this can mean the imposition of a governance structure on the project that the community is not willing to support.

- Instead of attempting to bring more diversity into existing projects, supporting projects run by groups that are underrepresented in tech can help contributors hone their confidence, skills and reputation, and enhance their standing.

- Establishing fellowships within existing projects exhibiting poor inclusivity can temporarily alleviate imbalances, but this unfairly puts the onus of reforming projects' structure onto the fellows.

2

Projects lack structure because of the values of project contributors.

“Our [community] rules are very developer-centric.”

As the four project types show, many projects make do without a defined project structure. This applies to collectives and embedded projects, but to a lesser degree can also influence work in organizations. The lack of structure is intentional and follows logically from the uniform path that leads people into open-source infrastructure projects: for the people who make it in the FOSS field, individual motivation and agency are core values. Our interviewees often saw the presence of governance structures as limiting their opportunities for action, decision-making and personal development.

PORTRAIT & COMMUNITY

Insights

“We have companies working with us – they need a contact person.”

- Projects that see themselves as a community (as opposed to an organization working with a community) value self-organization. Management and structure are treated with skepticism, even more so if they are implemented by external influences, such as a funder.

- Self-organization sets open-source infrastructure projects apart from companies that work in a similar field. Even if they share goals or work on the same products, the work culture is very different.

- Non-open-source organizations are likely to expect at least a basic structure and inner cohesiveness, especially when deliberating collaboration. Many open-source projects cannot deliver on this point – which stands in the way of more effective networking.

- Members of the community are affected differently by the lack of structure. While this can open up opportunities for taking greater responsibility, it can also lead to people feeling lost and, in the long run, dropping out.

Recommendations

- Providing examples of good practice for lightweight, result-oriented FOSS project structures can help communicate their benefits and make discussions about governance less dogmatic.

- Reach out to people who dropped out of a project in order to learn what contributed to them leaving.

- Facilitating dialogue between different actors in the field of open-source infrastructure (e.g. by supporting events that attract both communities and companies), can help both sides better understand their respective work culture and find ways to adapt.

3

The understanding of and appreciation for diversity varies widely across projects

Our interview partners talked frankly about diversity and the lack of it in FOSS infrastructure projects. Overall, interviewees were in favour of greater diversity, but the degree to which people proactively make their projects more inclusive varied a lot. Since these efforts would open up new ways of joining a project, they go against the self-image of the community. For this reason, diversity efforts are generally limited (cf. Recommendation 1).

COMMUNITY

Insights

- Data about diversity in FOSS infrastructure projects is mostly anecdotal or drawn solely from GitHub, which offers only a limited perspective. No comprehensive study exists.

- Since a self-motivated, self-organized work culture so heavily influences the open-source identity, changes to it are quickly perceived as a threat to the community's culture. However, in practice, this culture filters out people with different backgrounds.

- Projects without community managers or a governance structure tend not to gather data on the diversity of their contributors or take steps towards more diversity.

- Existing diversity efforts focus mostly on women from industrialized countries.

- Some female-presenting interview partners actively favoured projects with community management in place over other (even paid) positions in similar projects where it was absent.

- Diversity efforts are considered to be time and cost intensive, while their chances of success remain unclear. Projects are more likely to support people who match their profile of existing contributors because they are assumend to contribute more, on the basis of cultural similarity, financial independence, time zones and visa restrictions.

Recommendations

"It is a homogenous crowd, and it will likely remain that way – it's a shame."

"We lack a community person. The acceptance for it is missing, we need the money to produce code."

"We, the chosen few."

"I miss hardcore hacking women, representation."

- Reach out to people who dropped out of a project in order to learn what factors contributed to them leaving.
- Adopt an intersectional approach towards diversity that takes into account race, place of origin, gender, class and abilities.
- Rather than encouraging diversity in existing projects, support projects run by groups that are underrepresented in tech as this can have a greater impact. Contributors benefit from honed confidence, skills and reputation, and can pave the way for incoming contributors from diverse backgrounds.
- The kinds of work funders support sends messages of value. Explicitly support community management positions when working with existing projects that lack diversity; refrain from focusing solely on developer positions. At the same time, avoid filling non-coding positions with people from underrepresented groups; this can reinforce the idea that coding is performed by higher-status people

4

A lot of non-coding work is done by people who would rather just be coding.

“We are not very good at marketing; we are problem solvers.”

“I would prefer to be just an engineer. In practice I am a community manager.”

As previously noted, the typical path into FOSS infrastructure projects is by contributing code. However, a lot of work is done that is not directly connected to coding: project management, financial administration, design, community management, event organization, communication and coordination with other projects and companies, representation at events and public speaking. This other work is seen variously as a burden, an annoyance, an unwelcome surprise, and a side hobby.

COMMUNITY & FUNDING

Insights

“We are developers. We also do community and outreach, but that is learning by doing.”

- These non-coding tasks are taken on by developers involved in the project. They recognize they are neither qualified for this work, nor are they especially interested in doing it. Despite being a source of frustration that keeps them from doing what they enjoy, they do not easily delegate this work to others – one reason being that there are few people inside the community with the necessary skills.

- In spite of frequent complaints about this work, where dedicated roles exist, they are not much valued.

- Developers undertaking non-developer work can favour technical fixes to non-technical problems. One example is the “social fork” where a lack of community and care work within a project leads to massive social friction. Instead of solving the problems on a social level, parts of the community fork the code and establish a new technical project, partly to circumvent social tensions or abusive behavior. Matthew Garrett’s work on the Linux Kernel is a well-publicized example of a developer avoiding “the behavior of various high-profile people within the kernel community,”[1] in this case the Linux Kernel Mailing List.

1 https://www.zdnet.com/article/matthew-garrett-is-not-forking-linux/

Recommendations

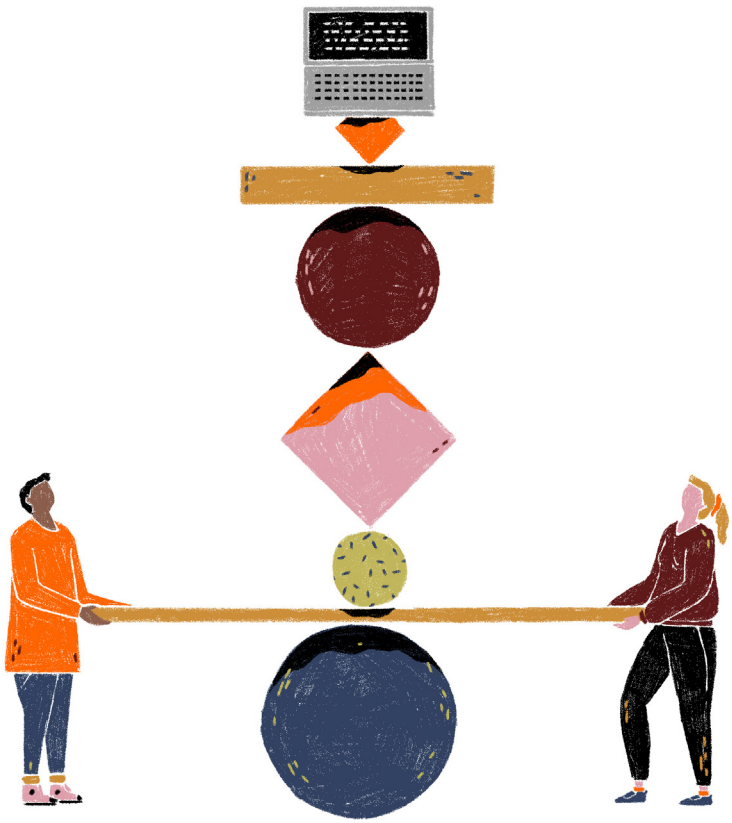
- Bringing professional moderators to community events can help foster more constructive dialogue.

- By choosing what kinds of work to support, funders send a message about what kinds of work are valuable. When working with projects in which essential management roles already exist, support them to the same degree as the developer positions.

- Opening channels of communication and knowledge exchange with existing groups of experts who work on non-coding tasks can make it easier for FOSS infrastructure projects to reach out to them. This can help foster respect for the people and the work, and lead to greater appreciation for these positions within the community.

- Fiscal sponsors can be put in charge of financial administration; incorporate this into project overheads. Fiscal sponsors are mostly a North American phenomenon, uncommon in other parts of the world. Organizations on their way to becoming fiscal sponsors in their respective legal and tax system should be supported so as to make it easier for FOSS infrastructure projects outside the USA to comply with funders' requirements.

5



Trust runs deep.

Trust is the basis for collaboration within FOSS infrastructure projects. Contributors and funders alike have to invest time and effort to earn it. Many of our recommendations for funders contain an element of “figuring things out together,” which makes establishing a trust-based relationship absolutely key.

COMMUNITY & FUNDING

Insights

“We need to trust each other.”

- Trust is built between individuals. It is not easily transferred to the organizations or communities they represent. This is true for funders, but also for people who professionally support FOSS infrastructure projects. Our interviewees overwhelmingly referred to specific individuals they would like to work with (e.g. as contractors facilitating an event or managing donations) rather than particular organizations or companies.

- Though FOSS communities might lack structure and clear roles, they value these in other organizations.

Recommendations

“Trust is created through cooperation.”

- By designating a specific contact person, funders can build stable relationships with their grantees.
- If grantees do not make use of external offers of support, one reason might be the absence of a trusting relationship. Personal introductions and recommendations can help build this.

6

Effective funding means understanding unusual needs.

“Funding for maintenance is hopeless.”

“The development of libraries is difficult to fund; it’s not very visible.”

Infrastructure projects have some needs that set them apart from projects and products at the application layer which might seem counterintuitive to funders more accustomed to supporting the latter.

TECHNOLOGY & FUNDING

Insights

“[A project developing a quasi-standard] makes too many policy decisions. Other developers then build around it at great expense.”

- The maintenance of digital infrastructure is essential to the security and resilience of the digital world. However, these activities suffer from being perceived as neither very innovative nor very visible – both qualities on which public funders especially tend to focus attention.

- In the context of digital infrastructure, the second and third implementations of a new standard are not only helpful, but necessary. A minimum of two reference implementations is necessary to advance a protocol to Draft Standard at the IETF, for example. Having several implementations of a protocol also means their developers need to agree on its functionality, even if it hasn’t completed the standardization process. This can help curb quasi-standards, in which one application implicitly defines how a protocol works, allowing it to make crucial changes without consulting the ecosystem.

- People who draft standards will not necessarily experience how their work impacts actual users. Whether there is a feedback loop between standard writers, implementers and services varies a lot. This knowledge lies with the people who run services on the basis of an implementation.

Recommendations

- Explicitly support maintenance. Avoid focusing solely on innovation.
- Support second and third implementations. This will help level the playing field and foster a healthy dialogue around standards.
- Encourage knowledge exchange between people who work on standards, those who implement them, and those who provide services around how standards impact users.

7

Adoption is a double-edged sword.

The adoption rate of a digital solution is typically an indicator of its financial success. Inexperienced funders may think that this rule of thumb extends to open-source work. However, this same measure does not easily apply to infrastructure projects. Too much growth too fast can strain groups who already do not place a high value on the types of work that help a community scale.

TECHNOLOGY, COMMUNITY & FUNDERS

Insights

“We need to trust each other. Growth would make us unhappy.”

“We want deceleration. Slowness.”

- With adoption comes responsibility. Applications and products which make use of a library, or other digital infrastructure, depend on its continued maintenance and development. Widely-adopted FOSS projects, especially one-person-shops and collectives, cannot always reliably deliver under pressure.
- FOSS infrastructure projects therefore take care to scale only to a degree that the community can still support. This can limit the speed by which new technologies and features are adopted, or services are opened up to new groups of users.
- People working on infrastructure projects care about the adoption of their code, but more for abstract reasons (“I want to help people”) than for economic incentives (such as market-share).
- FOSS contributors do not often work actively with other projects to get their work adopted – either in order to avoid an unsustainable growth of dependencies, or simply because of a lack of time.

Recommendations

“You work on a project and it becomes successful, people start filing bug reports and complain. It’s difficult not to become resentful towards the community.”

- In discussions about adoption, be consistent with the values of the ecosystem. Focus on scale rather than growth.
- When using adoption as a metric of success, be sure to factor in the necessary support resources.

8

Funders and infrastructure projects communicate differently.

FOSS contributors are sensitive to wording. As they often follow a not-for-profit approach, market terminology tends not to go down well. Projects might dismiss a call for applications because it uses terminology invoking innovation or business. When misinterpretation leads to misunderstandings between funders and infrastructure projects, trust can break down and relations permanently sour.

FUNDERS & COMMUNITY

Insights

- As we have seen with adoption, FOSS contributors are often critical of the concept of growth. At the same time, growth is still applied as a measure of success by many funders. Scale, on the other hand, is seen by projects to be more responsible and resilient.

- Infrastructure contributors don't often conceive of their work as a product to be distributed and marketed. Product thinking – taking a "user" perspective of a problem that needs solving – is not the norm (or at least not explicitly so), even though it would suit the work of a community that is adverse to process and structure and often follows a "scratch your own itch" approach.

Recommendations

- Try to avoid marketing terminology; e.g. use “identity” instead of “brand”, “outreach” istead of “market” etc.

- To make discussions about results as “products” meaningful, frame them within the context of usability and helpfulness instead of marketing.

9

A variety of factors prevent infrastructure projects from applying for funding.

“We have no policy on how we handle money.”

Many factors like the lack of fundraising roles, organizational structure and differences in communication keep infrastructure projects from applying for, or receiving, funding. They vary according to the project type and funders need to understand these differences in order to counterbalance them.

FUNDING & COMMUNITY

Insights

- Of the four different project types, only organizations are likely to have received substantial funding. FOSS projects need resources to apply for funding, and structure to manage a grant. Compared to other project types, organizations are better equipped to handle funding – which will often cement their structure.

- Aside from the organization, FOSS project types tend not to have the resources to navigate lengthy application processes. This feeds into why they believe funders do not understand how they work.

- Funding is usually framed in a way more easily applied to application layer projects. Infrastructure projects have to create hypothetical use-cases to fit the scope of a grant.

- Funders work under a set of values that can be at odds with the values of the community.

Recommendations

- Be aware of how your demands on grantees can unintentionally filter the projects you support (e.g. by supporting those with the requested structures rather than the projects that need your support most).

- Be transparent about your demands on future grantees, both during the application process (paperwork, legal status, response time), and during the grant period (reporting, availability, communication).

- Avoid a drawn-out application process. A two-tier process in which applicants get quick feedback on their chances for success can help. For each step, communicate clearly how far along in the process the applicants are, and what the next steps will be.

10

Accepting funding can be a risk.

When funders do not fully understand the circumstances under which their grantees operate, their funding can have unintended consequences, and even pose risks.

DEMOGRAPHICS

Insights

- In instances where funding causes teams and projects to need to adapt their structure (e.g. by giving up day jobs, dedicating more time to funded projects than others), receiving short-term funding can lead to long-term dependence.

- Funders who explicitly influence governance structure and decision-making are viewed as intrusive.

- Collective and embedded infrastructure projects are decentralized; they defy structure. As one interviewee put it: “decentralization means trust, which is built over a long time on the basis of personal connections”. If funders demand a higher degree of centralization (in the form of governance), this can harm the community.

- When funders push projects towards creating new, paid management positions, this changes the community dynamic. These positions and the people who fill them will only be trusted to stick around if the funder commits to supporting them in the long term.

- Even though the people who work on digital infrastructure perceive their work as political, the projects themselves often preserve a neutral status. Receiving grants from funders with a strong political position can sow doubt as to the integrity and intentions of even non-aligned grantees.

Recommendations

“There is no good mechanism [to enroll donors] for 1–2 people projects or teams.”

“We have been blamed for funding by [public funder] and [public funder].”

- Be transparent about whether projects can only expect short-term support or more.
- Work with your applicants to create a budget that avoids project “bloat” – especially with short-term funding.
- Be aware that in some contexts, projects may not credit you because of the political implications of your funding. Trust them to make this choice in your and their best interest.

VII Conclusion

Open digital infrastructure is overwhelmingly developed and maintained by individuals or groups of contributors working in the public interest. It provides the foundation of all digital technology. As one of the pillars of modern society and communication, open digital infrastructure deserves support from funders. Public and private funders provide a large share of support for FOSS projects, but to support this work effciently, funders need to understand these projects' strengths as well as their common challenges. By working together with grantees, funders can identify how to diversify infrastructure communities and create more stable and less privileged working conditions without weakening the core values of decentralization, self-organization and intrinsic motivation which drive FOSS development.

For the Internet to provide the public space necessary for an equal digital society, it needs to be more than just roads and bridges. For this to happen, open digital infrastructure and the people who build and maintain this software must become more visible, more understood, and more appreciated.

VIII Appendix

GLOSSARY

Adoption
In general software development terminology, adoption describes the rate at which users change to another technical system because it better answers their needs. Infrastructure code however, is not usually adopted directly by users but by other software projects, meaning adoption rates are indirect and more difficult to assess. Adoption is often used as a metric of success for software products.

FOSS
The abbreviation for free and open-source software (i.e. software that is published under a free or open license, is human-readable and can be lawfully copied, edited and developed further).

GDPR
The General Data Protection Regulation is a binding framework for data protection laws within EU member states, where data for this report was gathered. All tools used in this research were GDPR compliant.

GitHub
GitHub is both the name of a widely-used platform and the company behind it. The centralized platform uses the open-source version-control software Git and hosts the code base of many FOSS projects, while parts of its own software are closed-source.

HRPC Research Group
The Human Rights Protocol Considerations Research Group is part of the Internet Research Task Force (IRTF). It conducts research on how standards and protocols impact human rights, and comments on standardization discussions.

IETF
The Internet Engineering Task Force is an organization that develops Internet standards. In principle, anyone can participate in its working groups or attend its meetings. An informal slogan of the IETF is “rough consensus and running code”, which describes its method for decision making on the basis of working systems.

IRC
The Internet Relay Chat is a protocol for text-based communication that was developed in the 1980s and is still widely used in FOSS communities. Alternatives include more modern protocols like Matrix, or platforms like Slack.

IRTF
The Internet Research Task Force complements the work of the IETF in that it promotes continuous, more perpetual research on Internet standards.

INTERVIEW GUIDE

The following questions served as a guideline during our interviews and were continuously adapted according to the interview situation, the interviewee and the project.

Introduction
- What name do you go by?
- How do you identify your gender?
- How would you describe what you do right now?

Your trajectory and position in FOSS
- Why did you get into OS development?
- What is your educational background?
- What projects are you most involved in?
- For those projects: What is your role?
- How long have you been doing that?
- How did you get involved?
- Are you part of a team, and if so, how big is it?
- Have you had major involvement with other FOSS projects in the past?
- Which projects, and in what capacity?

- How does your FOSS work interact with your day job? Is the balance where you would like it?
- How are you supporting yourself, if not by working on the project?

Your outlook on FOSS

- What is your favorite part of your work?
- What's your least favorite part of your work?
- What do you perceive as the most important FOSS digital infrastructure projects out there? Why?

Governance & Management

- What are the communities that you would describe yourself as being a part of?
- How did the last person join your project?
- How did the last person leave your project?
- How do you define "contributor" to your project? Where do your contributors come from?
- Is there anybody who isn't coding who is a member of your core team?
- Who is not on your team/community, but should be?
- Are there structures about decision-making in your project/area?
- What was the biggest challenge in your current project/area?
- Can you tell me about a time that a conflict occurred in your project? What happened?
- How do you share knowledge in your project/area?
- Do you have a mentor? Do you see yourself as a mentor?
- Have you ever met people on your project face-to-face?
- What conferences do you attend for your work?

Support

- Where does your project get its funding and support from?
- What kind of non-monetary support does the project get?
- Do you need more support? If so, for what?
- Is there anybody you wouldn't accept support from? Why not?
- Have you ever applied for or received funding? How did that work out for you?

Standards – for standards people

- Did you ever comment or write up an RFC? How did that work for you?

- Do you talk to people who are using protocols and standards to which you are contributing? Is there a feedback loop?

Standards – for developers

- How does standardization impact your project (if applicable)?
- What other projects or code bases does your project rely on?
- Do you provide feedback on standards or contribute to discussions about them?

For implementers and service providers

- What are some roadblocks for you when implementing code?
- How does standardization impact your project, if applicable?
- Do you ever give feedback about standards? To whom?
- What other projects or code bases does your project rely on?

Values

- Do you see your work as political? Why/why not?
- Do you see yourself as an activist? Why/why not?
- How do you describe your FOSS work – is it a job, a hobby…?
- What does “open” mean to you? In what ways are your projects open, in what ways less so?
- Do you keep track of your time worked on FOSS?
- What keeps you up at night?

Your project’s state & outlook

- What does your work mean to you?
- What effect do you think your work has on society?
- What do you wish more people knew about your work?
- Do you think your project/area is sustainable? What are your role models for sustainable FOSS infrastructure?
- What is your best-case scenario for your project/area in 5 years? What is your worst-case scenario?

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Thank you to the FOSS community for their great work and for all the input and insights for this report! <3

Sponsored by the Ford Foundation & the Alfred P. Sloan Foundation