

Project Summaries, 2018 Digital Infrastructure Research Grants

Ford Foundation & Sloan Foundation

1. *Recipient:* Digital Civil Society Lab at Stanford Center on Philanthropy and Society (Lucy Bernholz, Jessica Feldman, Argyri Panezi) *

Headline: What makes an open source project “critical digital infrastructure?”

Description: There is currently no clear policy argument to help define which open source projects can be considered critical digital infrastructure. The legal system has developed a framework for regulating non-digital utilities such as roads and bridges, and has only started to navigate a similar approach to designating and regulating critical digital infrastructure. The regulation of non-digital public goods can be used as an analogy to help define and provide a policy framework for critical digital infrastructure. This project will bridge a quest for legal definition of “critical digital infrastructure” with an investigation of the values, methods, and funding relationships of the community groups that build open source software projects.
2. *Recipient:* University of Canberra, Telecom Paris Tech (Mathieu O’Neil Mathieu O’Neil, Laure Muselli, Mahin Raissi, Stefano Zacchiroli; Collaborators: Antonio Casilli (“invisible digital labour”) and Ursula Huws (“virtual work”)) ^

Headline: To what extent are F/OSS projects supported by waged labor, and how does this affect project cohesion and sustainability?

Description: The long-term viability of innovation-rich peer projects managed by international teams of volunteers is a key concern in the digital space. But as the not-for-profit and commercial sectors increasingly collaborate to produce digital infrastructure, questions arise concerning how commercial firms’ rules, priorities, and institutional logics emerge in peer projects, and how communal logics seep into commercial firms. This project will combine computational data analytics, qualitative content analysis, and ethnography to explore related questions across F/OSS projects, with a focus on waged labor.
3. *Recipient:* Caroline Sindors *

Headline: What can the history of Javascript teach us about techniques to mitigate harassment (a barrier to diversity and a threat to the sustainability of digital infrastructure projects) in open source communities?

Description: Over the past ten years, Javascript has evolved from an exclusionary culture of toxicity to a community of diversity and inclusion. Ethnography, interviews, and surveys will support an inquiry into whether and how offline interactions (i.e., meetups/conferences with codes of conduct) can help to build cultures of inclusion in primarily digital communities, particularly those around open source projects. Specific

techniques such as restorative justice will be considered for their potential to impact sustainable culture shifts. This historical inquiry into Javascript as a use case will uncover extensible insights that may apply across the open source community.

4. *Recipient:* Implicit Development Environments Research Group (Elisa Lindinger, Katharina Meyer, Julia Kloiber) *
Headline: How can funders and community leaders better meet the needs of digital infrastructure projects, and how are those needs distinct from projects at the application layer - particularly with respect to values, governing bodies, and supporting structures?
Description: This project will use ethnographic & sociological interviewing and literature review to uncover the unique needs of infrastructure projects, addressing barriers to community development and sustainability while formulating a set of practical recommendations for infrastructure communities and funders. For these projects, organisation structure and outputs often do not fit into traditional impact metrics, and their needs are often not addressed with financial support alone. The resulting report will provide a roadmap for funders and community leaders to better support the needs of (critical) software infrastructure projects.
5. *Recipient:* Arizona State University, UC Santa Barbara, U Wisconsin-Madison (Frank Timmes, Lars Bildsten, Richard Townsend) ^
Headline: What is the relationship between money and sustainability for community-driven, open-source software instruments that enable transformative research in stellar astrophysics?
Description: Discovery and innovation in astronomy are advancing along new pathways opened by the development of increasingly sophisticated open source software instruments. This project will take a deep look at the funding history of key community-driven science-based software instruments to investigate the relationship between money/funding and the sustainability of such instruments, and where/when the injection of new resources into an existing project may help or hurt.
6. *Recipient:* Martin Michlmayr *
Headline: How do FOSS Foundations (trade associations or non-profits that provide services such as asset management to open source infrastructure projects) contribute to the operations, sustainability, and success of critical digital infrastructure projects?
Description: FOSS projects have governance mechanisms but often don't exist as legal entities. FOSS Foundations appear critical to the success of open source projects but there is inadequate understanding of the nature of these organizations: what services do they provide, how do they contribute to project success and sustainability, and what challenges do they face? This project will use qualitative research and interviewing to develop a classification system for FOSS Foundations that specifies the goods and services they provide, as well as analysis of existing best practices.

7. *Recipient:* Carnegie Mellon University (Laura Dabbish, Bogdan Vasilescu, James Herbsleb) *

Headline: How might structural factors in the social networks of open source communities pose barriers to underrepresented newcomers, especially women, becoming full community members?

Description: Representation of women and minorities in open source software development is disappointingly low and getting worse. Previous studies have most often focused on this as a “pipeline” problem, often ignoring the structural factors in open source communities that pose specific barriers to women becoming integrated as full community members over time. As participation in open source software is increasingly important for obtaining employment in technical fields, this inquiry into how social network structures determine inclusivity in OSS communities will be valuable to workforce development efforts as well as to the OSS field. Interviews and surveys will be combined with quantitative network analysis to test hypotheses at scale.

8. *Recipient:* MIT, UCLA Anderson School of Business (Erin Ytsma & Jana Gallus) ^

Headline: How do non-financial and career incentives impact the motivation and productivity of contributors to open source and proprietary digital infrastructure projects?

Description: Benefits from committing code to open source (and proprietary) projects can be financial, reputational, symbolic, or career-advancing -- what incentives impact collaborative effort most, and how do these differ across types of code projects? A randomized field experiment with a series of trials on GitLab will be used to study how recognition, status, and reputational concerns affect innovative activity in an online collaborative software development context. Results could inform the design of open source platforms, as well as advance understanding of mechanisms explaining the motivational effects of awards and peer esteem.

9. *Recipient:* UC Berkeley Institute for Data Science, UC San Diego, UCONN (Stuart Geiger, Lilly Irani, Alexandra Paxton, Nelle Varoquaux, Chris Holdgraf, Dorothy Howard) ^

Headline: In community-based open-source software projects, what is the visible and invisible work of maintaining trusted, functioning software infrastructure -- especially as projects grow and transition from volunteer-based to various sustainability models?

Description: As originally volunteer-based open source software projects become infrastructure, visible and invisible labor is required to maintain trusted functionality. This project will investigate the technical, emotional, and social dimensions of maintenance work through qualitative and ethnographic methods, additionally studying how quantitative metrics (i.e., code commits) can and cannot capture such work. The goal here is to advance the conversation on visible and invisible work in OSS in ways that are constructive, sensitive, and empirically grounded, in order to help practitioners and stakeholders better understand related tensions and limitations of current resourcing and evaluation approaches.

10. *Recipient:* University of Washington (Kaylea Hascall Champion, Benjamin Mako Hill, Morten Warncke-Wang) *
Headline: How can we measure, model, and reduce underproduction in open source software infrastructure projects?
Description: As evidenced by the Heartbleed incident, ‘underproduction’ (mismatches between the supply and demand of quality software and volunteer labor) is a critical issue in open source software infrastructure. Production gaps represent areas of risk to the stability and security of digital infrastructure, but are currently rarely visible until it is too late. This project will investigate three linked questions about ‘underproduction’ in open source infrastructure: How can we measure underproduction before it leads to major failures? How can we model the causes of underproduction to help us predict it? How can we use this knowledge to reduce underproduction? Quantitative analysis of digital trace data will be used to model drivers of underproduction, using a dataset derived from the history of the Debian project.

11. *Recipient:* Rochester Institute of Technology (Mel Chua & Stephen Jacobs) *
Headline: How do mismatched conceptualizations between maintainers and users of a FOSS digital infrastructure project interact to affect the community health and thus sustainability of such projects?
Description: How do developers who maintain commonly-used FOSS projects compare to developers who use those same projects in terms of conceptualizations of what FOSS project communities are and how they operate? Literature review, and existing metrics-based analysis of software projects will be combined to identify a target infrastructure project. Narrative interviews, with contributors and community managers will be used to identify key questions about the extent and nature of misalignment between upstream maintainers and downstream users of FOSS projects. This pilot project aims to unpack examples of specific common mismatches in understandings and expectations in order to move toward effective resolution and improved communication methods.

12. *Recipient:* Guarini Institute for Global Legal Studies & Institute for International Law and Justice, NYU School of Law (Benedict Kingsbury, Thomas Streinz, Angelina Fisher) ^
Headline: How can legal devices and institutions be adapted and applied (both locally and transnationally) to overcome the under-maintenance of critical digital infrastructure?
Description: Previous analysis has identified various reasons for (non)maintenance of critical digital infrastructures but did not acknowledge the extent to which law entrenches and exacerbates this problem—and could be part of its solution. Through case studies and applied legal analysis, this project will show how legal technologies affect (non)maintenance of digital infrastructure, also creating a forum for dialogue between legal, policy, and open source communities to move toward innovative solutions. Creative readjustment of ‘legal technologies’ (such as contracting, licensing of property rights, incorporation, taxation, public regulation, etc.) and novel institutional design

(‘global digital infrastructure maintenance hubs’) could hold underexplored potential.

13. *Recipient:* UC Berkeley (Anushah Hossain) *

Headline: What factors encourage and sustain international communities of contributors to open source projects?

Description: Studies of code repositories consistently find that the majority of contributions come from individuals based in North America and Western Europe. This case study of the community supporting the private-by-default browser Brave, and specifically the rise of “Brave Bangladesh,” will look at factors driving the emergence of international communities, which other open source and digital infrastructure projects can learn to anticipate or leverage. This study will weigh the relevance of: formal and informal coordination between the center and periphery, political climate, and growing opportunities for technical training, amongst other factors. This project takes a look at the motivations and enabling conditions by which traditionally marginalized communities participate in the digital infrastructure field.

* *Grant managed by Ford Foundation.*

^ *Grant managed by Sloan Foundation.*