Field Scan on Technology Dissemination with Government
Provided to the City of Chicago

Mayors Challenge Research Partner Services
April 2014
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The purpose of this document is to provide background and reference material for the City of Chicago’s SmartData analytics platform project. Specifically, this document addresses lessons for sharing open source solutions from one government agency to another and resources needed to facilitate ease of adoption for those who reuse code created in other cities.

I. Open Government - Motivation

Open innovation strategy is a growing movement for governments to create and transfer open source technology between citizens, governments, and private firms. A core principle of open innovation is that organizations should source internal as well as external ideas to create value and advance technology. Federally, agencies are applying this concept under President Obama’s Open Government Directive. Local governments too can use this framework to increase adaptability and reuse of major IT investments by designing platform architecture to be modular and flexible and applying open-source concepts to platform dissemination, management, and evolution. For Chicago to create a data analytics platform that is scalable and replicable across cities, it must link design to dissemination in a way that not only permits customization of the platform but where customization enhances the platform.

In this document, we survey four cases of technology innovation and transfer to government, drawing insights from both government-to-government and external innovator-to-government transfers. Based on these examples and the academic literature, we derive key considerations for design, implementation, and evolution of open source platforms. Finally, we outline dissemination strategy and highlight in practical terms the dissemination tools used.

II. Open Technology for Government – Cases and Lessons

Technology innovation for government can emerge from non-profits, for-profits, or within government itself. The “best” pathway from innovation to dissemination is debated both academically and in the practitioner community. In this section we look at four cases of technology dissemination to provide context for Chicago’s efforts. For each case, we highlight the transfer path (gov-to-gov, public-to-gov, civic-to-gov) and the innovative approaches most relevant to Chicago’s SmartData platform.

Gov-to-Gov: OpenTripPlanner (OTP) is the world’s leading open source platform for multimodal trip itinerary planning and network analysis. Since its development and launch
in 2011 by Portland’s transportation agency (TriMet) and OpenPlans, OTP has been implemented in 12 countries in North America and Europe.\(^v\)

The motivation for OTP’s development is very similar to the Chicago SmartData platform: proprietary multimodal planners are cost prohibitive, most existing open source options are underdeveloped, and there was a need across transit agencies for a low-cost alternative. Built in partnership with OpenPlans and a network of developers, the platform was created with dissemination in mind from the start. To this end, the development team was guided by several broad directives:\(^vi\)

- **Community** – Open source projects flourish when backed by a dedicated community of developers and users who are cultivated and retained.
- **Usability** – Trip planning platforms often fall short in terms of functionality, so adoption by other agencies depends on user experience and quality.
- **Modularity** – Trip planning platforms are complex and require several components to interact. Where possible, OTP developers made module components useful on their own as well as useful in the larger system.
- **Deployability** – To disseminate to other agencies, OTP built documentation, intelligent design, installation, and confirmation to be as straightforward and reliable as possible (See Appendix I for a list of dissemination tools used).

Another key feature of OTP’s development was a collaborative method of software design, development, and distribution. All developer partners had full access to the code, and major decisions were voted on weekly, including open source licenses, homepage changes, code usage, and module construction.

One difference between OTP and SmartData is the open data/data interoperability obstacle. OTP relies on existing global data inputs from the General Transit Feed Spec (GTFS—used by over 200 transit agencies), USGS National Elevation Dataset, and OpenStreetMap. With SmartData, variations in municipal data policies and formats contribute to additional complexity in dissemination.

**Gov-to-Public/Public-to-Gov: Open NASA** is an initiative out of the President’s Open Government Directive to open NASA’s technological know-how and vast troves of data to the public and other agencies. The initiative covers a wide range of transparency goals, but it has developed specific tools focusing on technology and software dissemination. Through its code.nasa.gov portal, Github, and SourceForge, the initiative gives the public and other agencies direct access to NASA software technology.

Open NASA tackled several legal obstacles that are relevant to Chicago’s SmartData platform dissemination. First, NASA established special legal agreements to allow the agency to use GitHub and SourceForge to host its code repository. Second, the software was released under multiple open source licenses including the newly developed NASA Open Source Agreement and the Apache 2 license. Finally, NASA developed Contributor License
Agreements which enable third party contributions to be made to NASA open source projects.\textsuperscript{vii}

**Gov-to-Gov: DOJ Global Justice Information Sharing Initiative (“Global”)** is the Department of Justice’s effort to promote standards-based information exchange within the justice community. The standards and specifications produced by Global are used nationwide by the justice community in implementing tech and software innovation, and strive to ensure that justice agencies have the right information at the right time while still maintaining appropriate privacy protections. The premise is that end users should not have to piece together bits of information from uncoordinated datasets on an ad-hoc basis.

Global pioneered two initiatives to promote information sharing and interoperability that are relevant to the dissemination of a predictive analytics platform. First, they established guidelines for “fusion centers”—spaces where two or more agencies come together to share traditionally siloed intelligence. Similar to how analytics platforms must coordinate and consolidate data from thousands of sources, Global outlined how fusion centers can facilitate work with agencies to consolidate intelligence. Second, they developed a technical framework for information sharing (an information reference architecture) that outlines how different types of data and processes interact behind the scenes to create a usable product. Reaching agreement on function names, types of data, processes, and overall system design helps practitioners communicate clearly and quickly across organizational boundaries, and can promote standardization across vendors.\textsuperscript{vii}

**Civic-to-Gov: Race for Reuse** was a competition organized by Code for America (“CfA”) in 2012 to encourage civic hackers to disseminate existing innovative applications to their local communities. Rather than attempting to create wholly new applications, CfA challenged cities to adapt an existing civic technology to their specific circumstances, and focused its efforts on tools with broad applicability to municipal governments, such as Adopt-a-Hydrant and LocalWiki.\textsuperscript{ix} Teams of volunteers organized through the CfA Brigade program competed to deploy applications and drive engagement, and produced 31 applications in 28 cities.

The applications for the Race for Reuse had already been developed and had all of the necessary components for scalability: they were open source, interoperable with existing city data, customizable by its volunteer base, and capable of addressing a community need. The Brigade program allowed volunteers to contribute at their own pace and skill level, particularly for those who may not be able to participate in more time-intensive programs but have substantial technical experience. The key lesson from Race for Reuse is dissemination strategy. By providing a structured experience with specific goals and reduced barriers to action, CfA was able to rapidly spread useful applications.
III. Principles of Technology Dissemination in Government

Despite a lack of consensus about best practices in gov-to-gov software dissemination, the above cases and a rich literature in open source software and tech transferability provide context for key considerations. In this section, we turn our focus to four topics common to the cases and highlighted in the academic literature: Platform Architecture and Design, Interoperability, Ecosystem Development, and Governance Considerations.

Platform Architecture and Design

To make technology dissemination easy across governments, initiatives like DOJ Global and OpenTripPlanner have structured their open source tech initiatives with a focus on getting the platform architecture right from the start.

Platform architecture is a blueprint that describes how software is partitioned into modules and core components. Experts in platform architecture use a biological principle to describe successful initiatives: open source architecture is most transferable when it is made up of a core, stable platform and complementary components. The modular components are adaptable; their design is complementary but not rigidly prescribed and often can function as individual components. We see in OpenTripPlanner how this partition allows diverse users free reign to create programs and unique applications that do not compromise the integrity of the core analytics engine.

In the open source community, examples of this type of modular construction are numerous. Mozilla Firefox, the most prominent open source web browser, was one of the first browsers to build a core-operating platform with the capacity to integrate software add-ons developed by the community. In the proprietary software sector, Palantir’s analytics platform (Gotham) is constructed modularly: forward-deployed engineers create add-ons and special applications relying on Gotham’s stable core analytics engine to meet the client’s data analytics needs.

Interoperability – Open Data Standards

Every data analytics platform relies upon the quality and utility of the data it can access and meaningfully interpret, so one of the core challenges to implementing a data analytics platform in a new context is adapting to new forms of data. While some forms of data are standardized by legislation or convention, many cities use different definitions based on local conditions, or may want to make use of unstructured data. To plug Chicago’s analytics platform into a new city’s data landscape, it must be able to make sense of locally relevant sources of data—and the new city will have to re-evaluate its data management practices.
At the federal level, the White House Office of Management and Budget released a set of resources and policies to make open data operable across Federal agencies. At the municipal level, much effort has gone into creating open data standards within cities. Chicago has led the way with open standards around city data collection. New York City launched a Technical Standards Manual (see “Other Resources” below). But the dissemination of these standards to other local governments remains a challenge. A companion guide about open data standards would be a valuable resource to disseminate alongside the SmartData platform.

**Ecosystem Creation**

Synonymous with the “open source” movement, the ecosystem metaphor is used often in open government discussions to describe a strategy where product creation and dissemination relies heavily on dependencies with individuals and organizations outside government’s traditional procurement chain. The ecosystem metaphor in the Chicago context helps describe the interconnected relationship between platform provider (the City), users (other cities; individuals), data, material infrastructure, and institutions that engage in the process of adapting and growing the platform.

The value of orienting tech projects toward ecosystem management models rather than command and control is that it spurs continuous development and improvement from multiple sources. To that end, several large institutions have pushed their tech initiatives toward the ecosystem model. The Department of Health and Human Services created a “Community Health Data Initiative Ecosystem” that explicitly outlines interactions between end users, innovators, and applications of its health data. Data.gov has repositioned itself from a “repository of data” toward a “thriving ecosystem that creates opportunities in research and development.”

In structuring the Chicago open analytics platform with an eye toward ecosystem development, there are four areas that require strategic thinking:

1. **Components:** Identifying people and organizations that act as essential components of the ecosystem. (Who are the key individuals and organizations that contribute or derive value from the ecosystem? In this case, would likely include other city governments, advocacy organizations, developer communities, and academics)
2. **Interactions:** Understanding the transactions that are taking place between those entities. (What kinds of relationships or dependencies exist in the ecosystem, and where are the potential vulnerabilities? Who has responsibility for overall governance and accountability?)
3. **Practices**: Recognizing and developing the resources needed by each entity to make interactions valuable. (What role does each player have in the ecosystem, and what services do they provide? What are the key touchpoints between different players?)

4. **Metrics**: Developing metrics to observe and measure the relative health of the ecosystem as a whole. (Beyond adoption, what use metrics or indicators would help us know whether the platform is useful?)

*Transferability Considerations - Governance*

As cities use the Chicago predictive analytics platform and customize it to their needs, Chicago will need to address how the platform is regulated, who “owns” the platform, and how the platform evolution will be managed. A key consideration is how and whether to maintain a platform that is interoperable across different cities—so as more cities use and innovate on the platform, those innovations can be easily integrated nationally. The central decision is what level of control Chicago must retain of SmartData to ensure interoperability while releasing enough control to encourage innovations by contributors and other cities.xxii

**Platform Regulation** - There are two factors within platform regulation to consider: decision rights partitioning and incentives.xxiii Decision rights describe who has the authority for making specific decisions over the modules vs. the core platform components. GitHub, an online open source software community, solves this challenge by allowing users to “fork” their innovations from the master file and providing absolute transparency in code changes. But Chicago will need to decide what level of access to allow contributors, either to the core or complementary engines—and such a decision can create a trade-off between platform stability versus platform innovation.

To incentivize positive contributions and reuse of the code, experts highlight success in transferring software and creating a positive feedback loop of innovation through 1) turning contributions into a competitive marketplace (like Apple iTunes) or 2) creating a collaborative community by rewarding contributions with high reputation/social regard.xxiv

**Ownership** - Another key consideration in designing a transferrable platform is the openness of platform ownership. There are several models of ownership to consider. Google Chrome is open source but proprietary in its ownership; GNU Linux is open source with shared ownership over multiple users; Apple iOS is proprietary and closed source, but allows developers to create APIs.xxv As noted above, NASA has developed a mixed approach and uses a special Open Source Agreement with users to outline this distinction. As with
platform regulation, the ownership decision should balance the platform integrity and the ability of outsiders to adapt and innovate using the software.

**IV. Dissemination Strategy**

In open source contexts, dissemination is not the sole responsibility of the originator. However, at early stages, the sequence of peer-to-peer transfers that align push and pull factors will be important for disseminating a large, complex platform like SmartData, so intentionally building a network of peer cities at the implementation stage would be helpful. On the push side, what resources should Chicago provide to “push” this open innovation to other cities? On the pull side, what would cities need to implement this tool and how can Chicago identify viable Stage One Implementers?

**Push Factors:**

- **Clear documentation and reasonable accessibility:** Each of the successful technical innovations described above strives to provide documentation that allows someone with sufficient technical skill to replicate the solution, both from a technical architecture perspective and regarding potential changes in policies governing data use and process. For the Global project, DOJ provided documentation designed for varying audiences – summaries targeted at executive leadership as well as the detailed technical architecture for vendors and IT departments charged with implementation.

- **Strong value proposition:** With limited budgets and low appetite for risk, many local governments are wary of embarking on any non-routine IT project without a strong proof of return in similar situations. Like OTP’s dissemination, a compelling narrative would feature the quantitative and qualitative value of SmartData for Chicago’s residents and government, with targeted messages for key audiences: mayors, city managers, department heads and advocacy organizations.

- **City-to-City IT partnerships:** Some cities may be particularly valuable partners in enhancing SmartData, whether they are also known leaders in technology use in local government, potential partners for regional collaboration with Chicago, or cities that could benefit tremendously but lack the resources to implement effectively. For example, Chicago could establish partnerships with cities like Portland to draw upon their experience developing OpenTripPlanner.

- **Third-party institutional/non-profit partners:** Because some organizations and institutions are known leaders in the technology and local government space, coordination with these agencies could accelerate deployment of SmartData through validation, implementation assistance and advocacy support. Portland’s collaboration with OpenPlans and private developers was helpful in both technical
development and dissemination stages, and private sector implementers and academic organizations like the Ash Center or regional advocacy groups like SPUR or Regional Plan Association could play a similar role in encouraging broader adoption.

If we consider Chicago the Stage Zero Implementer, then we should consider Stage One Peer Implementers with criteria to evaluate whether they sufficient pull factors to implement effectively:

**Pull Factors:**

- **Forward-thinking Chief Technology Officer:** The earliest adopters of OTP were cities where CTOs were willing to adapt conventional proprietary IT procurement to this new model. Successful implementation will depend on how well CTOs can fit this project into their IT procurement plans and procedures.

- **Advanced users in department settings:** Given the interoperability considerations outlined above, implementation will require conforming data collection and reporting process across agencies. Even with a framework like DOJ Global, successful cities will need departments with enough technical know-how to standardize practices.

- **In-city technical support through partnerships with universities:** As we saw in Race for Reuse, implementation requires mobilizing a diverse group of stakeholders that will devote time and energy to the effort. Peer implementers with an array of technical support networks in-house, in the city, and nationally will be much more effective at implementing. Partnerships with universities and research organizations can provide the technical assistance needed to reuse and adapt the platform to new contexts.

**V. Key Components**

Successful dissemination of an open source predictive analytics platform will require a development process that aligns open government principles, platform design, strategic sequencing of implementation, and adequate resources for ecosystem development. Here are some of the most critical components based on the theory and practice literature outlined above:

1. Design modularly to make platform architecture most easily adapted to new contexts.

2. Promulgate a municipal-level open data standard to support the platform.
3. Identify legal and technical constraints regarding platform governance issues such as user agreements, ownership, and control over platform evolution.

4. Evaluate whether Chicago has adequate push factors and partner cities have enough pull factors to ensure transference.

5. Beyond making source code available, develop in-house or find a partner organization to develop a robust set of documentation and tutorials similar to those on OpenTripPlanner.
Appendix I: Tools for Dissemination

Examples from Open Trip Planner and Open NASA

**OTP Developer Tools**
- Web-based deployment utility served by Amazon’s Elastic Compute Cloud
- Two and five minute Quickstart Guides
- Wiki for developers and users (through Github)
  o Advanced User Reference
  o Detailed Developer Documentation and Tutorials
- Code Repository + Tutorial on Github
- Build automation and dependency management system repository

**OTP User and Ecosystem Tools**
- Issue Tracker
- Mailing Lists for both Users and Developers
- IRC Channel
- Weekly IRC Check-Ins
- Four vendors providing deployment and support services

**Open NASA Developer Tools**
- Software released under NASA Open Source Agreement and Apache 2 licenses
- Data Cookbook outlining methods for obtaining and using open NASA data
- Software easily downloadable through SourceForge & Github
- Direct contact information for software specialists by program

**Open NASA User and Ecosystem Tools**
- Space Apps hackathon to accelerate innovation
- Active and well-designed discussion forums
- Annual Open Source Summit
Appendix II: Resources

Experts

Nick Skytland is the Open Government Program Manager at NASA and oversees the Open NASA efforts.

Carliss Young Baldwin is a professor at Harvard Business School and an expert on the process of design and its impact on strategy. She is the author of Design Rules, Volume 1: The Power of Modularity.

Frank Hebbert is the Director of OpenPlans, a non-profit civic technology group that works with cities on open source software projects.

Andrew Hoppin is the Co-Founder and CEO of New Amsterdam Ideas, an open source software developer. Hoppin was formerly the Chief Information Officer for the New York State Senate and one numerous awards for his innovations.

Henry William Chesbrough is an adjunct professor and executive director of the Center for Open Innovation.

Gabriel Metcalf is the executive director of SPUR, a non-profit organization that promotes good government and good planning in San Francisco.

Steve Koonin is the director of NYU’s Center for Urban Science and Progress and is an expert on urban informatics.

Bibiana McHugh is TriMet’s Information Technology Manager and helped implement OpenTripPlanner.

Stephen Goldsmith is a Professor of Practice at Harvard Kennedy School and former Mayor of Indianapolis, and writes and speaks on government innovation.

Theory Literature


**Practice Literature**

January 3, 2014. 


Organizations & Examples

“DC Apps.” [http://apps.dc.gov/]. Platform for disseminating popular civic mobile applications created by DC and other organization.

“FixMyStreet.” [http://www.fixmystreet.com/]. A UK based application developed by a non-profit and now used by local governments across the UK to track local problems.

“open.NASA.” [http://open.nasa.gov/]. NASA’s open government initiative focused on releasing software, code, and catalyzing partnerships with public around space innovation.

“OpenPlans.” [http://openplans.org/]. Leading thought-leader and partner for civic participation through social media, software applications, and open data.

“OpenPublic.” [http://openpublicapp.com/]. Open source content management system designed for and used by governments in the US and UK.

“OpenTripPlanner.” [https://github.com/opentripplanner/OpenTripPlanner]. Sophisticated multimodal trip planner built by Portland TriMet and used in 12 countries.


“Health Data Initiative.” [http://www.hhs.gov/open/initiatives/hdi/]. Open data initiative from the Department of Health and Human Services focused on health data ecosystem development.

“CSP.” [http://cusp.nyu.edu/]. Public-private research center building the emerging field of urban informatics.

Technical Resources


Endnotes

i Cleland et al, 2013

ii Chesbrough, 2003

iii Open Government Directive, 2009

iv Cleland et al, 2013

v https://github.com/opentripplanner/OpenTripPlanner

vi McHugh, 2011

vii http://open.nasa.gov/plan/open-source-software/

viii https://it.ojp.gov/default.aspx?area=nationalInitiatives

ix http://brigade.codeforamerica.org/pages/race-for-reuse

x Tiwana et al, 2010

xi Cleland et al, 2013

xii Baldwin et al, 2000

xiii “Palantir: An Open Source Development Success Story,” 2013

xiv Health Data Initiative, 2010

xv APNewsBreak: Chicago to Publish Crime Stats Online, 2011

xvi Cleland et al, 2013

xvii Harrison et al, 2012

xviii Ibid.

xix Health Data Initiative, 2010

xx Harrison et al, 2012

xxi Adapted from Tiwana et al, 2010 and Antikainen et al, 2010

xxii Tiwana et al, 2010

xxiii Ibid.

xxiv Cleland et al, 2013

xxv Tiwana et al, 2010

xxvi Cleland provides a summary.