



Center for
Technology in Government

The Dynamics of Opening Government Data

A White Paper





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FOREWORD

Governments around the world are working to advance open government principles in a way that responds to their own unique context. One way they are doing this is by developing the appropriate policies and management practices that allow them to open their government data by taking full advantage of the increasing power of information and communication technologies. Many governments have asked for the help of academic researchers, industry, and the public in developing these capabilities.



In response, CTG is leading a project with support from industry experts SAP to develop better research, consulting, and government practice models to address the policy, technology, and management challenges in our increasingly computational and data-intensive world. This project is designed to produce new conceptual and analytical tools for governments to help them open government data in ways that improve government performance and create new value for citizens.

Our goal is to improve understanding of what shapes the value generated through open data initiatives. To do this, we present a more holistic approach to understanding and evaluating the impact of different technology, management, and policy choices before they are implemented. We offer a particular point of view, set of concepts, and analytic tools for dealing with the complexity surrounding the relationships between information, technology, people, and interests. A new understanding can guide designers of open data initiatives in working successfully with employees, advocacy groups, civic hackers, citizens and other stakeholders to create new ways of collecting, integrating, disseminating, and using information in pursuit of improved governance.

Theresa A. Pardo
Director
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EXECUTIVE SUMMARY

There is growing interest at all levels of government to increase access to and use of government data in support of good governance. As a result, public agencies are under pressure to create new capabilities to achieve this goal. A common assumption when opening government data is that simply supplying more data freely and in more formats will lead to more use. That use will lead to value creation and, in turn, will motivate government to make the necessary changes to continue opening more data. But, we know from experience, that supplying more and more data does not necessarily produce the results we anticipated.

This paper presents an approach to analyze and model open data initiatives based on two key ideas: *context* and *dynamics*. First, the approach acknowledges the significance of *context*, particularly in terms of the actors and their interests in the governance of government data and access to it. These aspects of opening government data are largely de-contextualized in common practice, often addressing in a limited sense the many ways context affects how information is acquired, understood, and used to impact government and public life. Second, we highlight the *dynamic* aspects of open data initiatives that impact value creation, in terms of making data available, making it *fit for reuse*, contextualizing information, and working with new stakeholders. These dynamics represent changes over time from new technologies, interests, issues, and patterns of interaction resulting in new practices, governance arrangements, policies, and ways to express the value generated.

Our approach uses the concept of an *information polity* as a more holistic way to understand context. Open data initiatives are a disturbance to existing practices, in that they alter some combination of technical, political, and social factors that influence governance. The paper begins by presenting a simple picture of the data sources and flows, actors and roles, and governance relationships involved in open data initiatives. It is a high-level description of possible components of an information polity. It provides a way to identify the particular stakeholders and patterns of interaction that can influence or control the generation,



Government, academic, and industry experts participated in CTG's June 26-27, 2012 *Open Government Consultative Workshop*. Their valuable insights and suggestions on a preliminary draft of this paper were incorporated into the final version.

flows, and uses of data and the governance relationships and interests in a particular initiative.

We then examine two open data cases. The first examines public access to restaurant health inspection data in New York City, USA and changes over several years. It deals primarily with the changes in information flows, governance relationships, and stakeholders as a result of technological disturbances. The second case, from the City of Edmonton, Canada, examines in some detail the early life of an open data initiative to increase public access to street construction projects data. The case focuses more on the capabilities of the agency, as well as the data management practices, business value, the selection process, and relationship with an external application developer.

In both cases the activities that make up much of the case story involve one or more actors scanning the environment and connecting the opportunities they see to capabilities they can mobilize to exploit the opportunity. Their initiatives forged more useful connections between providers of a data source and the public, increasing the potential for the data to be more useful both to primary users and other stakeholders.





The findings from these cases, combined with insights from reviewing other open data initiatives, highlight the importance of dynamics. The paper presents a system dynamics model to show how various opportunities and constraints have an impact on open data initiatives over time. The modeling shows how the disruptions of changing stakeholders, technologies, and information flows can impact the system as a whole and affect value creation. The cases describe how access and use are constrained by agency and user capabilities, data management practices, effort, politics, poor data quality, and relationships between government agencies, citizens, and other stakeholders. Over time, these constraints are activated and will accelerate, slow, or reduce the supply of data and use.

Together, this holistic approach enhances our understanding of how open data initiatives can play out in and affect rapidly changing contexts. In addition, the concepts and analytical tools can be used to:

- Identify and understand stakeholders and how their interests are impacted by opening government data.
- Help planners and decision makers anticipate stakeholder changes so that government can build capability to deal with the power, expectation, and performance changes.
- Aid planners in developing hypotheses for how interactions, relationships among stakeholders, and value will likely change over time.

Based on our analysis of the two cases we present a set of considerations for agencies:

- Release government data that are relevant to both agency performance and the public interest.
- Invest in strategies to estimate how different stakeholders will use the data.
- Devise data management practices that improve context in order to *future-proof* data resources.
- Think about sustainability.



Ashley Casovan, Strategic Coordinator for the Office of the CIO, City of Edmonton, giving input on the draft white paper. Seated to her right are Meghan Cook, program manager, CTG and Anthony Cresswell, senior fellow, CTG.

The next steps for this research is to create a functioning simulation model of an open data initiative. Simulated results can point to whether and where public value is being realized and identify the technical, policy, or management barriers to achieving enhanced value. The knowledge and insights acquired by these kinds of analyses can help governments better evaluate the costs, risks, and benefits of their open data initiatives.





INTRODUCTION

There is growing interest at all levels of government to increase access to and use of government data in support of good governance (OECD, 2003; OMB, 2009, 2010). As a result, public agencies are under pressure to create new capabilities to achieve this goal. A common assumption when opening government data is that simply supplying more data freely and in more formats will lead to more use and value creation. And, this in turn, will motivate government to make the necessary changes to make data more open and accessible. But, we know from experience, that supplying more and more data does not necessarily produce the anticipated results.

The premise of this paper is simple: If public leaders want to pursue opening government, particularly through the use of new technologies and information-driven activities, then they need a good understanding of how these things work. That understanding is not fully available in current guides, tools, techniques, and theories for dealing with opening data in the public sector. Nor is there an adequate foundation of knowledge from existing research or standards for practice.

Too much of the rhetoric tends to focus narrowly on the technical aspects of opening government data. We often see approaches that ignore or underestimate the full scope of the policy and management challenges involved in opening government data, which tend to increase the risks and undermine the potential value of these initiatives. Over the last year, we observed this narrowness in our review of dozens of open data initiatives. We found technically focused initiatives that amounted to little more than websites linked to miscellaneous data files, with no attention to the usability, quality of the content, or consequences of its use. We found other initiatives that were complex organizational or enterprise-level projects that envisioned wide reaching political and social outcomes, but lacked the technical design sophistication and implementation models necessary for such demanding and complex contexts.

In response to this wide continuum, we developed a new approach to analyze open data initiatives based on two key ideas: *context* and *dynamics*. First, the approach

Approaches to opening government data that underestimate the full scope of policy and management challenges increase the risk and undermine the potential value of its use.

acknowledges the significance of *context*, particularly in terms of the actors and their interests in the governance of government data and access to it. These aspects of opening government data are largely de-contextualized in common practice addressing in a very limited sense the many ways context affects how information is acquired, understood, and used to impact government and public life. Second, we highlight the *dynamics* of open data initiatives that impact value creation, in terms of making data available, making it 'fit for reuse', understanding how contextualizing the information is important, and the introduction of new stakeholders. These dynamics represent changes over time resulting from new technologies, interests, issues, and patterns of interaction that result in new practices, governance arrangements, policies, and ways to express the value generated.

The next sections present and elaborate a perspective for reaching improved understanding.

- First, we describe the value of an information polity perspective for broadening and sharpening our understanding of the nature of open government data initiatives.
- Second, we present two open data cases that illustrate how data, information flows, technology and relationships are central to the analysis.





- Third, we describe the dynamics of open data initiatives highlighting activities related to providing, using, and governing information in the public sector.

Our goal is to improve understanding of what shapes the value generated through open data initiatives. To do this, we present a more holistic approach to understanding and evaluating the impact of different technology, management, and policy choices before they are implemented. We offer a particular point of view, set of concepts, and analytic tools for dealing with the complexity surrounding the relationships between information, technology, people, and interests. A new understanding can guide designers of open data initiatives in working successfully with employees, advocacy groups, civic hackers, citizens and other stakeholders to create new ways of collecting, integrating, disseminating, and using information in pursuit of improved governance.





AN INFORMATION POLITY PERSPECTIVE

FOR OPENING GOVERNMENT DATA

One of the goals of opening government data is to improve governance by expanding information and access in ways that draw new actors, interests, and influence into government decision making. We use the concept of an *information polity* as a heuristic device to understand the ways that the new mixture of stakeholder interests are shaping, and are shaped by, new information flows and technologies (Bellamy, & Taylor 1992, 1998).

The value in thinking about an open data initiative in terms of *information polity* components is that it can help agencies identify and distinguish important data sources, flows, and stakeholders. This is an important starting point for understanding how the creation or modification of data sources, flows, or governance relationships affects the interests of various stakeholders and ultimately impacts value creation.

An Information Polity is the collection of stakeholders, data sources, data resources information flows, and governance relationships involved in the provision and use of government-held and non-governmental data sources.

Starting from the point of view of government agencies, Figure 1 is a simplified picture of an information polity when applied to open data initiatives.

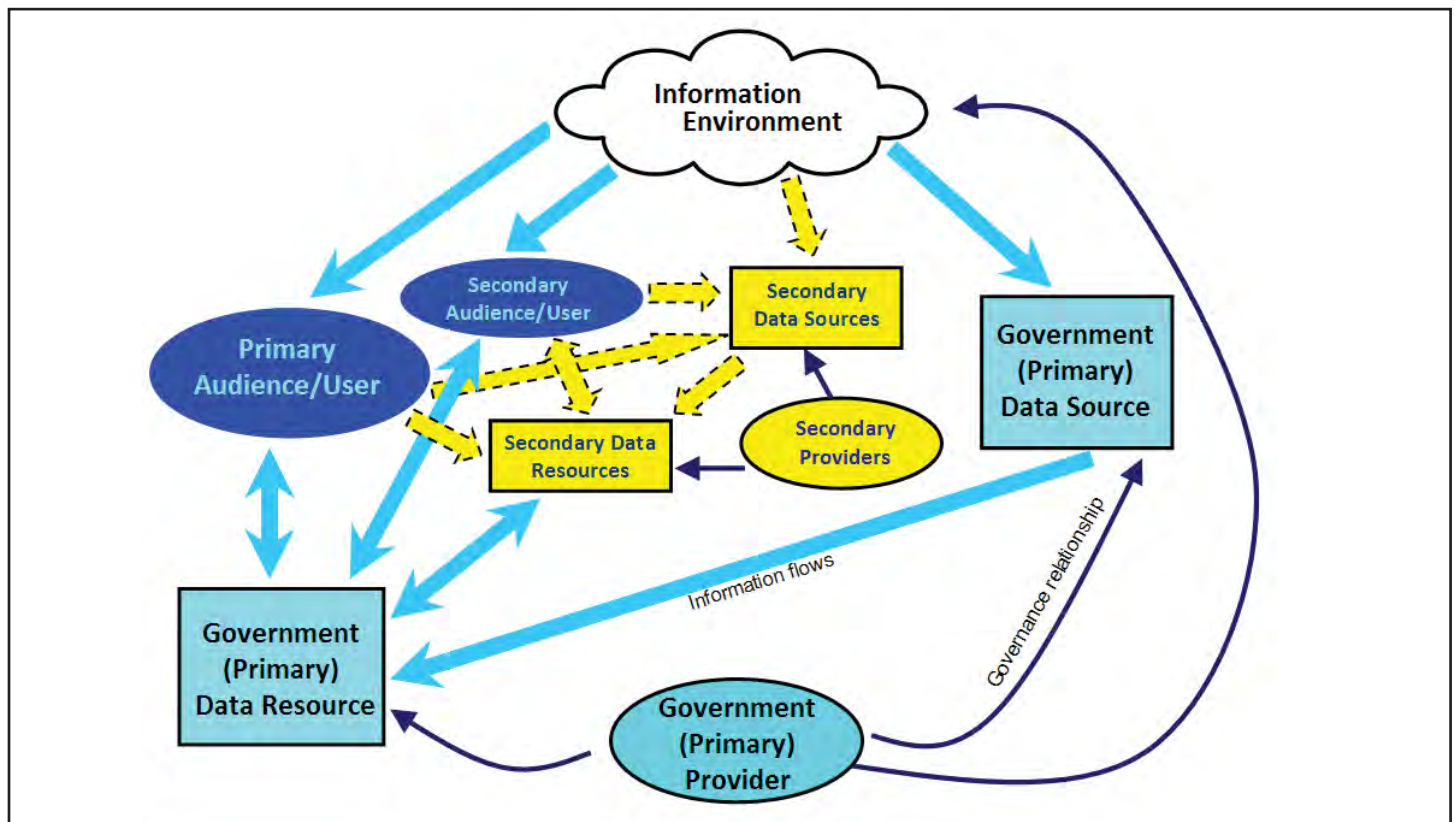


Figure 1. View of an information polity.





Data sources and flows

There are many different kinds and sources of information that are important for improving government, but not all kinds or sources of data are 'held' by government. When thinking about the value of open data initiatives, it is expected that government data will be combined with other data sources. While government has gotten better at sharing data between government agencies and levels, we still do not have a good idea of how to share data with 'the public,' 'app developers,' or others outside the traditional boundaries of government information sharing. Nor do public leaders have a good understanding of the implications of combining government data sources and secondary data sources. This is an important analytical distinction because it allows them to simultaneously think about the governance of 'government-held' data (such as datasets on a site like Data.gov) and 'non-governmental sources' of data (such as comments, geo-coded data, and social network data on third party social networking sites like Facebook or Twitter).

We present open data initiatives as potentially having a primary data source and a secondary data source; both collected as a result of the interactions in the information environment. The data flows of *Primary Data Sources* are shown by the light blue arrows and the data flows of *Secondary Data Sources* are shown by yellow arrows.

In our description, government is the *Primary Data Source*, *Provider*, and *Data Resources*. The *Primary Data Source* sends the data to the *Primary Data Resource* governed by the *Primary Provider*, which is then made available to the *Primary Audience/User*. The simple picture considers the possibility of the *Primary Audience/User* obtaining some of the same kinds of data directly from the *Information Environment* themselves. An example would be a citizen observing directly the sanitary conditions of a restaurant. However, there are aspects of the *Information Environment* that cannot be observed directly by the *Audience/User*, such as taking the temperature of a freezer in a restaurant that stores food.

In a Web 2.0 world, *Secondary Data Sources*, *Providers*,

PRIMARY COMPONENTS OF AN INFORMATION POLITY

- **Information Environment** is the multiple contexts from which data is extracted, encoded, and otherwise made visible.
- **Primary Data Sources**, in our view, are the public employees that interact with the information environment and encode the original data required as part of a government program, process, or reporting requirement. This data is then entered into a government information system.
- **Primary Data Resources** are the access/interface tools combined with primary data sources that are created that provide users with the data. The resource includes the data files, the software, networks, platforms, and organizational arrangements needed (such as creating a website or an application).
- **Primary Data Providers** are the government agencies with the authority and responsibility for creating and maintaining the primary data sources and resources. In this role, government providers acquire and structure data files, create requisite policy, governance, and management arrangements necessary to establish and maintain the primary data resource.
- **Primary Audiences/Users** are the persons or groups who are part of the government program, process, or reporting requirement (inside or outside of government) that are the intended users. The government data source and resource were created for them to advance some government objectives.

and *Resources* represent the explosion of new stakeholders (e.g. app developers, social networking sites, or citizens) *Secondary Data Sources* can also interact with the Information Environment to create data and initiate





additional secondary data flows. The *Secondary Data Resources* extract *Secondary Data Sources*, which are managed and governed by the *Secondary Providers*. Data from *Secondary Data Resources* can go directly to *Secondary Audiences/Users*, or be combined with *Primary Data Sources* and flow to the *Primary or Secondary Audience/Users*. Of course multiple *Secondary Data Sources* and *Resources* are possible, but are omitted from the figure for simplicity and readability.

Identifying the data sources and flows highlights the potential challenges in sharing and integrating data sources. Data does not exist in the wild; it is deliberately created by socio-technical processes. These processes may be as straightforward such as a digital temperature sensor sending a reading to a weather database or a nurse taking a blood pressure reading on a patient and entering it in a medical record. The processes may also be much more complex, such as a psychiatric emergency room physician deciding whether to identify a patient as a risk to himself or others and recording that in a medical record or a citizen providing analysis and comments on a piece of pending legislation. The usability of data, or its fitness for use, depends in large part on the nature of the encoding processes and data management practices.

Likewise, even within the same government department, different units can have widely varying data definitions, standards, and encoding methods for similar kinds of data. As long as they act independently, these differences are not necessarily an issue; however, when integrating or comparing data, the differences may have serious consequences that require governance decisions. These kinds of issues can become more problematic when data from non-governmental sources is involved. The more data providers are involved in working with a data resource, the more complex the roles and relationships.

Actors and roles

Government practitioners working to open government data make up only a part of the larger group of stakeholders who have an interest in and ability to influence how data is

SECONDARY COMPONENTS OF AN INFORMATION POLITY

- **Secondary Audiences/ Users** are the persons or groups that want access to or use the primary data in ways other than 'originally' intended.
- **Secondary Data Sources** are data that comes from sources other than the government provider. The data may be social media comments, sensor data, or other types of information collected from the information environment or from users directly.
- **Secondary Data Resources** are the access/ interface tools that are created that provide users with the data. These resources draw from both secondary data sources as well as primary data sources. The resources include the data files, the software, networks, platforms, facilities, and organizational arrangements needed (such as creating a mobile app).
- **Secondary Data Providers** are the persons or groups that acquire the data from the government or secondary data sources and redistribute it in a modified way that provides benefits or additional impacts beyond those resulting from access to the original data resource.

acquired, accessed, and used. Stakeholders can influence events in an information polity. Their presence represents an understanding that opening data directly involves the internal management of agency and information technology systems as well as external stakeholders that are producers or consumers of data. Other stakeholders represent other sources of influence on action, connected to the social and political environment, the nature of the information of interest, and the institutional context of law and policy. Open data initiatives disrupt government's traditional role as 'holder' or 'owner' of the data. In thinking about open data governance, we need to re-think government's role in relation to the entire set of new stakeholders. One





possibility is to characterize government, as well as all other stakeholders as stewards (Dawes, 2010) of primary and secondary data sources. The idea of stewardship focuses on the joint responsibility of all public officials and government organizations, as well as other stakeholders to assure the accuracy, validity, security, management, and preservation of data holdings. It demands that primary and secondary data be acquired, used, and managed as a resource that has organizational, jurisdictional, or societal value across purposes and over time (Dawes, 1996).

Governance relationships

Stakeholders in an information polity are oriented toward steering (consensually or antagonistically) (Corry, 2010) the data sources and resources involved in an open data initiative. Each stakeholder has interests in the nature of and success of an open data initiative, such as enhanced program effectiveness for a particular program or increased political influence or national security. The governance of open data initiatives involves creating policies, business processes, social processes, technologies, standards, meaning and interpretation, and adding value.

As a *Primary Provider*, a government agency can have governance relationships with the *Primary Audience/Users*, with the *Data Source*, *Secondary Data Provider*, and with the entities in the *Information Environment*. We show the governance relationship between the *Primary Provider* and the *Primary Audience* as a reciprocal one. The *Primary Provider* can influence the *Primary Audience* directly through data provision, and through other incentives, sanctions, and persuasive methods. Similarly, the *Primary Audience/User* can influence the *Primary Provider* through political processes and direct participation in decision making and data use.

Primary & Secondary Audiences/Users are not a monolithic entity, but an aggregate of persons and groups with various interests in access to and use of the data. These interests may not be fully aligned, leading to conflict between stakeholders and the introduction of competing goals for *Primary Providers*. The influence mechanisms used by *Primary* and *Secondary Audiences/Users* can take many

forms, including authoritative incentives or constraints from government agencies, political advocacy and actions by various stakeholders, shifts in consumer behavior, or social mobilization. More complex governance relationships are possible than the ones shown in the simple picture.



OPEN DATA CASE EXAMPLES

These cases offer two distinct opening government data initiatives. One case, which examines public access to restaurant health inspection data in New York City (NYC), traces in general terms, the development and changes due to the mix of technical and social processes over several years. The case deals primarily with the changes in information flows, governance relationships, and actors. The other, from Edmonton, Alberta, examines in some detail the early life of an open data initiative to increase public access to street construction project data. This case illustrates how the agency and public respond to new means of information access and use. It focuses more on the capabilities of the agency, as well as the data management practices, business value, the selection process, and the role of an external mobile app developer.

Though neither case tells the complete story, each contributes important insights into the dynamics of an information polity. In both cases, the activities that make up much of the case story involve one or more actors scanning the environment and connecting the opportunities they see to capabilities they can mobilize to exploit the opportunity. Their initiatives seek to forge more useful connections between data sources, information resources, and the public, increasing the potential for the data to be more useful both to the primary users and other stakeholders.

RELEASING RESTAURANT INSPECTION DATA IN NEW YORK CITY, USA

Since the mid-1990s, NYC has been posting its restaurant inspection data online to reach a wider audience. The basic story of releasing restaurant information pre-Internet is relatively simple. Prior to 1999, a website did not exist and the results of restaurant inspections were made available to citizens by posting the paper inspection reports in a conspicuous place in each of the city's restaurants. Figure 2 depicts the primary actors and information flows as between restaurant operators to the NYC Department of Health and Mental Hygiene (DOHMH), then back to the restaurant operators and from the restaurant operators to individual customers on site. Citizens and other actors (e.g., news

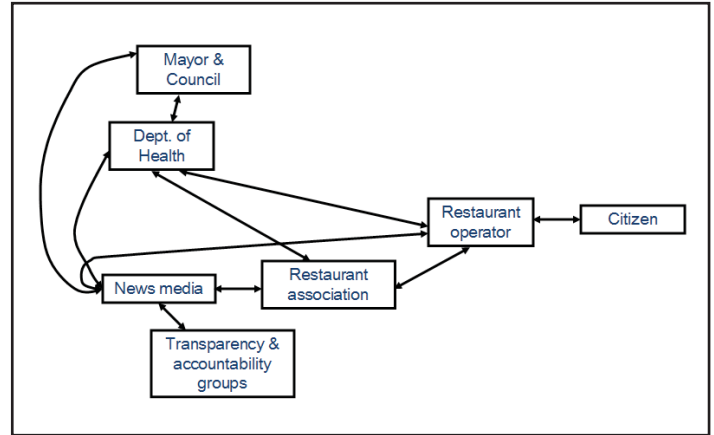


Figure 2. Restaurant inspection information polity-pre-website.

media, transparency, and accountability groups and other government units) with an interest in restaurant inspections could request the information from the DOHMH through a Freedom of Information request or by collecting it from individual restaurants.

Post 1999, the Internet surfaced as a technological disturbance that shifted the existing information flows and changed the number and types of actors with easy access to the restaurant information. Figure 3 (page 16) depicts the information still flowing from inspectors to restaurant operators to citizens, but with a technical disturbance, the website. The impact of expanded access through a website was discovered shortly after the restaurant inspection data went 'live.' Within 24 hours, the first Web server hosting the inspection results was overwhelmed by traffic and crashed.

The NYC Department of Health and Mental Hygiene (DOHMH) is responsible for inspecting the City's roughly 24,000 restaurants for compliance with the City's Health Code.

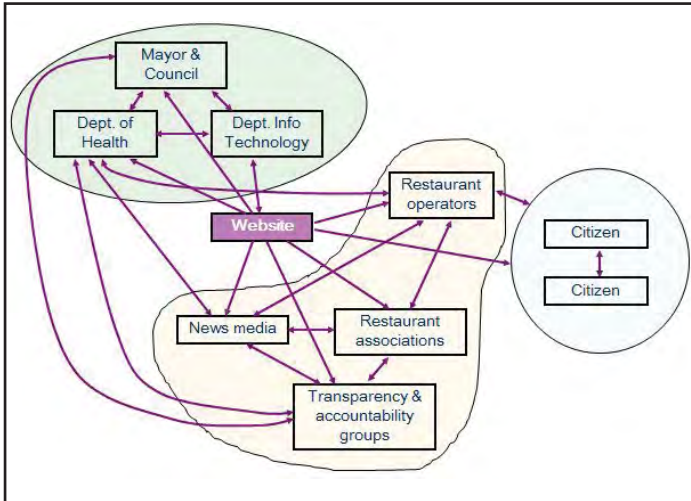


Figure 3. Restaurant inspection information polity–post-website.

There appeared to be a pent up demand for easy access to the inspection results and thus a perception of the dramatic increase in the importance of this type of data. The governance relationships began to change as well. Restaurant operators demanded more frequent inspections to correct bad scores and stories appeared in city news media about the inspection website and the favorable public reaction to it.

In 2010, the DOHMH changed its governance processes, moving from ratings to letter grades, A, B, or C. The City continued to require restaurants to post the letter grade result in the front window. When the city changed to the letter grade system, the restaurant association complained publicly and created their own survey of restaurant operators to document negative impacts on business. The city countered with statistics on reduced frequency of hospitalization for Salmonella infections in the city. Both the Mayor and the City Council took part in the back and forth in attack or defense of the inspection reporting system, and the issue remains alive today.

Figure 4 describes the further expansion of information flows, new actors, and governance relationships. By 2009,

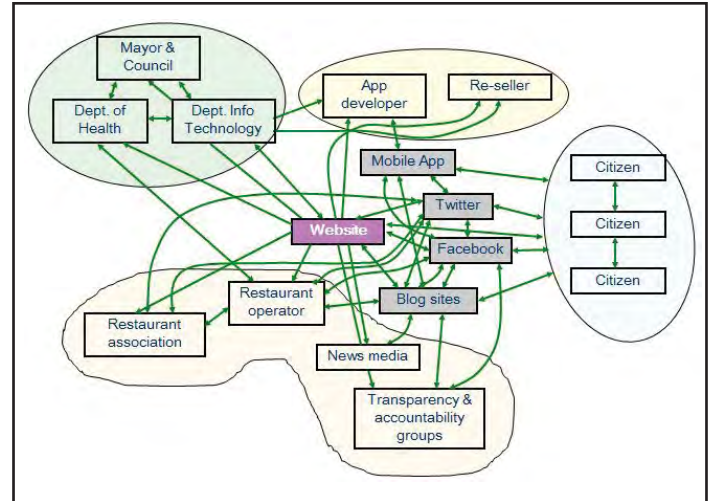
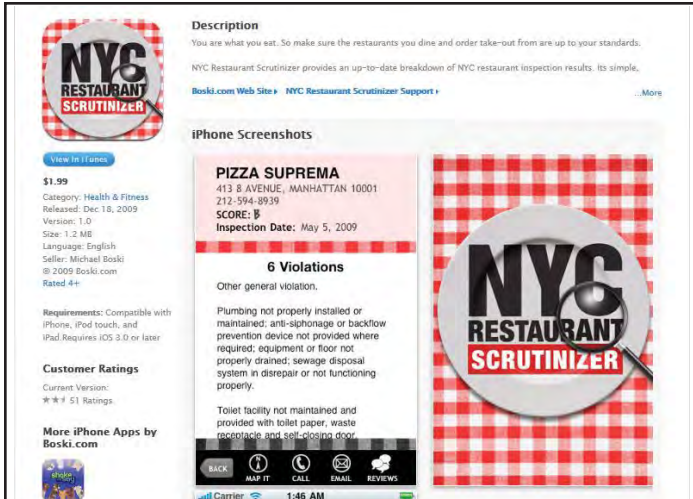


Figure 4. Restaurant inspection information polity–Web 2.0.

we witness the explosion of Web 2.0 social networking tools that can more easily link various data sources and citizen networks. In 2009, app developer Mike Boski created NYC Restaurant Scrutinizer, which provides an up-to-date breakdown of inspection results, claiming to put roughly 19 thousand pages of essential information at users' fingertips. Boski sells the app on iTunes for \$1.99, but makes it free if requested. In addition, the app lets users email violation results to a friend, map locations, call the restaurant directly, and read reviews by other users. Boski provides the following disclaimer for users, "The City of New York cannot vouch for the accuracy or completeness of data provided by this website or application or for the usefulness or integrity of the website or application. This site provides applications using data that has been modified for use from its original source, NYC.gov, the official website of the City of New York" (<http://youwail.com/restaurantInspection/>).

In 2012, the Department of Health and Mental Hygiene and the Department of Information Technology and Telecommunications (DOITT) released their own free application called *ABCEats*, also available on the iTunes site. The app lets users check inspection letter grades at restaurants near their current location or search by

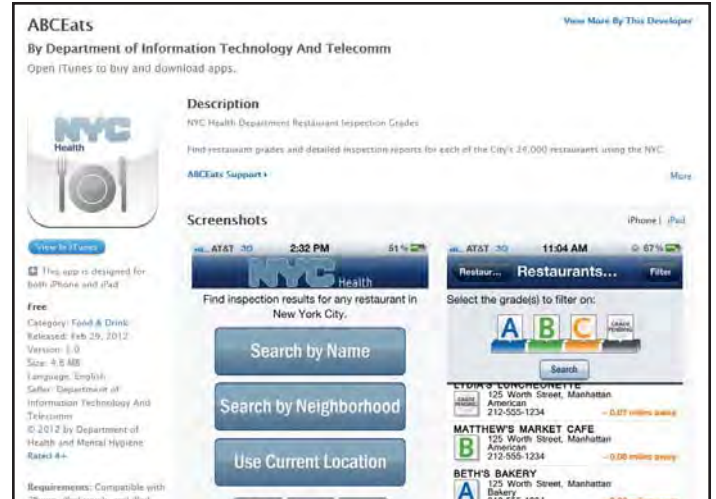




The NYC Restaurant Scrutinizer app was released in 2009 and provides an up-to-date breakdown of New York City restaurant inspection results.

restaurant name or neighborhood. Information is updated daily to provide users with the latest results (<https://itunes.apple.com/us/app/abceats/id502867547?mt=8>).

Recently, another secondary resource called EveryBlock picked up the restaurant inspection data. EveryBlock is a website, newsfeed service, and mobile application that tries to connect citizens to their neighbors and neighborhood news. It is currently in 19 U.S. cities. It was originally funded by a foundation grant, but is now owned by NBC Universal (<http://nyc.everyblock.com/>).



The official NYC app lets users check inspection letter grades at restaurants by current location, restaurant name, or neighborhood.

Customer Reviews

Great wingman ★★★★★
by Andrew Akira

Was arguing with a friend which sushi spot to eat at in the east vill. I remembered reading about this app, so I downloaded it, and let it decide our fate. We found out the place we were thinking of going to first failed their health inspection (live rodents, and unsanitary staff!) but the second only had a couple minor issues, so we rolled with that. Food was great. App was great, and quick.

Other types of data sources such as comments by mobile users of the restaurant inspection apps can be combined with government-held data sources.





RELEASING STREET CONSTRUCTION PROJECTS DATA IN EDMONTON, CANADA

The story of opening street construction projects data began several years prior to its official launch in April 2012. In 2009, the City of Edmonton, a recognized leader in open data initiatives, made a commitment to using “technology to make municipal information more open, transparent and accessible” through the launch of an *Open Data Catalogue*. The Office of the Chief Information Officer (OCIO) staff were responsible for working with the City’s major agencies—as the business owners of most of the City’s information assets—to identify data that were good candidates for inclusion in the *Catalogue*.

The OCIO staff began looking across the city departments and discovered that the Department of Transportation (DOT) had a number of data sets that were potentially good candidates. Discussions between both departments followed and street construction information quickly emerged as a data set that could be easily integrated into the *Open Data Catalogue*. OCIO staff noted how street construction projects data continued to “pop up” as a promising initiative among a growing list of data sets the OCIO wanted to include in the *Catalogue*. The street construction projects data was initially seen as a good candidate because it was a relatively small data set, simple in structure, and easy to render in a more accessible visual form using the city’s selected data visualization platform.

The business value of making this data open was clear to DOT. The volume of projects identified in their annual

Edmonton is known for its two seasons: Winter and Road Construction. It makes perfect sense that one of its flagship open data initiatives would involve releasing street construction projects data.

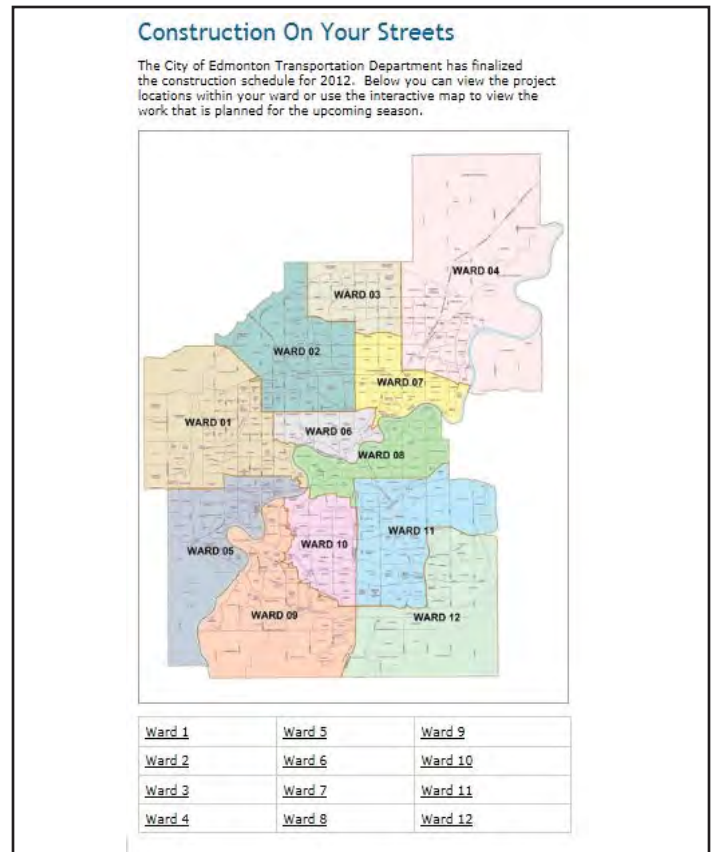


Figure 5. City of Edmonton Street Construction Projects Static Map.

plan represented a very large proportion of the DOT responsibility. Edmonton enjoys a very short period of warm weather when all construction projects seem to take place, thus at any given point during this time, the number of active projects is quite large. The result of this condensed construction period is felt by residents and other stakeholders as travel delays, disruptions in availability to local businesses, noise and other environmental impacts in neighborhoods, as well as impacts on different government agency projects (e.g., public works projects not under the control of DOT including water, sewer, and other utility projects). Construction work also increases the workload at DOT due to the large volume of calls about the construction work (to DOT and other city offices).



The DOT already had a process in place for making their street construction projects data available to the public and had been doing so for years. In addition, the city had clear existing standards for data definitions and formats already in place. Prior to construction season, DOT would post a static map of the planned projects on its departmental website. In addition, the map would be distributed to various media outlets such as the *Edmonton Sun*, which would post the map in its newspaper.

Using the less interactive DOT website or information provided in the Edmonton newspapers, citizens would either click on a ward link to bring up a relatively low resolution map of the ward showing projects located by numbered dots that referenced a list of projects on the page below the map. The list contains a mix of simple project identifiers along with links to pdf files that contain a more detailed map and project description for some, but not all projects. The most detailed and useful information is thus three clicks down and even then not always complete. The separation of the geospatial information about the project into three separate forms (overall map, ward map, project map) makes it much less accessible and useful than a single interactive map presentation. None of the maps included much in the way of additional information about streets, terrain, or points of interest. As one could imagine, the maps and street construction projects by ward information was even less interactive in newspaper print form.

By making the street construction projects data available in the *Open Data Catalogue* and using the city's data visualization platform, the city had the opportunity to improve the usability and therefore usefulness of this information compared to the static presentation shown on page 17. The OCIO staff completed the process quickly as a result of the relative simplicity of the data set combined with the robust capabilities of the application used to implement the catalog entry. A visualized entry based map on a GIS interface was created. This allowed users to access the data either through the map interface or directly in a data table, an option available on the map page.

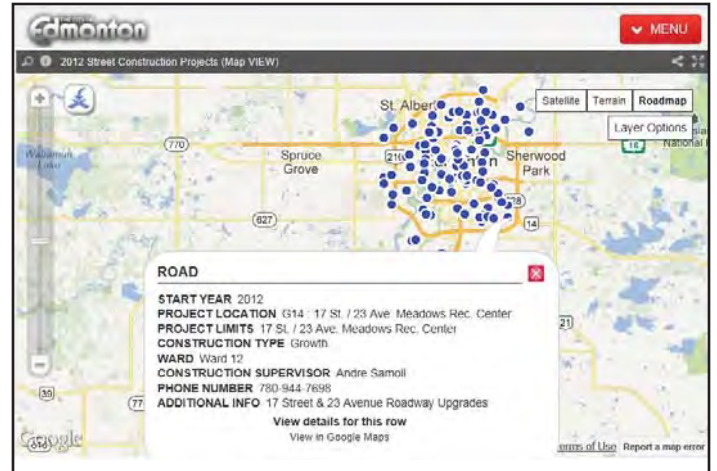


Figure 6. City of Edmonton Street Construction Projects Interactive Open Data Map.

The current city website presents the construction project information using both the static and interactive maps. The interactive map allows users to click on a blue dot and bring up a description of the project at that location, a screen shot of which is shown above.

The map can be enlarged to whatever scale the user prefers and shows increasing amounts of geo-referenced information at higher resolutions. The amount of detail available in the mapping interface allows the user to locate the project site with relatively high precision. A description of the construction types is included in a table below the map. However, the current record for an individual project does not always include information about the time frame or boundaries of the work. For example, the record for a repaving project may not identify all the road surfaces involved.

While moving from static maps to interactive maps helps to provide additional context and increase usability, it also creates a sense of 'what's next.' The release of the data generated increased interest in what else might be available to enhance usability. For example, the DOT staff and OCIO staff started to think about the cost and benefit of providing additional types of data, either that they already collected or



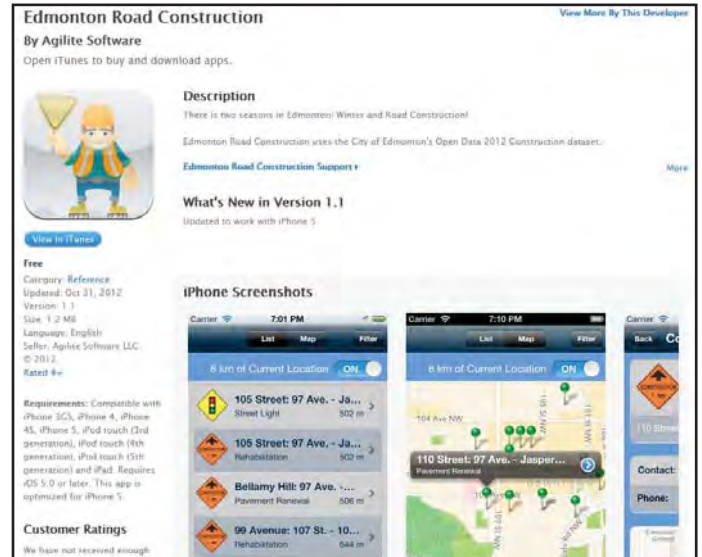


would need to begin to collect. Decisions regarding adding data elements, particularly those that are not currently collected will require new effort and may require new changes in governance. For example, the decision about which projects to conduct in a year is made as part of the city budget process in the early part of the year. Projects may be cancelled or added during the year but this is infrequent. However, deciding to provide start and end times maybe somewhat more dynamic. To date, no new technical methods or changes in business processes were needed to keep the data up to date.

Two factors contributed to the rapid growth in certain time periods of public access to the road construction data. First, the local news media quickly took notice and published information about the site and its value to the city's driving public. The *Edmonton Sun* published a positive article on April 4, 2012 followed shortly by a piece by the Canadian Broadcasting Corporation.

Secondly, a local application developer decided to create a mobile app for smart phones and similar devices to access the map interface. He saw the data as useful for the population and decided to make a contribution to his new home city, not as a commercial venture. He reported that creating the app was a relatively straightforward task for him, due in part to his extensive development experience and the high quality of the data set and metadata provided by the city. Particularly, he noted that the inclusion of geo tags listing longitude and latitude provided the right level of detail for the type of mobile application he wanted to construct. If this information was not available, he described a more time consuming and less accurate alternative – using third party mapping software or less precise geographic locations. He also noted that in his scan of other available government data sets, many lacked this quality of data and metadata. He explained that he would not have built the application if many of these components were not available, suggesting it would have been too time consuming and costly to him.

As a result of these promotional efforts and new tools, the use of the data set has increased substantially. From the opening of the *Open Data Catalogue* in April, monthly views



The Edmonton Road Construction app uses the City of Edmonton's Street Construction Projects open data set.

increased to over 1200, then declined gradually to less than 250 by mid-October, when the construction season was largely over. As of October 2012 there have been just short of 11,000 views, over 300 downloads of the data, and links to the site have been embedded over 7800 times.

In choosing and implementing the street construction projects data set, the City of Edmonton was motivated by the value proposition internal to the city government and also recognized the potential value of the data and its map interface outside of city government. Some of the potential value created included avoiding costs associated with fielding phone calls from citizens or avoiding damage to the City's reputation for inconveniencing the public with travel disruptions. The value proposition of the new data resource would be better informed and forewarned citizens, who would complain less and the elected officials and city professionals could enhance their reputations for supporting cutting edge services. Similarly, the OCIO staff could advance the CIO's and City Manager's objectives of increasing accessibility to city data sets, increasing their reputation for facilitating improved services, and building their capabilities for future achievements.





DYNAMIC MODEL OF OPENING DATA

Public managers face challenges when implementing open data initiatives. These challenges arise due to the multiple interactions between actors, information flows, technologies, and interests. By defining the problem of opening government data dynamically, we are placing emphasis on how processes and relationships change over time. The two open data cases clearly demonstrated how rapid and unpredictable technological developments and shifting relationships in the social and organizational environments change over time. This section illustrates how modeling the non-linear dynamics of opening government data systems supports decision making, learning, and understanding in a complex, unpredictable world.

We begin by describing a very simple mental model of opening government data as it is described in both cases. Open data initiatives are frequently described as virtuous cycles, or reinforcing loops. The logic of a virtuous cycle is that, if left unimpeded, it can generate exponential growth or decay. In the case of opening government data, advocates assume that simply supplying more and more data sets freely and in more formats will lead to more and more use. In such a mental model data use leads to value creation, which in turn will motivate government to make more data open and accessible. This reinforcing loop leads to some

form of exponential growth in supply and use represented by the solid lines in both graphs in Figure 7. What we saw in our cases, is a different mental model. In our complex model, the expansion of freely available data sets and use are constrained by agency and user capabilities, data management practices of agencies, agency effort, politics, interactions between citizens and data that create meaning conflict, and relationships with citizens and other stakeholders. Over time, these constraints are activated and the result is a set of negative or balancing feedback loops that tend to slow the supply of data and use or reduce it all together.

Although each of our illustrative cases involves intense use of the open data by citizens and the involvement of several stakeholders, anecdotal evidence suggests that the majority of available open data initiatives do not enjoy such success. Most open data strategies look for 'quick wins' in the first few years, but over time, the available set of data that is easily opened will diminish, reducing the number of open data sets folks are looking to use, which will result in a loss of interest in use, less stories of valuable use, and the virtuous cycle slows. In fact, it is more common that data use follows a pattern of behavior more similar to the dashed line in Figure 7 (a). Our two examples may be the

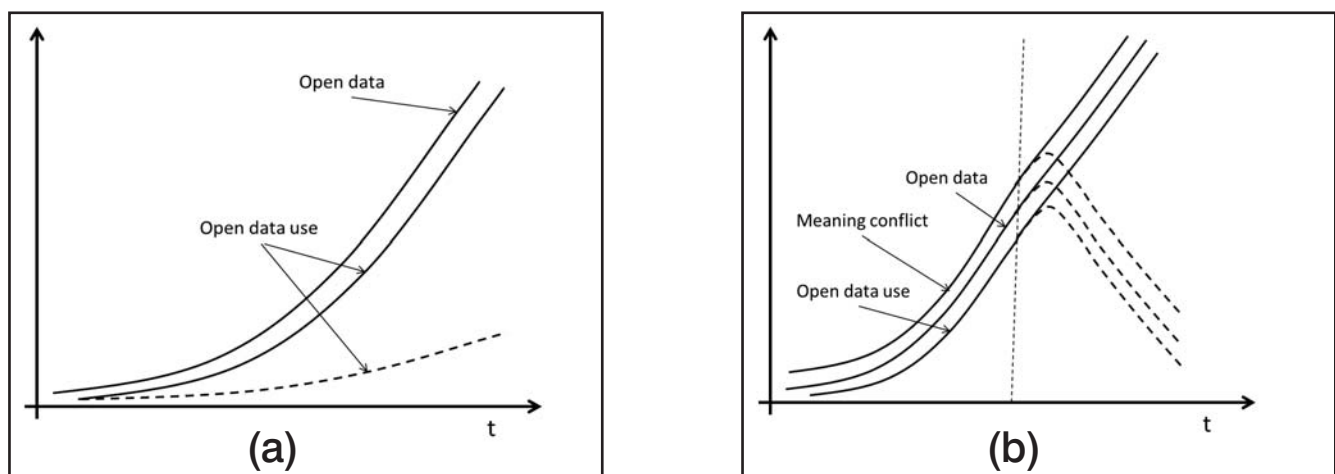


Figure 7. Dynamics of opening government data.





exception rather than the norm when considering the value creation of opening government data. Likewise, as we saw in the restaurant inspection case, meaning conflict among citizens attempting to use the information counterbalanced the virtuous cycle and actually shut down (for a brief time period) the release of data (Figure 7 (b) shows this impact). The model that we describe in the following paragraphs is a conceptual attempt to explain these patterns of behavior using stocks and flows.

A CAUSAL MAP TO FRAME OPEN DATA INITIATIVES

System dynamics is one modeling approach that can assist in uncovering the complexity of open data initiatives. This approach uses causal maps to visualize a systems structure and behavior. The basic building blocks of a causal map are stocks, flows and feedback loops. Stocks, represented by 'boxes', are any entity that accumulates or depletes over time. Flows, represented by 'valves', are the rate at which the stocks change. A variety of factors contribute to the rate at which a stock changes over time. A feedback loop exists when information resulting from some action within

the system (endogenous) travels through the system and eventually returns in some form to its point of origin and potentially influences future action. A loop can be reinforcing or balancing. If the tendency of the loop is to reinforce the initial action, the loop is called a positive or reinforcing feedback loop. Reinforcing loops are sources of exponential growth or collapse. When positive, they are considered a virtuous cycle. If the tendency of the loop is to oppose the initial action, it can be thought of counteracting or constraining the reinforcing loop which balances or prevents change from happening. The model presented is a partial explanation of both cases and presents only a small set of important casual relationships and feedback processes. It is not a fully developed simulation model.

Making government information available

The basic story in both cases starts with opening government data—making available to the public the information about restaurant inspections in New York City and street construction projects data in Edmonton. Figure 8 shows a conceptual representation of this process. The box *Government Information* represents the accumulation of government records created from government activity.

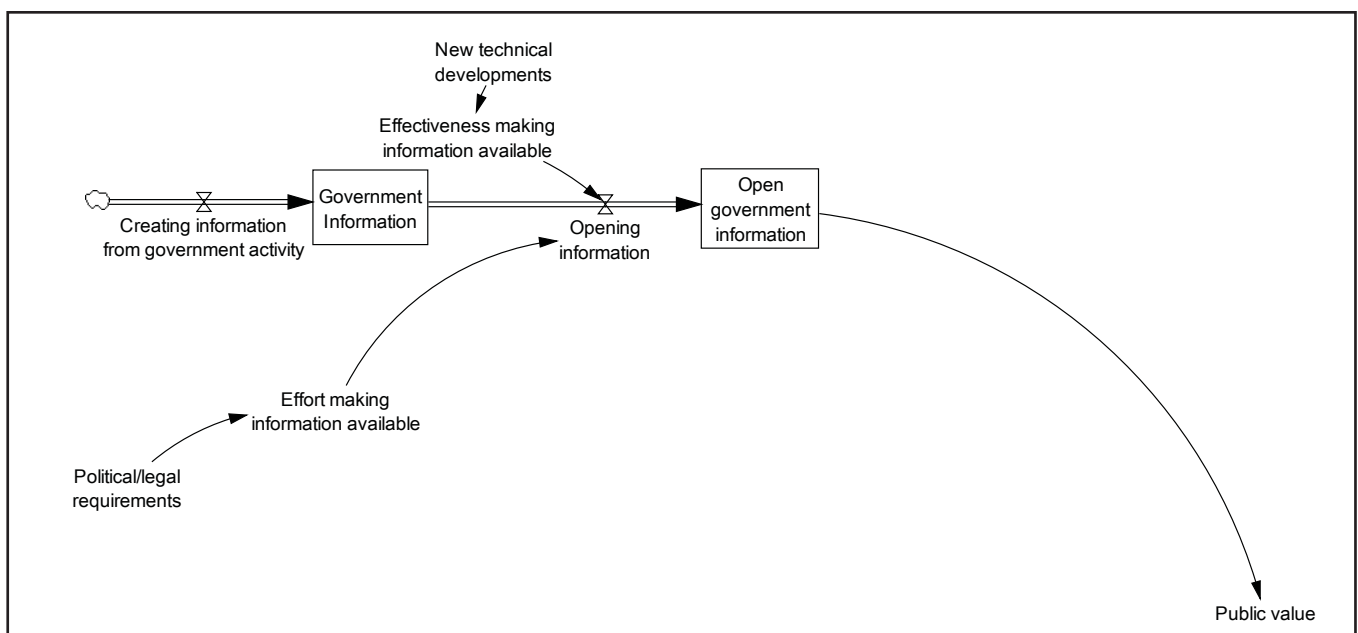


Figure 8. Making government information available

⁵(Richardson, 1999)

⁶Ibid.



All data in this accumulation becomes candidate data to be opened to the public. The second box in the figure—*Open government information*—represents the accumulation of all open data available to the public and the valve ‘Opening information’ represents the activities necessary to make available such information. *Opening information* adds to the accumulation of available open government information over time. To make this happen, governments need to allocate some effort to opening information. Every (person*hour) of effort varies on how effective the person is, which reflects that the most experienced people will be able to open more information with the same effort. In our two cases, agencies are putting effort into restaurant inspection and street construction projects data in order to move *Government Information* into the box *Open government information*.

As it is shown in Figure 8, on the one hand, agencies’ efforts to make information available may be increased or decreased by political or legal requirements. On the other, new technical developments will contribute to people’s effectiveness in making this information available. In the restaurant inspection case, for example, the Internet as a new technology was an important trigger for making the information available in the first place. In the Edmonton case, it is clearer that new policy related to open government constitutes the main motivation to make the street construction projects data set available. Of course, the expectation of governments is to create public value by making information available. That is to say, making restaurant inspection information available to the public creates value by informing the public about their health safety when eating in a restaurant by ensuring basic requirements of hygiene in each establishment. Making street construction projects data available, on the other hand, creates value by helping people better plan their routes when driving from one place to another or for taking into consideration increased commuting times.

Making government information ‘fit-for-reuse’

Government information has been available to citizens long before the Internet or open data initiatives. However, the effort needed by citizens to physically get this data has

been reduced over time. First, the Internet made it easier to post and access and second, recent platforms and format changes make machine-readable data more fit for re-use in different applications.

Figure 9 (page 23) represents these changes in technological ease over time by adding a second set of stocks, *Government information fitness to re-use*, and *Open information fitness to re-use*. The boxes in the figure represent the way in which the characteristics of information have been changing over time. For example, in the case of restaurant inspection information, prior to the Internet, it was not very easy to re-use the signs that displayed the information at each restaurant location. However, by placing a variety of related information together in HTML or PDF formats in a single location on a website reduced the effort of gathering this information. But, a citizen would still need to print, re-type it or pre-process it before being able to re-use it. Today’s tools make machine-readable formats quite easy to re-use and as a result, new applications are developed to encourage mobile use of the information.

The valves *Archiving information* and *Making information easy to re-use* are fed by the agency activities needed to make such information available in any format. The release of street construction projects data offers insight into agency processes for archiving and making it fit for reuse. In Edmonton, there are a variety of candidate data sets to be made available to the public. When trying to balance resources, time, and effort, choosing which data to pay attention to was not an easy task. Interviewees from the case commented that this particular data set was made available, at least partially, because of the commitment of the data set owners. They considered commitment from data owners as a key factor for success. Additionally, the current data management practices of the department that owned the street construction projects data enhanced the commitment from data owners and increased the effectiveness of making data more fit to re-use. Good data management practices will reduce the cost and effort of making information available and increase the probability the data will be opened and easy to re-use. On the other hand, poor data



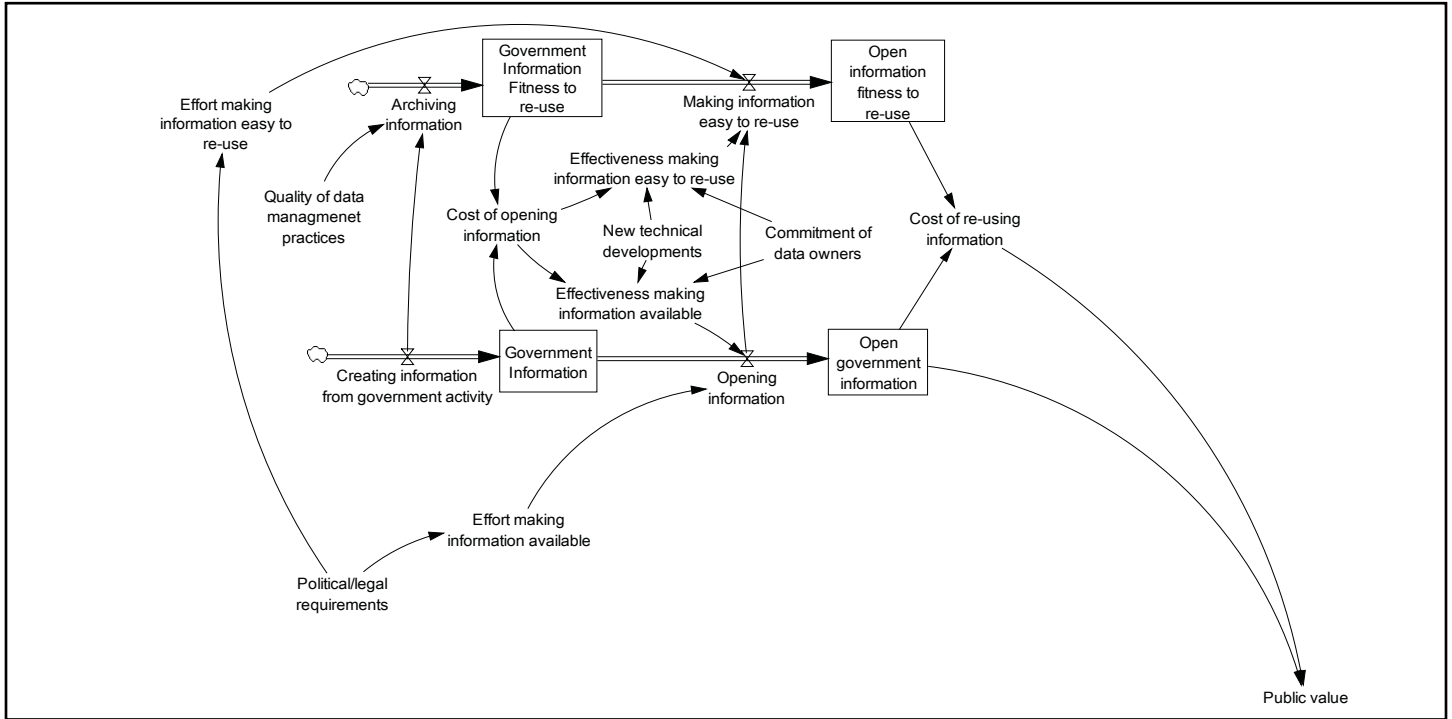


Figure 9. Making open information fit for re-use.

management practices will increase the cost and effort required to open data and make it available in machine-readable formats.

Another important aspect is the quality of data management practices. Good practices involve providing excellent metadata suitable for the purposes of opening government data. The developer of the road construction application in Edmonton described how the excellent quality of DOT's metadata for this particular data made it easier for him to, first, imagine what kind of application he could build and second, to make a quick assessment that the development of this app would take approximately 30-40 person hours. These decision points were very important in his analysis of whether or not to build an application.

Making information more fit to re-use requires agencies to allocate some effort to the process and it is likely that agencies will vary in their levels of effectiveness in trying to

accomplish this task. As it is shown in Figure 9, the amount of effort to prepare the open information also depends, at least partially, on political and legal requirements. The agency's effectiveness in providing open information fit for re-use also depends on technical developments. The development of XML, for example, makes it easier to prepare information to be machine readable and US President Obama's *Open Government Directive* (a political and legal requirement) has clearly signaled to US agencies that they must increase effort to open information and make it more fit to re-use.

Looking at Figure 9, we can begin to see the virtuous cycle and the constraints. We can imagine that in the last 25 years access to government information has been increasing, with two main points of rapid growth, one of them around the mid 90's with the introduction of the Internet, and a second around 2009 with the US *Open Government Directive* and other similar open government initiatives elsewhere in



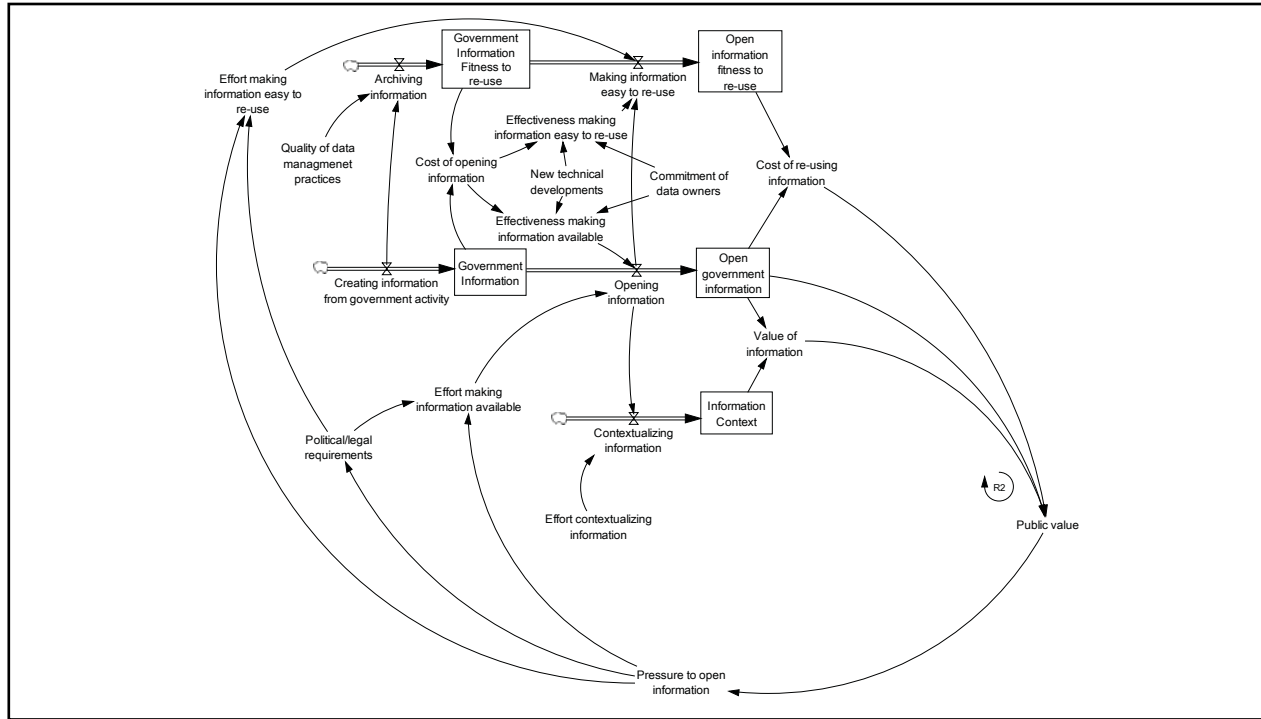


Figure 10. Contextualizing open government information and creating value.

the world. We can also imagine that *Fitness to re-use* has increased over time with new technical developments, with an important push around 2009 when political and legal requirements mandated agencies to allocate more effort to this task. Globally, national governments are endorsing an open government policy with 55 governments committed to the Open Government Partnership initiative. However, commitment of data owners and current practices in data management remain limiting factors both in terms of data availability and their fitness to re-use.

Contextualizing open government information and creating value

It is not enough to focus only on the technical components of opening government data, strategies must also consider the social aspects of information more generally, particularly providing sufficient context for information use. The effort agencies make to contextualize the information for use among diverse audiences and users is important. The box

Information Context is a third accumulation (see Figure 10). As with the other boxes discussed so far, adding context to data requires effort by the agency and capability to be developed. Providing additional context makes the data more *fit for use* by various audiences and users, which contributes to public value creation by increasing the value of the information.

The dynamics of providing context are often not addressed by agencies when designing open data initiatives. Context is closely related to creating public value for specific stakeholders, purposes, and applications. Since technical developments do not help to improve context, it may partially explain why the availability of so many open government data sets has not generated the uptake of use first envisioned.

Figures 10 and 11 also show for the first time two possible reinforcing (virtuous) feedback loops labeled as 'R1'





and 'R2'. As noted earlier, a reinforcing loop is a virtuous cycle that contributes to exponential growth or decline in public value, but over time, constraints are engaged. A lot of agency effort is spent creating data that is machine-readable but it is not contextualized in a way that might generate value. Thus, stakeholder involvement is a way to increase the effectiveness of contextualizing information. For example, restaurant and consumer associations and citizens could participate in the process of agreeing on types of data to be opened and ways to present this data in order to create value. However, as we mentioned before, reinforcing processes can represent an initial trap. It is hard in the beginning to get stakeholder involvement because they are uncertain of the value of the information.

Conflict of meaning

Some constraints even have the potential to shut down an initiative (see Figure 11). In the case of restaurant inspection

data, when the information was initially released it was made available in exactly the same format to the public as its primary users (e.g., inspectors, restaurant owners). Less of an emphasis was placed on potential new users such as city visitors or citizens. The lack of information context (i.e., releasing technical language like *vermin*) created a conflict in meaning, or misunderstanding of the underlying or intended data element. This conflict of meaning triggered two other feedback balancing loops labeled in the figure as B1 and B2. In this case, conflict of meaning for some data elements created negative pressure to hide public data, reducing the effort by agencies to make the data available or even forcing the political/legal areas to create safeguards to eliminate easier public access to the already public data (see B1). On the other hand, the same conflict of meaning may trigger positive pressure to contextualize the information, increasing agencies' efforts and potentially improving the quality of the information that will lead to public value (process B2).

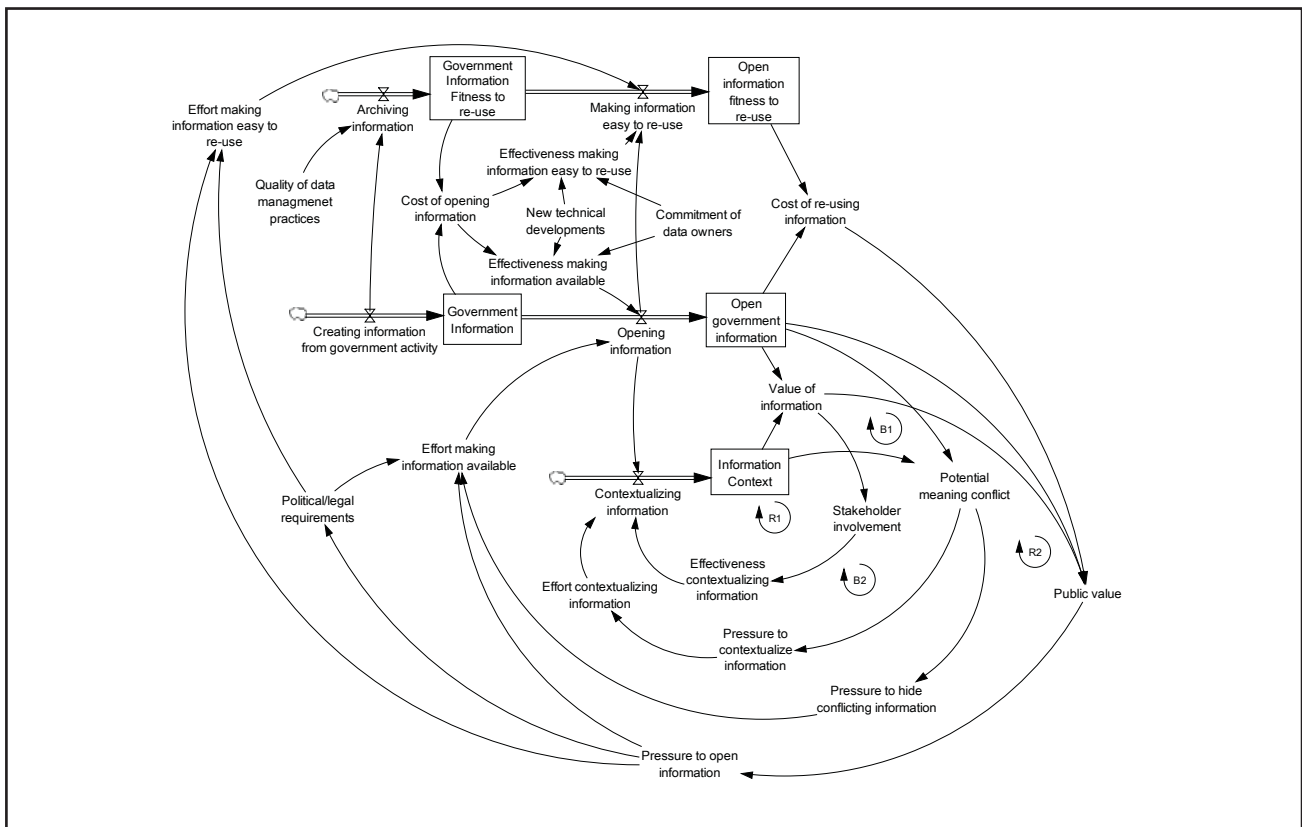


Figure 11. Potential meaning conflict in opening government data projects.





In the street construction projects case, we see what happens when a feedback loop is dormant (B1). That is to say, the agency provided the information in the same way that the primary/users see the information and did not provide any additional context. Releasing the data in this way did not create meaning conflict or create any pressure to hide the information. However, both other feedback loops remained active (R1 and B2). As noted in the case, a variety of new stakeholders are encouraging the agency to make more frequent updates to the data or provide additional data fields that will improve the value of the information for their new and intended uses.

Developing apps and creating value

Finally, both cases show that public value creation from opening the data is increased by the development of mobile or Web applications as seen in the reinforcing loops R3 and R4 in Figure 12. Both loops contribute to value creation by

making information more useful to more audiences/users. R4 describes how the quality of the data set for re-use incentivizes the application developer to create an app. In the Edmonton case, the relevance of the data, how easy it was to use, and the quality of the metadata made his decision easy. His personal motivations, including that he was new to the area and recently attended a conference of fellow civic hackers, also contributed. R3 describes the social components that support use through applications, which are not just for the few that are capable in figuring out how to use machine-readable structures. This was evident in the positive reviews of the apps. While we do not have direct evidence of citizen use of the mobile apps in either case, it is presumed that the mobile apps provide additional flexibility and value.

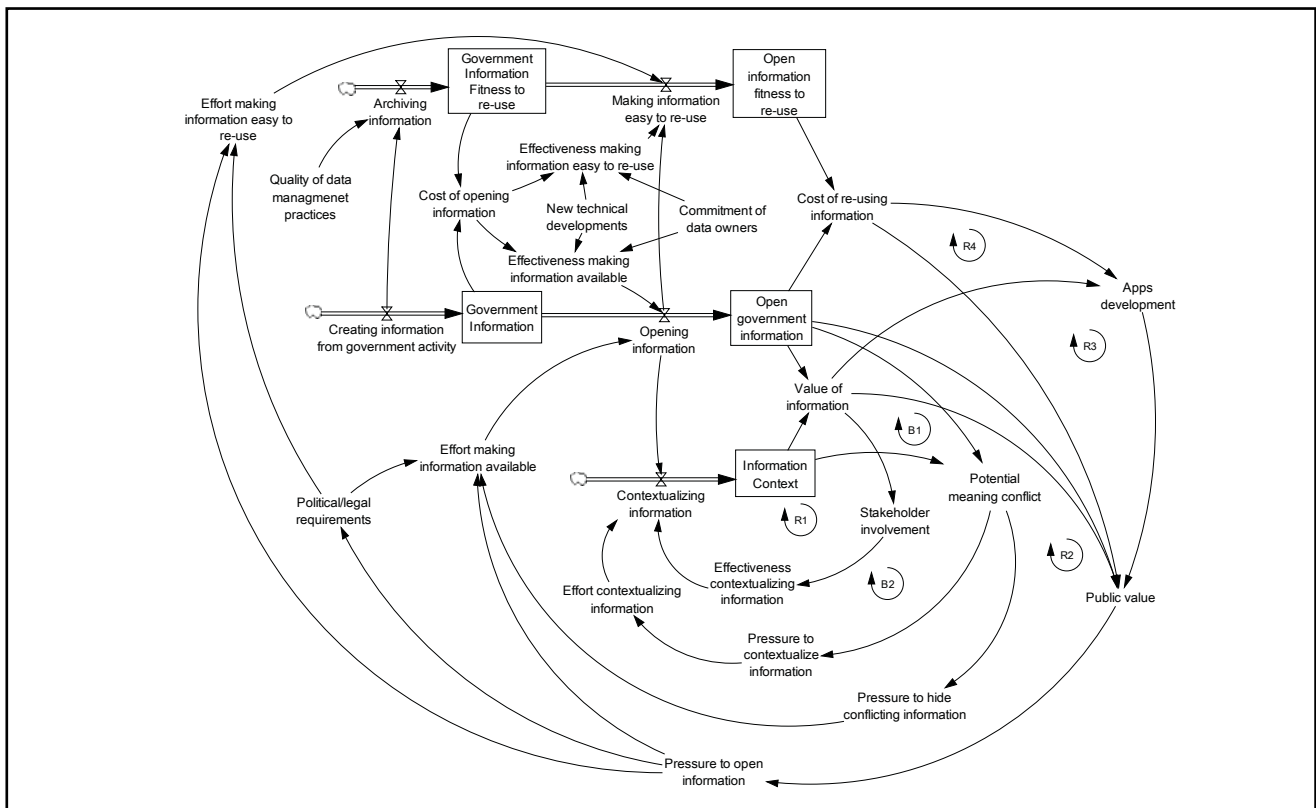


Figure 12. Application development and value creation





DISCUSSION AND IMPLICATIONS

The two opening government data cases presented here show how the various stakeholders and their patterns of interaction will change over time and will require new practices, new governance arrangements, new policies, and different ways to measure the value generated. Based on our analysis of the two cases, we present the following considerations for agencies in pursuit of opening government data.

Release government data that are relevant to both agency performance and the public interest. In both cases, demand for the data already existed and the act of “opening that data” just further improved services for both government and the public. However, most government agencies are facing an expanding list of ‘data’ to populate in open data catalogues. Therefore, trying to balance resources, time, and effort and choosing which data to release is not an easy task. Anecdotal evidence suggests that the majority of available open data initiatives do not enjoy the quick success or public value created in the case examples. The number of available data sets far exceeds the number of success stories. As the dynamic model indicated, looking for ‘quick wins’ in the first few years is easiest, relying on data that is easily opened and has an established stakeholder base. In the long run, the quick wins will diminish, reducing the number of open data sets folks are looking to use, which may result in a loss of interest and less stories of use, and the virtuous cycle slows. Releasing government data sets that are relevant to both agency performance and the public interest are always a good investment.

Invest in strategies to estimate how different stakeholders will use the data. The wide range of potential uses underscores the fundamentally versatile and valuable nature of open data and explains why it is an attractive strategy. But it will be just as important to understand citizen demand as it is to understand intergovernmental demand, as it is to understand developer or third-party entrepreneur demand for the data. In the road construction data case, business owners reported that some stakeholders have started to ask for additional types of data. For example, public expectation that this data resource can provide

them with more real time updates on traffic disruptions, or changes in project status, would require changes in the type and timeliness of the data currently collected. As business owners, the agency will need to make the decision whether they can and should invest in new business or data collection processes in the future.

Devise data management practices that improve context in order to ‘future-proof’ data resources. There are no sure fire ways to eliminate *conflicts of meaning* when it comes to government data. What makes data fit for use is context dependent. The intended use determines the specific data attributes needed by users. For example, the context of a motorist looking at road construction data to plan her morning’s commute is far different from that of an electrical utility engineer seeking ways to use the data to understand the impact of road construction on an infrastructure upgrade project. However, the dynamics of these cases suggest some possible strategies for contextualizing and better ‘future-proofing’ the data resources. These two examples imply quite distinct requirements for various stakeholders regarding data quality, timeliness of data needs, useful formats, and metadata that make it more or less useful for the variety of stakeholders interested in the data. By providing users the opportunity and a mechanism to communicate data errors and enhancements back to the source, the overall integrity and quality of government data can improve while increasing benefit to all future users.

Think about sustainability. Data that is not ‘demanded’ by a stakeholder group may experience little or no value creation. Without extensive prior research, it is unlikely that most agencies will find it easy to accurately predict demand for a new or enhanced data resource. However, it is not harmful to think of opening data as a virtuous cycle, where opening data leads to use and more use. But, as our dynamic model indicated, there are constraints that can affect the positive aspects of opening government data. Downstream assessment of the impacts of open data initiatives should also be part of the longer term picture. At some point, baseline usage data and attention to performance metrics early in the process can





have substantial longer term benefits for existing and new initiatives. In addition, attention to immediate and downstream governance issues is also critical. If the existing governance arrangements for an initiative's data ownership and use policies are not clear or well-structured, attention to those issues should be part of the overall effort.

CONCLUSION

The holistic approach described in this white paper can help planners and decision makers understand proposed and existing open data initiatives. An information polity perspective provides a way to identify the various stakeholders and their patterns of interaction that influence or control the generation, flows, and uses of enhanced information resources in open data initiatives. The dynamic modeling techniques used highlight the ways different constraints can impact the system as a whole and affect value creation. These tools support planners' ability to generate informed hypotheses about changing patterns of interaction among existing and potential new stakeholders. In this way, governments can better evaluate the costs, risks, and benefits of a wide variety of open data initiatives. The goal is to become better at building the capability between government and other stakeholders to address the ways that open data initiatives change power relationships, expectations, and performance.

Although tested and refined by a combination of expert feedback and two opening government data cases, our approach is still a work in progress. The next steps in our research and examination of practice will be to use our initial results to guide new investigations. The possible variety of open data initiatives is huge. We believe that our approach can be useful across a much wider range of initiatives, but that belief requires testing. Additional research and review of new developments in practice can further our understanding of information polities. It is also potentially valuable to test the use of these analytical and modeling methods with other open data and related government transformational efforts. In addition we plan to use this work as a basis for developing practical tools to support efforts to open government data.







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ABOUT

THE CENTER FOR TECHNOLOGY IN GOVERNMENT

The mission of the Center for Technology in Government (CTG) at the University at Albany/SUNY is to foster public sector innovation, enhance capability, generate public value, and support good governance. We carry out this mission through applied research, knowledge sharing, and collaborative problem solving at the intersection of policy, management, and technology.

The results generated by each CTG project add to a growing knowledge base designed to support the work of both government professionals and academic researchers. Our guides, reports, and tools are freely available on our publications page: www.ctg.albany.edu/publications.

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Natalie assists in the development, planning, implementation, analysis, and writing associated with a variety of projects at CTG. Her work has focused on understanding information use and management in public organizations and the impact and changes brought about by new technologies such as mobile technologies or social media. Natalie's expertise also includes the digital divide, open government and transparency, and fostering research-practice partnerships. Prior work at CTG includes an online skills assessment survey for NYS' IT workforce and an examination of parcel data as an important public information resource. Natalie completed her doctorate in Public Administration at the University at Albany in 2010.



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From 1999 to 2011, Tony served as deputy director of CTG working with a variety of government, corporate and university partners to conduct applied research projects on the policy, management, and technology issues surrounding information use in the public sector. He retired at the end of 2011, but continues to work at CTG as a Senior Fellow. He began working at CTG as a senior research fellow in 1994 and also served as interim director from 2008-2009. One of his major contributions has been his focus on return on investment for government information technology and addressing the core issue of determining public value. In addition, Tony's efforts have been directed at problems of interorganizational information sharing, knowledge networks, and IT impacts on practice.



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Brian is responsible for designing and managing Center projects and developing new research opportunities focused on helping government foster public sector innovation, enhance capability, and generate public value. Brian also represents CTG on state, national, and international level advisory and work groups and at various academic and other professional conferences. Brian has worked closely with governments at all levels in the United States and internationally as well as private sector experts and fellow researchers on understanding how policies, management practices, and information and communication technologies interact with and influence the performance of government and government's relationships with citizens and other non-government actors. Most recently, Brian's work has focused on the topics of Cross-Boundary and Transnational Knowledge and Information Sharing, Government Interoperability, and Assessing the Public Value of ICT Investments.





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Luis is a Professor of Business at the Universidad de las Américas-Puebla in México. He holds a PhD in Information Science from the University at Albany. He has been co-chair of an International Research Group with members from Canada, the United States and Mexico, and a Fulbright Scholar at the Center for Technology in Government. Luna-Reyes is also a member of the Mexican National Research System. His research focuses on electronic government and on modeling collaboration processes in the development of information technologies across functional and organizational boundaries. His research projects are related to areas such as inter-organizational collaboration, open government, information sharing, information systems development, success of government-wide Web sites, digital divide policies, and information policy to promote economic exchange in the NAFTA region. He is the author or co-author of articles published in *Government Information Quarterly*, *European Journal of Information Systems*, *International Journal of Electronic Government Research*, *Gestión y Política Pública*, and *System Dynamics Review*, among others.





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