Article

Creating Open Government Ecosystems: A Research and Development Agenda

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Abstract: In this paper, we propose to view the concept of open government from the perspective of an *ecosystem*, a metaphor often used by policy makers, scholars, and technology gurus to convey a sense of the interdependent social systems of actors, organizations, material infrastructures, and symbolic resources that can be created in technology-enabled, information-intensive social systems. We use the concept of an ecosystem to provide a framework for considering the outcomes of a workshop organized to generate a research and development agenda for open government. The agenda was produced in discussions among participants from the government (at the federal, state, and local levels), academic and civil sector communities at the Center for Technology in Government (CTG) at the University at Albany, SUNY in April 2011. The paper begins by discussing concepts central to understanding what is meant by an ecosystem and some principles that characterize its functioning. We then apply this metaphor more directly to government, proposing that policymakers engage in strategic ecosystems thinking, which means being guided by the goal of explicitly and purposefully constructing *open government ecosystems*. From there, we present the research agenda questions essential to the development of this new view of government's interaction with users and organizations. Our goal is to call attention to some of the fundamental ways in which government must change in order to evolve from outdated industrial bureaucratic forms to information age networked and interdependent systems.

1. Introduction

The now frequently used label of "Government 2.0" was originally inspired by demands for government organizations to transition, as William Eggers put it some years ago, "from Industrial Age" into the "Information Age" [1] (p. 8). Such sentiments have certainly proliferated over the past two decades of Internet and Web diffusion, even in the midst of considerable uncertainty over what an information age government should look like and a gauntlet of potential legal, economic, and organizational obstacles to its realization. However, the more recent advances characterized as Web 2.0 now invite a view of Government 2.0 well beyond what might be conceived as "information age". Profound interdependencies are commonplace in Web 2.0 environments; users function as both producers and consumers of information and form complex networks of interaction with each other and the organizations and communities they are part of [2–4]. These interdependencies point to the need for even more radical views of Government 2.0. At the same time that we appreciate more fully these independencies, the path forward remains substantially undefined since we have few models for a state in which government contributes proactively to a culture of innovation, transformation, and accountability within a network of interrelationships comprised of citizens and commercial, academic, civil society, and other government organizations.

A key term in the discourse of Web 2.0-inspired transformations across business, education, and government contexts is "open," as in open access, open data, open information, open innovation, open knowledge, open platform, and open source, to identify some of the most prominent variations on this theme. This *open* theme has gained currency because a central affordance of technology evolution is the ability to distribute, share, and collaborate in the use of critical resources, and in so doing stimulate innovation. Thus, for example, *open standards* (and, by extension, *open platforms*) enables the achievement of interoperability, allowing users to access electronic information and resources from diverse computing devices, and allowing designers to add functionalities to or alter the operations of existing hardware and software systems in ways not envisioned by the original developers (see, e.g., [5,6]). *Open source* describes an approach to software development with relaxed or non-existent copyright protection that encourages collaborative production of software systems, from module creation to de-bugging to operating systems, based on peer contributions or user co-production [see e.g., [7,8]]. Advocates of *open data* claim significant growth in knowledge and innovation when scientists, entrepreneurs, and others share data; the term also suggests an obligation on the part of government to make freely available data that has been generated by public sector funds (see e.g., [9–12]). The business approach known as *open innovation* acknowledges that knowledge and new ideas are widely distributed and advises organizations to supplement their internal innovation processes by transforming previously closed into semi-permeable boundaries that enable interaction with external sources of innovation in pursuit of new products, market advantage, and other opportunities [13–15].

In the United States, the most obvious application of these ideas to government can be found in the Obama Administration's *open government directive (OGD)* [16], which has sought to catalyze transformation in the executive branch. While the idea of open government traces back through hundreds of years of political theory, contemporary use of the term draws on the concepts of open standards, source, data, and innovation in proposing a new approach to management of the federal bureaucracy. "Just as open source software allows users to change and contribute to the source code of their software," according to Lathrop and Ruma, "open government now means government where citizens not only have access to information, documents, and proceedings, but can also become participants in a meaningful way" [17] (p. xix).

While the term *open government* draws heavily from the collaborative relationships that characterize contemporary technology innovation, it is also tied conceptually to demands for transparency in political governance. Indeed, use of the term *open* as a way to describe government is nearly synonymous with the vocabulary of "transparency," which some see as the "contemporary term of choice" [18] (p. 25). Here too there are substantial ties to new technology. Although there continue to be formidable barriers to achieving transparency [19], the Internet and associated information and communication technologies (ICT) radically reduce the cost of information capture, management, and use, and make sharing with nongovernmental entities and individuals feasible and useful. These new possibilities contribute to the pressures citizens exert on government to make data and documents available to them online and have made a full-scale commitment to sharing government data possible. The marriage of political goals for transparency and contemporary ICT tools has fueled the advocacy of new civil sector watchdog organizations, such as the Sunlight Foundation, which operates a "lab" to develop software applications that can be used by citizens to analyze and interpret data related to evaluating government performance.

As former chief technology officer Aneesh Chopra acknowledged in a recent interview, innovation and accountability are both encompassed in the Obama Administration's open government initiative [20]. Further, these ideas associated with opening government are increasingly aligned with similar commitments being made by governments around the world. Great Britain has committed to a program of open data as a way to achieve both improved accountability and transparency through the creation of new data products [21]. Canada's Access to Information and Privacy Commissioners issued the Open Government Resolution, which articulated the need to make information and data open in order to improve government accountability [22]. Australia issued a "Declaration of Open Government" in 2010 [23], with an emphasis on informing, which requires the establishment of a "pro-disclosure culture" in Australian government organizations; engaging, which seeks to promote collaboration as a way of improving government processes; and participating, which seeks to make government more consultative. And as a part of its Government 2.0 planning, Australia is exploring the value of open public sector information in stimulating innovation and expanding knowledge [24].

More recently, the "Open Government Partnership (OGP)" has made good on a pledge made by President Obama to the United Nations General Assembly in September 2010 to foster the development of more open governments around the world in order to combat corruption and increase accountability. Launched in the fall 2011, the OGP is led by an international, multi-stakeholder steering committee comprised of countries (including the US, Brazil, Indonesia, Mexico, Norway, Philippines, South Africa and the United Kingdom) and numerous civil society organizations such as

the International Budget Project and the Transparency and Accountability Initiative, among others. Joining the Partnership requires that countries meet a set of minimum eligibility requirements focused on existing practices related to fiscal transparency, access to information, citizen engagement, and financial disclosures by elected leaders and senior public officials. Following that, countries must commit to carrying out detailed "open government plans" that further develop these practices, reporting on their continued progress. So far, a total of 55 countries have made commitments to join the OGP [25].

Enthusiasm for *open government* is being translated into major programs and services and a wide range of technology, policy and management innovations. Yet, at the same time, substantial uncertainty remains about how best to accomplish the broad goals of an open government. How does a government move from *industrial age* to *open* in its configuration, management, and interaction with constituencies? The principle tenets of open government, while still largely unarticulated, seem to require new and challenging participative and consultative relationships with citizens and private sector organizations. Even prior to widespread discussion of open government, public administration scholars have advocated changes in the education of public servants that emphasize engagement, consultation, and social networking, but these are by no means part of the standard curriculum [26–28].

Further, the multiple constituencies of open government exert pressures in different and potentially conflicting ways. As Yu and Robinson [29] point out, there has been conceptual confusion about the role of open data in discussions of open government. Thus, the data most likely to be useful to business entrepreneurs is not necessarily the data best used to enable citizens' assessment of accountability. In selecting high quality data sets to make public, as US federal government agencies have been instructed to do, policy makers need to think carefully about whose interests are being served. It is not surprising to discover disappointment with the efforts made so far to share data [30,31]. Together with these considerations are even more basic issues related to the quality of the data to be made available, and how best to insure that data sets are discoverable and usable to those who might benefit from them.

Beyond these very specific issues related to bringing open government to life are equally pressing questions related to how best to evaluate the success of any open government effort. Metrics for assessing the impact of government efforts to operationalize the principles of open government are not obvious. Initial assessment of agency plans created pursuant to the OGD have tended to focus on compliance; moving to assessment of indicators of value such as information availability, use, and impact has proven to be considerably more complicated [32]. While many would agree that simple counts of datasets available, dataset downloads, discussion posts, and contest contributions are not completely informative, efforts to implement open government programs generally lack alternative conceptual frameworks and the performance benchmarks for evaluating their success [33]. This is a precarious position indeed in a context of declining resources and tough budget decisions. We have argued that a public value framework in which open government initiatives are linked to agency missions, internal and external stakeholders, and specific types of value may present a useful system for conceptualizing and assessing the success of such initiatives [34], but it is clear that no consensus has emerged on what counts as metrics for success in open government.

In the U.S., while the open government agenda has moved forward it has become increasingly clear that progress requires confronting important but unresolved challenges that might be addressed through research in the computing and information sciences, policy sciences and social sciences. A

summit held in February of 2011 called for the development of an open government research and development agenda to guide investments into answers to the questions most critical to the U.S. Government's efforts to implement the President's OGD. Through the course of 2011, several workshops were convened to discuss, articulate and define these research challenges. In this paper, we report on the outcomes of one of these workshops, describing a research agenda for open government produced in discussions among workshop participants from the government (at the federal, state, and local levels), academic, and civil sector communities at the Center for Technology in Government (CTG) at the University at Albany, SUNY in April 2011. The workshop, sponsored and conducted by a collaborative team from the Center for Technology in Government (CTG) at the University at Albany, which included James Hendler of the Tetherless World Constellation (TWC) at Rensselaer Polytechnic Institute, Beth Simone Noveck of the Institute for Information Law and Policy (IILP) at New York Law School, and Andrew Hoppin of the Civic Commons, was organized to outline a research agenda focused on opening up, federating, and using data to improve the lives of citizens.

The workshop identified numerous research questions for inclusion in an open government research agenda focusing principally on open data (since additional workshops were planned to address further themes within open government). Participants proposed questions from the perspectives of law, policy, technology, and data and sought to address both short and long term challenges. Numerous questions across a variety of disparate topic areas were raised, inviting the creation of a more general conceptual scheme to serve as a background interpretive context. Thus we propose that the questions raised are best understood in the context of a more general and evocative conceptual framework that situates government and the entities with which it interacts in relationships of mutual interdependence. We turn to the idea of an *ecosystem*, a metaphor often used by policy makers, scholars, and technology gurus to convey a sense of the interdependent social systems of actors, organizations, material infrastructures, and symbolic resources that must be created in technology-enabled, information-intensive social systems, among them, open government. We discuss concepts central to understanding what is meant by an ecosystem and some principles that characterize its functioning. We then apply this metaphor more directly to government, proposing that policymakers be guided by the goal of explicitly and purposefully constructing *open government ecosystems*, which involves engaging in what we call *strategic ecosystems thinking*. From there, we present the research agenda questions essential to the development of this new view of government's interaction with users and organizations.

2. Ecosystems and Open Government

The discourse of *open* is often found in the same contexts as discussions of the metaphorical *ecosystem*, an image drawn from the natural world and now used widely across intellectual domains by those who think about the interdependencies among data, technology, and innovation in a variety of complex organizational and technological contexts. For example, the ecological metaphor has been used to describe an approach to contemporary business strategy for organizations whose success depends highly on interdependencies with other organizations well outside the traditional value chains that contribute directly to product or service creation [35]. And it has also been used to describe the Internet as a whole, as in the Internet ecosystem, a social, technical, and material formation shaped through its interactions with technical and management organizations, but also with end users,

governments, business, civil society organizations, and technical experts [36,37]. At the same time, and in contrast to these large scale applications of the metaphor, others have also used the ecosystem metaphor to describe the communities of users and software developers who work on open source software projects, such as the Linux operating system, since these extended and voluntary cultures, bazaar-like in their organization, are characterized by cooperation, feedback, spontaneous order, and self-correction [38].

Quite recently, the metaphor has become ubiquitous in discourse related to open government. In a recent discussion of open data, former U.S. chief information officer Vivek Kundra referred to a critical set of decisions known as the "Bermuda Principles" which had the effect of making human genome data freely available and to which he attributes the creation of an "ecosystem" of scientists and companies that fostered advancements in personalized medicine and other beneficial economic activity [10] (p. 3). Economist Rufus Pollock [11] has championed the creation of an holistic "open data ecosystem," in which he suggests the basic model of data processing will be transformed from a "one way street" into a dynamic system characterized by data cycles. As a "one way street," government and other sources release data into the world, where it is processed by intermediaries such as application creators or analysts, and ultimately consumed by end users. The ecosystem Pollock seeks to cultivate is characterized by data cycles in which intermediaries release products back into the ecosystem in a "reusable way" as cleaned, corrected, and integrated datasets, which "are often more valuable than the original source" [11]. O'Reilly draws the analogy between open government and ecosystem explicitly when he argues that government itself should be viewed as a "platform" [39]. Technology platforms such as the personal computer, the World Wide Web, and the iPhone have enabled the development efforts of thousands of small and large companies, creating for each a corresponding "ecosystem" of innovation [39] (p. 13). Similarly, government may be treated as an infrastructure or platform that can become an ecosystem of economic and social innovation as well as accountability, especially when data of sufficient quality and usefulness is made available to citizens, consumers, and entrepreneurs.

However, while the metaphor is used frequently and resonates strongly with scholars and practitioners alike, there are few explanations of what an ecosystem is, how it behaves, and what that implies for the design and management of open government. In what follows below, we seek to fill this gap between the frequent discourse using the ecosystem metaphor and the absence of efforts to integrate an understanding of the dynamics of this concept into the way we think about open government research.

2.1. The Ecosystems Metaphor

Scholars in information intensive environments have used the ecosystems metaphor to focus on the multiple and varying interrelationships between providers, users, data, material infrastructure, and institutions. The metaphor clarifies and updates because this image replaces simple unidirectional models of causality and development with the idea of complex interactional systems in the process of adapting and growing. The metaphor can be used to describe existing conditions or those one might try to create; its users often aim to provoke new thinking about the conditions and requirements necessary to actively cultivate development of an ecosystem to achieve a set of specific and desirable goals.

Perhaps the earliest and certainly the most elaborated use of the ecosystem metaphor appears in Nardi and O'Day's case studies of information ecologies represented by hospitals, libraries, schools, and offices [40]. They suggested that "the ecology metaphor provides a distinctive, powerful set of organizing properties around which to have conversations" (p. 50). Agreeing, Parsons, *et al.* [41] have drawn on the ecological metaphor to explain what they believe is needed to create a global data ecosystem as a vision for interdisciplinary science. Similarly, we use this metaphor to inform our own thinking about open government. Prior to doing so, it is useful to review some of the properties characteristic of ecosystems.

An ecosystem is defined as "a system of people, practices, values, and technologies in a particular local environment" [40] (p. 49); such systems are socio-technical in that the "spotlight" is "on human activities that are served by technology" [40] (p. 49). Ecosystems are comprised of interacting, relatively tightly connected components with substantial interdependencies. Specific components will vary from ecosystem to ecosystem. For example, in Parsons' description of an interdisciplinary science ecosystem, the components consist of data collectors, stewards and users, sponsors and stakeholders; emergent and historical transparent technologies; and ever-growing datasets along with their associated artifacts [40].

The product of such interconnected and interacting components is continuous systemic change since "when one element is changed, effects can be felt throughout the whole system" [40] (p .51). The components of an ecosystem are diverse, an empirical issue due to the many actors, tools, and resources that can be connected through ICT, but also as a matter of necessity since the health of an ecosystem depends in part on the variety of ideas, people, and technologies available for adapting to change. The dynamic of ecosystems is one of flow and movement—people, ideas, activities, and tools in motion as the ecosystem evolves continuously in the form of components that "adjust and are adjusted in relation to each other, always attempting and never quite achieving a perfect fit. This is part of the dynamic balance achieved in healthy ecologies—a balance found in motion, not stillness" [40] (p. 53).

Ecological health is also enabled partially by the presence of what Nardi and O'Day call "keystone species", considered crucial to ecological functioning because their presence performs some vital function [40] (p. 53). In their information ecologies, they point to the presence of mediators, people who bridge distances across institutional boundaries and translate across disciplines for members. Parsons *et al.* have experienced the need for individuals playing an analogous role but, in their absence, suggest other ameliorating activities such as greater interpersonal communication between data providers and data managers [41]. Iansiti and Levien [35] point out that keystones "create value for their ecosystems in numerous ways, but the first requirement usually involves the creation of a platform, an asset in the form of services, tools, or technologies that offers solutions to others in the ecosystem."

Finally, Nardi and O'Day recognize the idea of locality in describing an ecology. They stress that technologies are located within networks of particular and localized relationships, a concept they call *habitation*, and are thus defined and owned by members who are connected by them and use them to connect to resources and others. The habitation of a technology gives rise to local specialized knowledge that is a property of members of a specific ecosystem, unavailable to outsiders. Local knowledge arises because particular members shape the way a technology works within the ecosystem and the functioning of the ecosystem itself. Thus, it is clear that human ecosystems possess a

self-organizing and potentially self-correcting character, born principally of members' knowledgeable insight into ecosystem functioning. It may be valuable to construct models of such systems and their dynamics in order to cultivate explicit and potentially consensual views of their components and functioning. It is also possible to envision such ecosystems scaling upward conceptually in that smaller, localized ecosystems might come to be viewed as encompassed by larger more generalized ecosystems that are interdependent at the institutional level.

2.2. Open Government Ecosystems

We are certainly not the first to propose the idea of an ecosystem as an organizing framework for discussions about open government. As mentioned earlier, the ecosystem idea was referenced by O'Reilly in one of the first documented contemporary discussions of open government [39]. More recently the metaphor was used by outgoing US chief technology officer Aneesh Chopra in differentiating between Data.gov as a "repository of data" versus an alternative view, which is "to foster a thriving ecosystem that creates opportunities in research and development" [20]. This has clearly been a guiding vision for some of the work done by U.S. agencies in response to the Open Government Directive [16] such as the Department of Health and Human Services in their creation of the "Community Health Data Initiative Ecosystem" [42]. It also appears to be guiding the World Bank's partnership with the government of Kenya, Moldova, and others, as they work to foster open innovation ecosystems that integrate user demand, open data, partnerships with application developers, and the creation of ongoing networks for continued development over time [43].

We may, however, be the first to make the point that, although ecosystems are naturally occurring phenomena and the metaphor may be applied to any existing socio-technical domain, they can also be seeded, modeled, developed, managed, that is, intentionally cultivated for the purpose of achieving a managerial and policy vision. Our perspective on the *open government ecosystem* envisions government organizations as central actors, taking the initiative within networked systems organized to achieve specific goals related to innovation and good government.

In so doing, government leaders will build on some ideas and concepts that are already relatively well accepted, which the ecosystem metaphor embraces, but goes considerably beyond. A prime example of this is the concept of networks, in which individuals or offices or institutions are conceived as nodes within or across organizational boundaries who regularly share information and ideas with each other facilitated by communication media. The network concept is well diffused in public administration and discussed in terms of government information networks that may address policy, collaboration, and governance (see, e.g., [44]). Open government implicates these ideas, as former U.S. Open Government architect Beth Simone Noveck made clear in her call for 21st century government institutions to cultivate networks of expertise in pursuit of new approaches to problem solving [45].

ICT enabled networks of interacting individuals and the organizations they represent might be thought of as the social infrastructure of an ecosystem, the socio-technical pipelines through which data, information, and ideas are shared and transmitted. Beyond the dependencies between specific nodes on such networks, the ecosystem metaphor adds the idea of system-wide interdependencies. It becomes easier to understand that what happens (or does not happen) in one part of a network may

have consequences for the rest of the ecosystem. If the ecosystem is scaled up to the level of institutions that are interconnected, we also begin to comprehend that individuals in connected networks are likely to be members of hierarchical organizations, with their own unique norms and traditional top-down authority practices, providing additional complexity to the encompassing ecosystem.

We do not posit a single open government ecosystem; instead, we envision multiple government ecosystems organized around the practices and products of particular government units as they interact with their particular citizen constituencies, private sector organizations, civil society organizations, and other relevant partners. Broad goals of innovation and good government may be translated into more specific terms related to the particular ecosystem context. Thinking about ecosystem management would focus on what public managers should do to actively facilitate the effective functioning and goal accomplishment of the ecosystems they are cultivating.

However, the ecosystem idea can also be scaled up to create a more generalized ecosystem view (see Figure 1) that represents government in relations of interdependence with innovators on the one hand and citizens on the other hand, nested within the larger environment of the economy, legal system, and policy expertise. From the standpoint of stimulating innovation, the open government ecosystem foregrounds interactions between government and innovators from technology sectors, private industry, and academic institutions to produce "practice innovations" in the form of new data standards, new designs for information systems, and new technology platforms, among others, that figure in the development of information or technology resources for the future.

Figure 1. Domains and environment comprising an open government ecosystem.
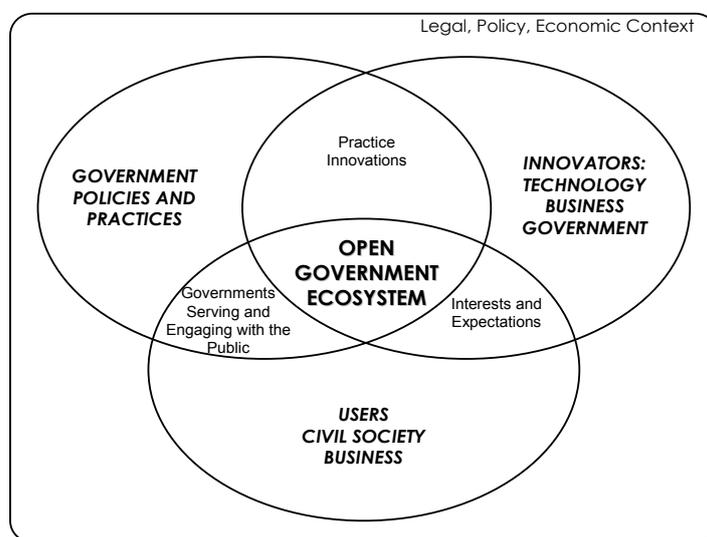
In pursuit of good government, the open government ecosystem foregrounds interactions by government engaging with users *qua* citizens, business, and civil sector organizations. Here we situate current and new forms of exchange between public managers and citizens, civil society organizations, and businesses that enable government to discover what kinds of data and/or information about government is wanted, what data or government information services count as transparency. In pursuit of innovation, the open government ecosystem also foregrounds users *qua* entrepreneurs who approach government data from the perspective of the business opportunities they represent. Indeed, the creation

of Brightscope, a new business created after fifty FOIA requests for government data about 401(k) plans, has illustrated that data in digitized form may well be seen, as Howard [46] has suggested, as "driv[ing] the innovation economy."

Of course, citizens and innovators regularly interact as innovators test markets for their ideas and citizens develop experience with and expectations for what technology can achieve that are subsequently brought to bear on their expectations for government. We do not expect government organizations to be technology innovators, but increasingly citizens' expectations, interests in, and appetite for government services and data—what they think is possible, normal, and desirable—will be engendered by what they experience in their interactions with non-governmental and private organizations.

All of these transactions are two-way in that government itself benefits from ideas and feedback about their own processes received through transactions with innovators and citizens. In the interactions formed by the intersection of government, innovators, and citizens, we situate the heart of the ecosystem, a milieu in which data, information, and technology are transformed into innovative products and citizen tools for interacting with government across a range of purposes.

The properties of an open government ecosystem (see Figure 1) are located in three primary interdependent domains of actors: government policies and practices; users, businesses, and civil society; and innovators. These domains interact in various ways as they influence the evolution of the ecosystem: governments' policies and practices interact with users, civil society, and businesses as governments serve and engage with the public. Users, civil society, and businesses interact with innovators to engender whole new sets of interests and expectations. Practice innovations result from the interactions of government policies and practices and innovators of all kinds.

The government components of the ecosystems we are describing are still very much hierarchical organizations, comprised of departments, bureaus, and offices interacting in multiple ways with each other; some of these offices are interacting with counterparts on state and local levels. These layers comprise multiple contexts with quasi-independent decision makers, customized technologies, legacy systems, strained budgets, amounting to complexity at every level. All this may work fairly well within given organizational units, but the more organizational units that are interconnected, the harder it becomes to predict and manage as issues related to coordinating technological and organizational infrastructure are presented. The complexities and limitations of this practice context make data sharing and the process of enabling data access difficult.

The policy and practice context consists of the institutional policies, standard procedures, behavioral norms and enabling or limiting laws that are brought to bear in the way any particular unit functions. But that context is also characterized by the skills of employees, their openness to experimentation and change, their opportunities for training and development, and the resources they can bring to their tasks. Open government ecosystems are inevitably structured by existing policy and practice contexts which must be managed and reconfigured over time to support new cultures of innovation and citizen interaction.

3. Strategic Ecosystem Thinking

Although the execution of public laws remains the primary responsibility of government, we propose that in the 21st century, public managers must also cultivate the development of their relevant

open government ecosystems. To do so, leaders must engage in a kind of *strategic ecosystem thinking*, which, to sketch some basic topics, focuses on (1) identifying the people and organizations that act as essential components of the ecosystem; (2) understanding the nature of the transactions that take place between those entities, perhaps aided by the creation of a visualization of the localized ecosystem in action; (3) recognizing what resources are needed by each entity in order to engage with each other in transactions of value; and (4) observing the indicators that signal the relative health of the ecosystem as a whole.

This view is thus heuristic in suggesting that the open government ecosystem be defined and constructed as a representation or model of the ecosystem space in which agencies, or departments within agencies, operate. Public managers need to appreciate the delicate interdependencies between entities in that space and the resources needed for valuable transactions. For example, an accessible platform and government data are frequently viewed as prerequisites to innovation in the development of information services by potential product developers. At the same time, important considerations related to security, privacy, and relevance need to be factored into the creation of any data sets configured for dissemination.

As Nardi and O'Day [40] illustrate through their case studies of information ecologies, it is possible to sketch the interactions between and among the members and components of a specific system, which enable routine, and exceptional, practices to become visible and allows analysts to examine the ways that components, interactions, and practices function together. This can be useful for the purpose of determining what new directions to take in developing a work process or creating a new technology service. As emphasized earlier, these ecologies are highly localized and idiosyncratic.

As outsiders, Nardi and O'Day [40] used ethnographic data collection methods for their case analyses, but there seems to be no reason why insiders might not be able to use their own experiences and knowledge. Thus, applying this idea to open government ecosystems would mean that government leaders and data managers engage in a similar conceptual exercise by identifying the components (both technological and organizational), the interactions (and actors who engage in them), and the practices that comprise their open government ecosystem. Who are the creators of data? Who are the guardians of data? Who are the short term, and perhaps, long term users of data? What do they use data for? When do they use it? What other stakeholders have an interest in these processes? The exercise might be improved if government actors engaged in it together, creating a joint representation of their ecosystem and its functioning.

It is not possible in this paper to present a model of a specific open government ecosystem or an empirically based generic ecosystem. Instead, we call attention to some characteristics that we think may be relevant across a variety of open government ecosystems. Whatever the empirical specifics might be, we believe that three basic processes are likely to figure in the dynamics of ecosystem functioning.

From the perspective of public managers, we suggest that strategic ecosystem thinking is framed by three primary interacting concerns: *intentionality*, *value creation*, and *sustainability*. Interactions between these three, in point of fact, the tensions between them, define the dynamic of the ecosystem: Government designs systems with the intent to create value, finds ways to keep them financially and politically viable, and the creation of value and sustainability feed back to influence what it is possible to design for the future. Understanding these interactions and using that understanding to inform future actions is challenging especially given that ecosystems are dynamic.

3.1. Intentionality

Ecosystems are driven in part by executives, informed by ideas in the culture about what government should do, by organizations created to achieve "good" government, and potentially other factors in the culture. In the US, the shape and character of the open government ecosystem may be viewed, at the highest level, as a matter of presidential directive to federal bureaucracies: Presidents Clinton, Bush, and Obama have each fashioned e-government in specific directions, producing change in what kinds of technology projects are attempted, which are viewed as valuable, and which are ultimately sustainable. Balancing the old with the new is part of the challenge of the ecosystem. With each passing administration, vestiges of past technological initiatives remain and influence the ecosystem space, but there is always opportunity for leadership to prescribe new policy and, in so doing, recalibrate ecosystem dynamics.

President Obama's Open Government Directive and the creation of administrative posts for open government, innovation, and technology may be viewed as goal driven, *intentional* actions that have aimed to reset the dynamics of the ecosystem at the policy level. Some of the proposals made by recently appointed Chief Innovation Officer Steven VanRoekel illustrate strategic ecosystem thinking in action that can be emulated. Vowing to "get out of the data business and into the platform business" [47], VanRoekel's strategy is to move the federal government away from the distribution of raw data files and the creation of applications and other forms of content, toward becoming platform providers that enable the creation of APIs to be used by citizens or developers to create their own content. Following this lead, the Census Bureau has recently announced that they will launch an API that will stream data to developers that can be used to build applications that enable homebuyers to identify neighborhoods with particular features, such as similarly aged children, or to aid prospective businesses in finding good locations for new restaurants, movie theaters, or bowling alleys [48].

Of course, API development is not without its drawbacks, as some have argued (see e.g., [49]). Our point is not to debate the wisdom of this approach, but rather to applaud both the thinking and the debate over it, since each course of action, purposefully and strategically undertaken, is related to how strategic ecosystem thinking must be done. In taking these actions, these government leaders may be characterized as "keystones" within the ecosystem in the sense described earlier, that is, as actors creating value in the form of a technology platform that they share with others, thus contributing to the overall health and vitality of the open government ecosystem.

The recent release of the "Open Government Platform" (OGPL), open source code that enables any government to create an open data site, reflects a similar ecosystem-style of thinking and action, on an international scale (which we do not attempt to depict). Here developers from Data.gov in the US and the National Informatics Centre in India have jointly created a web portal to distribute open source software applications for use by any government to build a variety of services [25]. Currently these include the ability to create web and mobile applications that use existing datasets, initiate challenges and competitions to seed other application development, merge geographic data with other data to create maps for policy decision making, and create community spaces and exchange systems for collecting and distributing feedback. They envision that developers will add new modules to the system, make modifications to the base code, share templates and views, and in these ways contribute to the further development of OGPL. The impact of this platform in terms of stimulating the

development of open government ecosystems in countries participating in the Open Government Partnership remains to be seen. However, again it is clear that this US-India partnership is attempting to seed ecosystem development with an approach intended to promote open government efforts around the world.

3.2. Value

The success of ecosystem thinking inevitably turns on issues of value. In the projects discussed earlier we see a vision for how to stimulate innovative technology projects downstream in the ecosystem. But so far, advocates have struggled to find metrics that can be used to assess the success of particular open government initiatives. It now seems clear that standard analytics such as numbers of clicks or downloads, while informative to some extent, do not tell us what we need to know about the ultimate worth and usefulness of the data or information that is being provided. Ultimately, the value of open data rests on whether or not it enables us to solve problems and meet important needs of individuals, communities, or society writ large. Thus the ability to gauge value, or potential value, lies at least partially in knowing something about the context of use and that context will influence who leverages open data and for what purpose. This means understanding potential uses and users, and their needs, desires, and exigencies.

Part of the difficulty in understanding users is that there is relatively little public awareness of or citizen demand for the activities that have been set in motion by the open government program. There is little awareness of the term "open government" among ordinary technology consumers. And the term itself is still in the process of being defined. The ways in which ecosystems are developed and maintained will inevitably shape the meanings associated with open government. Value resides in the implications of all of this for the lives of citizens. Do our lives improve? If so, in which ways?

This lack of awareness about open government is not to say that ordinary users do not appreciate the value of a good application; clearly they do and they may well purchase or use it if offered the ability to do so. But they seldom present demands for such applications to the government and have little awareness that government owns data that could be useful to them. Most of those who advocate for open data are technology leaders and civic activists who understand the potential in making public sector data available, but who are not in a position themselves to design specific products. It is neither realistic nor wise to expect high levels of innovation to emanate from government technology leaders.

Thus, government must find ways to cultivate synergies between data and the innovators that might be able to use data in possible application, service, or product development. We see evidence of efforts to create value from data in the wide variety of "civic hackathons," "data paloozas," and "data jams" that bring software developers together with data and government representatives to brainstorm the possibilities that may only be implicit in diverse data sets. Civic hackathons are events organized to find solutions to problems faced in particular geographic communities; they bring software developers or "hackers" together with local journalists, educators, members of the arts community, or others representing areas of need or focus [50]. Governments that support such events will quickly become aware of what has value. And of course, the idea of hackathon might be easily transported to other cultures, as the efforts with Moldova's innovation hackathon attest [43].

At the US federal level, Chief Technology Officer Todd Park is also chief advocate for the creation of national competitions to find the best new applications and services for government data. A recent competition has focused on health data, spotlighting the winners at the recent Health Datapalooza, which took place in June 2012 [51]. Education, particularly college affordability and making informed educational choices, is the focus of a recent "Data Jam" in Washington DC that brought educational technology experts and entrepreneurs together to brainstorm how using open education data could support student success [52].

In such efforts, one sees an active search for value by leaders who understand that data does not stand by itself and that ecosystem management must embrace innovators outside of government, and bring them into the open government ecosystem. Data must be incorporated into tools and services that address the needs, problems, and concerns of ordinary people. It has been revolutionary to recognize that government possesses vast storehouses of accumulated data that might be used in innovative problem solving. But that recognition is only the first step of the real job, which is to create the means for using the data resources that are already within our possession.

3.3. Sustainability

Situated in the midst of a substantial effort to identify and create value from the data government currently collects and stores, it may seem premature to begin a discussion of sustainability. And yet that discussion must start now. The experiments begun today to cultivate the development of open government ecosystems and manage them in their earliest instantiations must eventually be assessed for their effectiveness and decisions made about what to continue to do, what to tweak and fine tune, and where it might be necessary to start over. Part of defining effectiveness and success lies in determining and utilizing the metrics that bear most relevantly on the value that has produced and the efficiency of the processes that have produced them. Such metrics will constitute the information in feedback systems that are key to functional ecosystem operation because they enable decision makers to think and plan strategically.

Based on relevant feedback, strategic ecosystem thinking will need to consider which open government programs and services should be continued, revised, or abandoned in favor of alternatives. However, the stakes are even greater. It seems clear to us that the sustainability of open government ecosystems will ultimately be predicated upon significant changes in the form and functions of IT infrastructure within government agencies. If information itself is thought of as a basic service routinely provided by government agencies to their ecosystem constituencies, then IT architectures and infrastructures must be reconfigured in support of this new line of business.

One gets a glimpse of the potential magnitude of the changes that may be in store for government more generally when one considers the substantial changes now taking place as agencies administer the Freedom of Information Act (FOIA), following the current Administration's commitment to liberalizing FOIA policies [53]. Agencies are in the midst of restructuring and streamlining their procedures for responding to requests, creating new staff positions, broadening the training available to current and new staff, and creating new web sites and other technologies to support these activities. It is as if federal agencies now recognize that they are *in the business of* providing information in response to citizen requests and are organizing their work processes around this program.

We expect a similar realization about open government will soon take hold, stimulating very substantial reorganizations of agency missions, IT and other relevant material infrastructures, and career preparation of public managers not only in the federal government, but at all levels of government and around the world. The sustainability of open government will take root in the creation of a genuine Government 2.0 that reorganizes government for the information age.

The latest evolutionary phase of the open government ecosystem evolution has raised many critical questions about the short and long term intent, value, and sustainability of the ecosystem. Questions are being raised about how best to prepare for and guide the necessary strategic ecosystem thinking. A call for new knowledge about the ecosystem and the complex interactions that influence its potential for value creation and sustainability resulted in the launch of a series of national discussions in the U.S. organized to systematically identify these questions and to explore strategies for addressing them.

4. An Ecosystem as a Framework for an Open Government Research Agenda

To engage in strategic ecosystems thinking for the purpose of achieving a managerial and policy vision related to open government, public managers and other interested actors must understand the dynamic nature of the open government ecosystem. The academic community and other researchers and innovators can use the ecosystems metaphor and specifically, the properties of ecosystems, as a framework for identifying where interesting problems exist in the ecosystem and how specific new knowledge about the interdependencies and interaction can inform problem solutions and trigger innovation. The set of organizing properties provided above engender a frame of reference for identifying what is known about how ecosystems evolve in response to unique social, political and economic conditions and about how the multiple layers of context and their attendant complexities interact with the actors in an ecosystem. The properties also provide a reference point for what is not known and for guiding the development of a research agenda targeted at filling the current knowledge gap.

The next section introduces the open government research agenda developed by a multi-sector expert group convened to contribute to an ongoing national dialogue on the most critical questions facing open government researchers, policy makers and practitioners. First, the national effort is introduced to set the larger context for the research and development agenda discussion.

4.1. A Call for an Open Government Research and Development Agenda

In their 2010 report to the President and Congress entitled, *Designing a Digital Future: Federally Funded Research and Development in Networking and Information Technology*, the President's Council of Advisers on Science and Technology (PCAST)[54] noted that achieving our U.S. national priorities, including making open government a reality, rests on advances in networking and information technology (NIT). They highlighted the central role advances in NIT will play in ensuring better access to government records, better and more accessible government services, and the ability both to learn from and communicate with the American public more effectively.

Advances in NIT, the report states, "are essential to achieving the goals of open government. NIT touches everyone's lives, changing the way we live, work, learn, and communicate. Increasingly, widespread use of NIT has important public policy implications, ranging from e-voting and identity management to the nature and global spread of democracy" [54] (p. 5). The report calls for the

development of a research and development agenda focused on open government and resulting from the collective efforts of existing government research and development organizations that coordinate Federal networking and information technology research and development efforts. In response, then U.S. Chief Technology Officer, Aneesh Chopra convened a summit charged with setting the foundation for "a robust R&D agenda to ensure the benefits of open government are widely realized, with emphasis on economic growth and improving the lives of everyday Americans" [55].

The March 2011 Open Government Research & Development Summit [56] consisted of a series of panel sessions designed to lay the foundation for subsequent workshops that would more specifically outline the outstanding questions requiring the attention of formalized research efforts. The Summit served as a call-to-arms for stakeholders to come together around specific issues or topics that were almost inevitably interdisciplinary. Government officials, private sector partners, civil society organization leaders, and academic researchers alike discussed the need for the specification of a research agenda as well as the funding of formal research programs focused on open government. Two communities subsequently responded to this call; the first focused on a research and development agenda for open data and the second on an agenda for evaluating transparency. Each is summarized below as background before the agenda produced in the open data workshop is presented.

4.1.1. A Focus on Open Data

The first Open Government Research and Development Agenda setting workshop focused on open data. The workshop, organized by a multi-institution, multi-sector team comprised of the Center for Technology in Government at the University at Albany [57] the Tetherless World Constellation at Rensselaer Polytechnic Institute [58], the Institute for Law and Policy at New York Law School [59], and Civic Commons [60], brought together over 30 practitioners, scholars, and leaders of civil society organizations from across the United States to explore and outline an actionable and relevant multi-year agenda designed to draw attention to the most critical unanswered questions related to open data [61]. Taking an interactive and interdisciplinary approach, the workshop activities were a mix of plenary and small group sessions focused on identifying critical needs, mapping needs to potential solutions, identifying legal and policy barriers, exploring critical evaluative approaches, and laying out strategies for obtaining future research funding. All workshop sessions were documented and published in the report "An Open Government Research and Development Agenda Setting Workshop: A Summary Activity Report" which describes the workshop discussion and the information generated, lists the participants and the organizations they represent, and provides the agenda [62].

4.1.2. A Focus on Evaluating Transparency

The second workshop was organized by the Penn Program on Regulation at University of Pennsylvania Law School and held in May of 2011 in Washington, DC. This workshop, entitled "Assessing Open Government: Research Challenges in Evaluating Transparency," brought together over two dozen academics, government officials, and representatives from non-governmental organizations in order to launch a collaborative research agenda from across the fields of law, social science, and information science. The robust, interactive dialogue around a research agenda for open government concluded that for the purposes of research, the meaning of open government should

ultimately be defined for each policy or program by its purpose, logic, and audience. For a brief summary of this workshop see [63].

4.2. An Open Government Ecosystem Research Agenda

The idea of an ecosystem metaphor for understanding open government emerged from the discussions in the open data workshop as a compelling one that, once developed, could be used to frame the research agenda and further to support efforts to map the landscape of open data. Participants recognized the utility of the metaphor to both unpack and better connect the varied social and material components relevant to open government. They recognized the commonality of interests that exist among academics and practitioners, who are both clearly intent on trying to understand the impact of the actions they take and who recognize that their actions have political, civic, organizational and managerial implications. One value of an ecosystem metaphor is to bring these communities together to support efforts to model impacts of open government and to ensure that the agenda under development is sensitive to the dynamic and complex nature of the interdependencies that link intent, value, and sustainability in driving open government ecosystems. Participants also recognized the nature of continuous evolution in an ecosystem, as components "adjust and are adjusted in relation to each other." This evolutionary perspective brought to the fore the need for short, medium, and long term perspectives on the critical questions facing open government ecosystems. Issues related to data, as we discuss below, are particular sensitive to evolutionary considerations.

Discussions among workshop participants about challenges facing open government provided further support for the development and use of the ecosystems metaphor for open government. The ecosystem view, they agreed, would be very useful in ensuring that any research focused on very specific data challenges, such as those related to the design of an extensible metadata system enabling federated catalogues among federal agencies, states, and municipalities, would be complemented by research that considers related policy questions, such as those relevant to what is now technically feasible in data exchange. A further challenge was acknowledged as a lack of interest from elected officials about the use of open government data to improve government services. The general, and limited, view of the value of open government data is in informing citizens about the activities of government and encouraging an open dialogue between governments and other societal actors. The broader value of open government data in informing governments about service quality and, subsequently, informing service improvement strategies, a priority for many elected officials, is in most cases overlooked.

An Open Government Research Agenda, they also agreed, must be informed by a full understanding of what is already known: what research has been done, who has done it and how might we map the landscape so that we "know where to start"? Attention to the logics of open government are foundational to such a research agenda, testing such basic assumptions as (1) when government data is released, it will be valuable and good things will happen, and (2) that transparency, efficiency, and accountability, often taken to be synonymous, should be treated as different concepts. They argued for an agenda that supports the modeling of open government impacts on institutional design, on one hand, and that explores the gap between data available and data used, on the other. The discussions

produced a multi-faceted agenda focusing on questions about users and uses, data, value, and innovation, which, once answered, would improve the lives of citizens.

In each discussion, the experts used the lenses of technology, management, law, and policy, and considered questions from a short, mid, and long term view. In some cases the questions focused on conceptual gaps, in others empirical or practice gaps, and yet others, methodological. In all cases, answers to the questions were recognized as critical to our collective understanding of the process of opening government and the ecosystem within which these efforts are taking place. Our ability to create the new knowledge sought by PCAST, and others committed to improving the lives of citizens through networking and information technology will result, in our view, in no small part, from attention to the open government research and development agenda laid out below.

4.3. Users Interests, Expectations and Capabilities

At the heart of the open government ecosystem is the assumption that government possesses information that users want and will use. This is an assumption that can be easily defended. The tricky questions focus on what kinds of information and/or data individual users want and under what circumstances they will be best equipped to make use of it. Initially, one thinks of individuals using government information about particular services or functions provided by agencies (such as recreation, taxation, or financial entitlements), or as informed voters to make sense of government activities and policy, or as government watchdogs to assess performance or accountability. But users are also prospective entrepreneurs who are looking for business opportunities and who might gain economically through the use of information resources that their tax dollars have helped to create.

The lack of a marketplace for government and citizens to effectively engage with each other was noted by the workshop participants as an issue related to incentivizing governments to release data and for individuals and others to use the data. They recognized that creating that connection among suppliers and consumers of data might lower the "cost of entry" for both. New research is needed here to understand the nature of the information relationships between government data providers and data consumers and how this relationship is evolving over time, having a greater or lesser influence on data providers and data users. Regardless of the particular constituency, strategic ecosystem thinking mandates that government engage with users to assess their expectations for data and information sharing, together with their capabilities for information consumption and creation, and explore the circumstances in which data is best used. Participants at the expert workshop were keenly aware of these new imperatives and articulated the related research questions in terms of the issues outlined below.

4.3.1. What Do Users Want?

Governments have always collected, analyzed, and used information in their legislatively mandated duties; such activities are essential to delivering any service to citizens. But government has rarely been in a position to have to think about what users, in a wide variety of roles, would find personally, politically, professionally, economically, or medically valuable to know from among the data that government already possesses or could move to acquire. The workshop participants acknowledged the growing realization that government must engage with citizens to discover answers to such questions.

Some of the discussion at the workshop was related to interests in transparency. The international Open Government Partnership, for example, is predicated on the principle that publicly available government information enables citizens to participate effectively in decision-making, assess the efficiency and effectiveness of government performance, and hold governments accountable for their performance. Key to controlling corruption, for example, government budget information enables citizens and civil society organizations to track disbursements and expenditures. Thus, governments must work with civic groups and other civil society organizations to identify what information about government activities and operations needs to be made public, and how to institutionalize the procedures for doing so.

But from the standpoint of stimulating innovative entrepreneurial activity, recognized as something users want, the questions center around which data sets collected by government are economically valuable. The illustrative example here has been weather data and the billions of dollars of economic activity that accrue from businesses that use meteorological data collected by government funded programs. Government needs to work with business leaders and entrepreneurs, as users of interest, to identify data that can be similarly synergistic and that may be currently possessed or easily obtained.

It was also clear to many workshop attendees that government currently possesses data on a variety of topics that might be used by individual consumers to make decisions about topics as mundane but frequently both complex and consequential as cell phone plans, retirement plan options, medical care, educational best-buys, and other lifestyle or market place decisions. The new White House sponsored Smart Disclosure program is actively considering such questions [64]. The challenge here is a kind of product development exercise. What data resources currently exist, or that may be easily mobilized or jawboned through industry collaboration, would, if appropriately packaged, enable consumers to make wise and thrifty consumer choices?

4.3.2. Uses, Usability and Context

As new capabilities to answer questions about what data to use are developed and answers begin to emerge, we move somewhat fluidly to questions about how users *qua* consumers use such information and the environments in which it is used. Government has been in the business of disseminating information electronically for quite some time. But there are enormous differences in the skills and capacity required to design static web pages and those needed to create applications that enable and empower decision-making.

Workshop participants generated questions about how users search, where users go to find government data, and how government can collect data about its own website use that can be used to improve services and help to foster engagement with the public. Such questions are common in the fields of human-computer interaction and information science and focus squarely on generic issues of website, or application design, usability, and information seeking. Clearly, we need answers to questions that more specifically focus on how users interact with and use government information in the context of government sponsored or enabled tools or applications. How does government acquire the answers to such questions? Here workshop participants pointed ecosystem managers to the researchers, both academic and commercial, who are specialists in this area and suggested that, together, they cultivate a sub-specialty devoted to the government information context.

Questions about what data and information users want and the environments in which it is best provided and used can only be answered when governments find ways to interact with and engage members of their target audiences in the process of developing answers. Clearly, open government implies two-way, dialogical processes in which discussions between government employees and members of target audiences, however structured, take place. At the 2012 International Conference for Digital Government Research, we were pleased to hear that representatives of the US Environmental Protection Agency (EPA), Consumer Financial Protection Bureau (CFPB), and the General Services Administration (GSA) began recently to engage in such ventures. Particularly notable for our purpose were EPA's efforts to ask users what kinds of environmental information applications they would like to see developed. In another "public dialogue" EPA used IdeaScale to gather ideas about how to improve Data.gov. The CFPB asked members of the public for feedback about forms they would soon be deploying as part of the process of housing related disclosures. The GSA has solicited feedback from government managers, mobile experts, and the general public about what kinds of mobile government applications would be seen as desirable. And they initiated their own public dialogue about how to improve federal websites.

These examples are illustrative for the topics they have addressed, of course, but also for the particular set of methods and electronic resources used to structure each dialogue [65,66]. Clearly, there is much to learn about how to design, implement, and gather information from the public dialogues and other audience-oriented research that is deemed useful in open government projects. From an ecosystem perspective, one consideration raises above all these and it is a strategic one. Government can create the applications that render its data useful, or it can be in the business of seeding such creations within developer communities. Either way, government organizations, according to workshop participants, need new tools and techniques to get further into the business of understanding their audiences.

4.4. Data

A second assumption at the heart of the open government movement is that the data itself is readily available and once made accessible, is fit for any use a citizen, entrepreneur, activist or government might make of it. Creating data that adheres to standards, has the appropriate metadata, is accessible outside of government, is fit for use by a wide range of potential users, and generates value through its reuse is not cheap. Each of these characteristics requires an investment of time, energy and effort on the part of many individuals along the workflow of defining data of interest, prioritizing data collection, conducting data collection, publishing the data, and then using it. Generally, workshop participants agreed that we have limited understanding of the economic implications of adopting open data as a new line of business for government and, as a consequence, it is not easy to publish or find and use "trusted" data. What does it cost to create and make available and then use trusted government data and who will pay? How can new knowledge about costs and value be used to incentivize governments and other key actors to enter the "marketplace"? Will a more robust data market create connections between suppliers and consumers and result in more informed investments—more targeted products—and lower the cost of entry for all? What does that market look like?

There is also the assumption that other critical components of an open government ecosystem such as data governance models and data sharing capability are well-developed and in place. Unfortunately, this is not so in either case. Seemingly simple questions about data quality, formats, and standards plague efforts to share and integrate data. Making data accessible and fit for re-use are not insignificant challenges and raises a wide range of complex research questions, including issues about data sharing itself, for example, how and when sharing is appropriate. Questions ranged from how government data can be presented to facilitate a more open dialogue, to what new capabilities do government agencies need to have to increase openness in the interest of such a dialogue. Incentivizing communities across the sectors to care about and use government data may in part depend on having access to what is generally called "high-value" datasets. Again, calling attention to a set of unanswered questions about the governance issues around data release: who should decide what data is "high value" and how do they choose? How does a user know when data is fit for re-use, how does a user know what has been done to that data, and what restrictions govern its use? Workshop participants saw the ecosystem view as particularly useful here in that it provides a way to depoliticize the subject and support feedback between research and practice, arguing for and enabling an experimental "sandbox" that would support interdisciplinary teams with expertise in information and computer science, public policy and organizational theory, diffusion of innovation, and usability.

Workshop participants recognized the increasing need for new data governance models to inform questions such as who should be the responsible party or parties in the creation of technical architecture, infrastructure, and policies and standards for open government data. New research on standards, in particular metadata standards, was called for. They urged the support of research that focuses on standards development and adoption; noting a fundamental disconnect between the recognition that standards are key to scale and use of data, and that resistance to standards use is prevalent across the sectors.

As noted above, data and its associated storage and transmission technologies, in particular, demands short term, mid-range, and long view perspectives. One relatively short term question identified in the workshop asked "What basic standards are needed to ensure that machine-readable data from different federal departments and agencies is interoperable" and focuses on today's more or less immediate need for standards to support interoperability among existing datasets. A related mid-range question, "What technologies are required to associate similar data in disparate datasets," draws attention to questions about how technologies might be developed in the mid-term to automatically generate the desired associations among disparate data sets. And a further related question for the long view, "What does it look like to no longer be *publishing* data sets but to have data available *by default*?" envisions the implications of one possible future, but also draws attention to the enormous challenges involved in imagining what novel technologies must be developed for any such futures to be realized. Taken together these questions highlight the challenges of producing a coherent agenda that attends to issues of both immediate import to open government efforts and to the long range and far reaching imaginative requirements for the future.

4.5. Open Government and Public Value

"What is the value of open government?" Workshop participants identified questions about the value of open government as among the highest priority ones in the research and development agenda. They believe such knowledge would play a critical role in fueling investments in open government, ideally supporting innovations in practice and informing strategic problem solving and capacity building. They also recognized the limitations in current approaches. Future approaches, they suggest, might emerge from research about the utility of hybrid or combined methods based on both econometrics and a public value framework. Who and how questions dominated the discussions about the value of open government.

Who benefits? This was the dominant question of the workshop. Is it citizens? If so, in what ways are their lives improved? Is the benefit shared? If so, in what way and how do we use that information to inform future investments? Citizens can benefit in many ways from open data; this was easily agreed upon by the participants. The best ways to understand that benefit, essentially describing it and then also being able to model the sets of actions and investments to create that benefit, was not so readily agreed to.

To measure the success of open government initiatives, innovators and evaluators must know what impact was intended; they must know who they were seeking to provide value to. What is the outcome sought or expected from any one open government initiative and how is it connected to other activities within the ecosystem? What is the intent? What change in the ecosystem is sought? More accountable public officials, improved policy outcomes, more engaged citizenry, reductions in political and economic inequity, better services; the question of what is expected in terms of impact must be identified and taken into account in developing measurement models. How measurement then occurs, what tools and techniques are relevant, for example, to measuring improvements in the lives of citizens and other actors in the open government ecosystem can then be taken on as a research questions. Do current tools and techniques address these measurement challenges? Workshop participants considered the utility of current tools and techniques for measuring value in the open government ecosystem to be a major unanswered question. What types of value should be measured and what instruments can provide valid measures for each value type for each stakeholder? What tools and techniques are relevant for measuring impact on the average citizen and the economy writ large? How can the link between open data and public accountability be empirically established? Can tools and techniques, established in one context, designed to measure the impact of one very specific purpose or intent, for one specific stakeholder community, be made relevant across multiple contexts?.

What can we define as success in open government? Seeking to create such a definition, and then using that definition to guide planning, prioritizing and evaluation of open government were seen by the workshop participants as the biggest challenges faced across open government contexts. They agreed that developing consensus around this definition and testing its utility within the many variations of open government ecosystems will begin to help us to formulate the necessary guidelines, metrics and standards, as well as case studies, exemplars, and models.

Sustainability was raised as an open question in the value and measurement discussions at the workshop. Sustainability of an open government ecosystem, participants agreed, rests on our ability to generate new understanding of the value being generated from the innovations now in place and

planned and to express that public value in ways that matter to the relevant stakeholders at all levels of government and across the sectors.

5. Conclusions

While open government is a term that has been used for centuries, the contemporary meaning of open government is still very much under construction. In proposing to view the concept of open government from the perspective of the ecosystems metaphor, our goal has been to call attention to some of the fundamental ways in which government must change in order to evolve from outdated industrial bureaucratic forms to information age networked and interdependent systems. The recognition that government is now in the business of providing information and data to users of all kinds is essential to guiding further efforts to transform the processes and forms of government work. However, what is new and intrinsic to the ecosystems metaphor is the recognition that users, technology innovators, and government leaders, data managers, and policy makers are mutually interdependent in developing this business efficiently, effectively, and in ways calculated to bring value to all participants. While the interdependencies are mutual, we have argued that government leaders and policy makers must take the initiative to cultivate and develop open government ecosystems. Government leaders are in the best position to understand how the contributions of individuals and organizations that are essential ecosystem components are linked, to assess ecosystem operations and overall vitality, and to function as "keystones" in providing valuable resources that ecosystem partners can share.

The following lines of inquiry emerged as essential dimensions of an open government research agenda that will drive significant change in the future. The workshop discussion underscored the importance of

- Users: cultivating new engagements between government and users of all types (citizens, businesses, civil society), to assess users' expectations and requirements for information and data on the one hand, and users' abilities to consume and create information and data on the other hand;
- Data: developing the social and material infrastructures for creating, managing, and sharing data in the short term, along with the governance structures through which innovative architectures, infrastructures, and standards will be negotiated for the future;
- Valued outcomes: theorizing the outcomes of open government in terms of who benefits and how value is generated; measuring and documenting outcomes in the short term and as a basis for ecosystem sustainability.

While each of the particular research questions or lines of inquiry may not be individually surprising, taken together, the research agenda presents a research enterprise of considerable magnitude and complexity. This is particularly the case when we recognize that government organizations (e.g., health, defense, space, environment, *etc.*) will participate in substantially different ecosystems, each comprised of different sectors of users, with potentially idiosyncratic dynamics. Beyond this variety, the ecosystems idea also underscores the ongoing evolutionary character of change within the system and in the nature of relationships between components. As noted earlier,

ecosystem health will be found in appropriate balances among the components, but these are balances of motion, not stillness.

The idea of open government ecosystems suggests that public managers must change the way they think about what they are doing. This, as we have argued, requires recognition of the interdependencies and interactional qualities of the dynamic systems they are managing. Strategic ecosystem thinking presupposes a keen understanding of ecosystem components and the linkages between them, and an evolving appreciation for how the interactions among those components are related to the services, programs, and other outcomes of value that are produced, either within a government organization or by organizations external to government but internal to the ecosystem. We have suggested creating a graphical representation of ecosystem space, and doing so as a collective enterprise so that this representation is shared, thereby supporting efforts to guide or focus research or process improvements targeted at specific components or interconnections among components within the ecosystem.

Further, strategic ecosystem thinking must be complemented by the development of communication and management skills that enable public managers to cultivate continued evolution of the dynamic systems they are creating. Implicit in the ecosystem concept is the ongoing need to keep components coordinated, which requires high levels of understanding between them, or failing that, significant motivation to cultivate understanding in pursuit of coordinated action. Public managers need to be able to connect with diverse user and innovator constituencies to bring these new actors, and the perspectives they represent, inside the ecosystem. Public managers will require substantial training in the skills of generating participation and incentivizing consultation to be successful in doing this.

How can technology innovation and the potential of open data catalyze us to rethink the way government works? The world is changing around us all; workshop participants, drawing on the ecosystem metaphor, called for new models of practice and research that, in recognition of the dynamic nature of the ecosystem and the interdependencies inherent within, capitalize on change and evolution as inevitable consequences of open government initiatives. From an ecosystem perspective, new open government data products or services released to relevant user constituencies may be viewed as transformational "disturbances" since such output is still quite novel, with consequences that may be hard to predict. Ecosystems managers must devote substantial effort to understanding the nature of the causal linkages between ecosystem components, new data products and services, stakeholders in the environment, and the transformations that may be stimulated within and outside their ecosystems. Elsewhere, we have proposed the modeling of system dynamics as a conceptual strategy that enables public managers to map information relationships between system components, and to anticipate the feedback loops that may create positive and/or negative repercussions from particular open government initiatives [67].

Can open government in the form of open data improve the lives of citizens? Many believe it can. Others remain skeptical. Regardless, there is agreement that new knowledge about measurement and evaluation of open government and about related costs and value are necessary and may rely on more collaborative methods for both research and practice. We see significant potential in a strategy that builds on the concept of an open government ecosystem as a heuristic device for decision making and planning and look forward to continuing to participate in both the research on and practice of open

government data with an eye toward using new knowledge about open government ecosystems, and in particular, open data, to improve the lives of citizens.

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