The Trend Toward "Open" IT in the Public Sector: Motives, Choices, and Outcomes

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Abstract

Over the past decade, governments at all levels have begun to explore "open" information technologies: open-source software, open standards requirements, and open data initiatives. However, the strategic decisions associated with "open" are not as straightforward for the public sector as they are for the private sector, which can effectively evaluate available solutions based on their associated costs and benefits. By contrast, government IT decisions involve additional motivations and tradeoffs, and must take into account less easily quantified benefits such as transparency and improvements to public welfare. In this paper, we examine the motivations and outcomes of governments' moves toward "open," comparing initiatives launched in Brazil, France, Germany, Massachusetts, and Vancouver. We interviewed stakeholders and decision makers involved with these case studies, and we analyzed their very different approaches to making IT decisions. Our research shows that the conversation has moved beyond "open versus closed" software – and that, in fact, the term "open" in the context of IT decision-making is fraught with ambiguity and multiple interpretations. Based on these findings, we developed a framework for bringing transparency to the decision-making process itself by articulating the motives, choices, and tradeoffs associated with IT purchasing decisions. Finally, we conclude that the most effective moves toward "open" government are not related to traditional software-purchasing decisions; instead, openness in government has become more about transparency and availability of information than about which systems enable that transparency.

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Introduction

In 2006, France's Assemblée Nationale (the Parliament) unanimously decided to switch the desktop computers of all 577 members of Parliament and their assistants to a completely open source software stack consisting of the Ubuntu Linux operating system, OpenOffice software suite, Mozilla Firefox browser, and Thunderbird email client.[1] An important impetus for this very high profile open source software adoption was a study, commissioned by the Prime Minister's office, examining industry competitiveness in France in a range of high-profile sectors, including software. Specifically, the report recommended the adoption of open source technologies as a means to promote open standards, increase competition, reduce dependency on large U.S. firms, improve the local IT sector, and overcome the digital divide.[2] The report suggested that Parliament could, in fact, play an activist role, promoting the adoption of open source technologies in France. The implementation faced challenges, particularly in smartphone synchronization, but the government's adoption of open source has been reported as ultimately successful along all of these dimensions.[3]

The French Parliament's decision to adopt open source was neither unique nor new. Over the past decade, numerous governments at all levels have explored the move toward greater "openness" – not just in terms of software solutions, but also in the form of open standards and access to data. As a result of mandates issued to leverage IT resources for the purposes of achieving a more open government,[4] "openness" – which began as a discussion of open source infrastructure and applications – has evolved. IT decision makers will need to consider a diverse set of factors for introducing "openness" into their ecosystems – looking at the easily quantifiable elements (costs, technical effectiveness, and implementation issues) as well as broader public goals (for example, the benefits citizens gain if they have more and better access to information).

This distinction highlights a core difference between purchasing decisions made in the private sector versus those made in the public sector. Businesses have generally learned to effectively evaluate the cost-benefit trade-offs between open source, proprietary and home-grown IT solutions, and for the most part, these decisions are made on a straightforward economic basis.

There is relatively little disagreement over the sources of cost and value to be assessed. The evaluation of technology is often driven by pragmatism, focused on the capabilities and the strategic value, and is agnostic to the licensing.[5] By contrast, in the public sector, these decisions are often influenced by expectations for greater transparency and tangible effects on public welfare through procurement decisions.

Our research shows that some of the most effective moves toward open government are not related to software purchasing decisions. And decisions for open source software, such as those in the French Parliament, had primary objectives that were unrelated to openness or transparency per se. While the literature and previous public debate suggest that open source software enables open government, this may not necessarily be the case.[6]

In order to move beyond the rhetoric around openness in the public sector, we analyzed five in-depth case studies – including conducting interviews with important stakeholders and decision makers – in the federal government of Brazil, the French Parliament, the German Parliament, the Commonwealth of Massachusetts, and the city of Vancouver. This cross-sectional view allowed us to compare and contrast decision types, the size and scope of decisions, the level of government where the decision was made, recent and established moves, and decisions that were "bottom up" from those that were "top down." We examined the specific context in which these decisions were made and collected first-hand perspectives on the motives, choices, and eventual outcomes. In turn, those observations informed our development of a framework that, we believe, enables better IT purchasing decisions and prevents confusion (and conflation) of the costs and benefits of open source, open standards, and open data.

Our results also show that the conversation has largely shifted away from "open vs. closed" software to an explicit recognition that hybrid solutions are the norm; that interoperability and standards are the linchpin to a successful IT ecosystem; and that the move toward open is more about the transparency of information and processes than it is about the systems that enable that transparency. We also find, not surprisingly, that the term "open" in the context of IT decision making is fraught with ambiguity and multiple interpretations, and that it is difficult to measure the openness of an IT ecosystem.[7, 8]

While part of our purpose is to provide evidence of the move toward open in the public sector in order to further this discussion, our more immediate purpose is to provide stakeholders a robust framework that brings transparency to the IT decision-making process itself, carefully weighing both open and proprietary solutions for software, standards, and data in increasingly hybrid public sector IT environments. Success requires stakeholders to articulate explicit motives, make pragmatic choices, and attempt to define measurable outcomes. Only with compelling rationale, creative resources, and high levels of commitment will their initiatives be successful.

The Decision Making Framework

The framework we developed categorizes the five factors that most influence IT decision making in the public sector: cost, technology, interoperability, public welfare, and beliefs. [See the exhibit "Decision Making Framework and Critical Questions"] The first three are traditional decision-making factors and have always prompted decision makers to consider necessary tradeoffs, based on competing priorities—for instance, the tradeoff between the technology itself (quality, innovation) and the cost of it. With open source on the scene, the traditional factors compete even more vigorously with the less-tangible factors, public welfare and beliefs, and the attendant tradeoffs here—for instance, the tradeoff between the efficiency gained from transparency and the benefits of that openness to public welfare. Let's take a closer look at each.

Cost. Despite the lengthy list of public sector organizations which have adopted open source policies,[9] there is no definite answer to the question of whether these policies translate into cost savings, particularly from open source software adoption. Depending on the circumstances, significant cost savings may be realized, and many high profile implementations of open source in the public sector report of such cost savings. In other situations, it appears that the total cost of ownership ("TCO") for open source solutions is similar to or higher than that of proprietary solutions.[10] This comparison tends to be more favorable to open source if a Greenfield deployment is considered, and more favorable to proprietary software, due to switching cost, if an existing proprietary system needs to be replaced.

Particularly in the recent economic climate and with many public sector organizations facing fiscal crises, there has been a surge of interest in open source solutions as a cost-saving measure. The argument that a bad economy is good for open source is not uncommon.[11] It would not be accurate, however, to make general statements such as "the public sector is more resource constrained" or "the public sector is less able to quantify the total cost of ownership" relative to the private sector. Along these dimensions, there are few differences between the public and private sectors necessarily favoring open source. What is true is that the public sector has a broader mandate than private sector firms in terms of the reliability, security, and accuracy of the systems they use to manage their work and interact with a diverse base of constituents. As one of the government leaders we interviewed put it, "…the government cannot pick and choose which citizens to serve…they are not like private firms with target markets." Therefore, cost is not always the primary factor in public sector IT decisions; it is often a common motive, but it is not always the primary dimension to evaluate outcomes relative to these mandates.

Technology is a generic label for the considerations of the IT staff. It includes functionality, features, reliability, security, flexibility, and versatility. Also under this umbrella is the availability of support. This last item was traditionally considered the critical factor in decisions against open source, but the maturation and commercialization of open source is closing the gap. The tradeoff for this is frequently an increase in cost.[12]

We won't get into the debate over the technical merits of open source versus proprietary solutions; these comparisons are readily available through a variety of public sources, particularly for established software such as Linux. Some trends are clear, however: open-source technologies are more prevalent in Internet-related applications; proprietary still dominates business applications and desktops. These neat distinctions are increasingly blurred as technological advances allow users to run mixed environments smoothly for many types of systems.[13] One estimate is that the mix of software deployed in firms today is roughly 50% proprietary, 25% open source software, and 25% homegrown.[14] Open source also enters the IT ecosystem embedded in other software.[15] The point is simply that evaluating the IT ecosystem in terms of open or proprietary is difficult, as the mix continues to change, technology priorities shift, and organizations gain experience with open source software that allows them to evaluate it

ex-post.[16] Explicit government preferences for open source, which were perhaps reasonable in order to overcome adoption inertia when IT environments were all-proprietary, seem less necessary when mixed environments dominate.[17]

Interoperability is of increasing importance as the IT ecosystem becomes more complex and interconnected. Proprietary vendors may in some cases have higher incentives than open source projects to restrict interoperability of other software with their own solutions. Still, the assumption that "open" means "accessible" and "interoperable" is not, however, necessarily accurate or fulfilled. For example both license and technological incompatibilities between similar projects can prevent code sharing. The confusion of terms, and the difficulty in evaluating the relative performance of solutions on this dimension, causes it to be one of the most challenging factors to examine within a decision-making framework.

For public and private sector IT decision makers, interoperability matters and the basic considerations pertaining to it are the same: standards enable platforms on which others may develop applications, even where there is no open source being used—for instance, Apple's iPhone, or Microsoft's Xbox. However, the issue is even more important in the public sector, because organizations are often large and highly matrixed—connected organizationally and sometimes technologically with partners such as nonprofit organizations, educational institutions, and private companies.[18] Understanding that standards are serving as a means to an end shifts the debate. Whether or not the standard is open or closed is not the key question. Decision makers are asking whether and to what extent the standard enables the exchange of information and data in ways that increase openness.

Public Welfare and Beliefs are the least quantifiable aspects of the framework. There are many public welfare considerations that are part of the debate over whether to adopt open-source solutions, including job creation; encouragement of competition; entrepreneurial spillover; an increase in intellectual property, knowledge, and expertise on the national level; tax revenues; "digital inclusion"; and the value associated with a nation's reputation for leadership. In principle, these same benefits are possible using proprietary and hybrid systems. However, in situations where a software category is dominated by proprietary vendors, open source solutions

may provide the highest odds of attaining the above goals, and so they are frequently cited reasons for considering open source alternatives.[19] A full cost-benefit analysis would include the economic benefits and costs associated with these considerations for each potential solution. However, doing so in a quantifiable way is difficult in many cases, as the economic spillovers from such choices occur over time horizons that are longer than the decision-making time frame. Thus the literature reports scant evidence that this is done on a regular basis, and we have seen almost no evidence that it is done incremental to the various solutions being considered. We have distinguished public welfare from beliefs in our framework, defining beliefs as those factors (policies, ideas, goals, and perspectives) influencing IT decisions that lack an economic or technical basis. This is not to say that this factor should be discounted. Beliefs are not easily changed, even by purely economic or technical arguments; and they can be powerful motives within the decision-making framework.

While there is little doubt that the advent of open source solutions has, overall, increased the consideration set for IT purchasing and thus increased competition, quantifying policy objectives and measuring gains to public welfare as a direct result of specific IT decisions in favor of open source software is challenging. In particular, determining the net gain from the positive effects of reduced license fees and (possibly) increased local employment and tax revenues and the negative effects of increased service costs (concomitant to local job creation) and reduced productivity while gaining competence with new technology is not an easy task. It is thus not surprising that there is sparse quantitative evidence in the literature regarding job-related benefits of open source software adoption. The problem is further obfuscated by the need to measure open source-related job creation in comparison to the number of net jobs that would occur as a result of adopting proprietary and home-grown solutions. And finally, welfare gains from adopting open source software are time dependent insofar as, for example, “increasing competition” to proprietary vendors was more important around the year 2000 than it is ten years later, with many open source solutions firmly established in the marketplace.

The implication is that public sector policy and decision makers seeking to increase openness in government can benefit from a framework that makes explicit the factors influencing their decisions, particularly the competing priorities and tradeoffs between economic and non-

economic factors. The framework we have developed not only encourages a thoughtful decision process but also challenges decision makers to define and measure their desired outcomes along traditional cost/technology dimensions and to do the same with less tangible public welfare objectives, whether they are evaluating open source, proprietary, or hybrid solutions that are commercialized, freely available, or homegrown.

IT Decision Making in the Public Sector: Case Studies

The public sector is large and influential: current IT spending is estimated to be more than $400 billion per year.[20] We wanted to take a closer look at the additional motivations and tradeoffs involved in public sector acquisition of IT, particularly as it relates to the trend toward "openness." In the following pages, we describe five real-world case studies, examining the motives, choices, and outcomes that several public sector organizations experienced in their decisions to adopt open software, standards, and data. Our purpose is not to benchmark these cases against one another or against an absolute measure of "openness." Nor are we advocating that there is an optimal level of openness for IT ecosystems. As we noted earlier, the debate has moved beyond open vs. closed, and we believe hybrid environments and competing considerations are the new norm.[21]

We've separated our case studies by whether they were primarily about open source software acquisition, the adoption of open standards, mandates for open data, or the promotion of "openness" as a public good. Doing so makes clear that the benefits to society of being "open" accrue disproportionately in favor of open data and open standards, and are frequently indifferent to whether the software is open or proprietary. Not surprisingly, we also see that promoting "openness" is successful only when specific decisions and behaviors are articulated in support of the broader objective.

Software Purchasing Decisions

Often, the discussion of "open" in the context of public sector IT decisions refers specifically to software purchasing decisions. While the debate between "open vs. closed" is sometimes cast in moral terms - "open is good, closed is evil" - in practice, the procurement process is often more

pragmatic. When it is viable to consider open source on equal footing to proprietary software, IT decision makers in the public sector do so.[22] For established solutions (Linux, Open Office, Firefox) the business case is generally built on the same cost/technology considerations as proprietary solutions, and can be assessed with the traditional TCO framework.[23] However, as our case studies demonstrate, a TCO framework does not make explicit the public welfare and belief aspects of IT purchasing decisions in the public sector.

As mentioned earlier, in France's Assemblée Nationale, the decision to adopt open source desktops was made in 2006 and implemented in June 2007. The decision was largely unanimous, with consensus across the major parties. The synchronization between smart phones and the open source desktops, however, cost more than anticipated, and according to one interviewee, there is still "effectively no local synchronization," due to technical problems. Still, feedback published by *April* (a French free and open source software advocacy group) in July 2008 stated that the migration had unanimous support.[24] The Members of Parliament (MPs) said they were satisfied with their new equipment, and touted the quick and easy adaptation by users. A survey polling MPs found that 80% were happy with the new software while 14% felt Windows should return.[25] Even the challenges encountered in the context of smartphone synchronization are described by stakeholders as valuable lessons for other potential adopters, including that some open source technologies have not yet "caught up" with proprietary ones.

The primary motives in the case of the French Parliament, however, were not technical. They were economic and explicit in terms of the expected public welfare gains, including "encouraging" French firms to participate in this "promising economic sector."[26] But did it encourage economic growth more broadly? The ex-post evaluation of this decision has highlighted the positive welfare effect of the French Parliament's adoption of open source in terms of knowledge externalities. By demonstrating that the switch was feasible for such an important and relatively large organization, and also by highlighting areas of difficulties, the Parliament provided valuable information to other potential adopters. As a result, France's largest administrative body, the Gendarmerie, announced in 2008 that it will be switching all 70,000 of its workstations from Windows XP to Ubuntu Linux, citing cost reductions as well as better control of security functions and a greater independence from outside software vendors.[27]

The information externality was welfare-enhancing (to the extent that the Gendarmerie's move was beneficial for France and that it was made possible by the Assemblée Nationale's experiences). It is plausible that tangible benefits in terms of local jobs created and businesses supported in the IT sector were achieved relative to the public welfare gains that would have been achieved with a non-open source solution. On the other hand, one may ask if a country should nurture the service segment rather than the product segment of its IT industry.

Similar to the French Parliament, the public welfare arguments were brought to the fore in the German Parliament's decision, including: supporting the local IT industry; restricting the market power of dominant U.S.-based software firms; and providing a positive information externality by showing that, and how, the migration to open source is feasible even for large organizations.[28] The Bundestag (German Parliament) decided to migrate from a largely Microsoft-based IT infrastructure to a mixed environment in 2002, after completing a study of the costs and benefits of various scenarios.[29] The decision was influenced by stakeholders within and outside of the Bundestag that lobbied partly for, partly against, the introduction of open source. The debate became emotional and political, both within the Bundestag and in the public. Decision makers understood that costs would be somewhat higher with the chosen solution than with an alternative containing much less open source, but they were willing to incur these costs for other benefits. The Bundestag has a fragmented IT support system – with separate organizations for the Parliament itself and for each parliamentary group. Individuals with whom we recently spoke from within these IT organizations have differing opinions as to whether or not the mixed environment is superior to a largely proprietary alternative.

However, the issue of open source vs. proprietary software appears much less emotional in the Bundestag today than it did in 2002.[30] Public welfare arguments still play a certain role, owing partly to the guidelines decided in 2002, but technological and cost arguments seem to dominate. For example, in 2007 the Bundestag opted for Microsoft Exchange when a realization of the required functionality with open source components proved problematic within the available time frame.[31]

The debate in Germany was emotional but controversial, while the debate in France was emotional and unanimously pro-open source. Motivated by public welfare, both made tradeoffs with cost and/or technology, and were fully aware they were doing so. Each had a process for decision making that made these tradeoffs clear. Each used a third party to evaluate open source, hybrid, and proprietary solutions. While Germany ended up with an outcome that was hybrid, France did not, in part because this would have been at odds with their desire to serve as a proof of concept for the implementation of open source. There are no metrics evaluating the TCO of the French decision to adopt a fully open source desktop. Nor are there measures of the public welfare impact the French Parliament has had with its decision. However, neither seems to be a concern as the evidence shows they have motivated other public sector organizations in France to follow their lead, and they are a frequently cited "success story" for the adoption of open source.

Because public sector decision making typically tries to balance IT efficiency and policy objectives, if the TCO for competing solutions is close, open source may be favored. But TCO frameworks do not make public welfare and belief considerations explicit. When policy makers want public welfare to be considered in the software purchasing decision, a framework to evaluate these tradeoffs, and a mechanism to measure impact, should be employed. In some instances, it is, and the results are indicative of this more measured approach. For example, the technology procurement standards in the Commonwealth of Massachusetts use a "best value" approach. Return on investment is the primary factor, but there is often a "tipping factor," and the perception that open source software as a riskier (read: less predictable in its cost) choice is common, according to one interviewee. At times these are legitimate concerns, and at times it is just a perception. Thus we see beliefs working both in favor of and against decisions to purchase open source software solutions, and not surprisingly, without an explicit recognition of the tradeoffs involved.

Establishing Standards

In addition to "purchasing" types of decision, today's dialogue regarding open government includes another type of decision: those made to encourage more "open" behavior through the establishment of standards. Standards are important in this context for enabling interoperability and access; however, an open standard (that is, one that is both developed collectively and

royalty-free) is not a prerequisite. Whether or not the standard is open or closed is often less important than whether the standard is effective at encouraging the sharing of information and data in ways that enhance public welfare.

The Commonwealth of Massachusetts in 2004 adopted a policy favoring the Open Document Format (ODF) for all state agencies.[32] Applications that did not support this format were to be phased out by 2007. The program's goal was to ensure that vital state documents would not be locked up in the event of vendor capriciousness or future standard wars and that access to past data and documents would be preserved.[33] This implied that most proprietary solutions – like Microsoft Office, Lotus Notes, and WordPerfect – would need to be replaced.[34] Interestingly, one effect of this policy was to spur software vendors to reconsider their proprietary document formats and develop products and adopt standards that met and exceeded the new state requirements. This decision by the Commonwealth of Massachusetts to adopt open standards was not based on reducing an immediate, tangible cost, but was motivated by a longer term perspective: namely, that data stored in a proprietary format might, in the future, either not be accessible, or only be accessible at a high price set by the owner of the format itself. The Commonwealth hoped to avoid incurring potential future costs by requiring vendors to adhere to common industry standards. This mandate was part of a longer-term technology plan, with the stated goal of saving money and increasing collaboration across departments by encouraging open technology and open standards.

Subsequent projects have, in the words of one interviewee, "taken to heart" the policies around open standards and used them as the cornerstone of their system design and procurement criteria, including a large scale project in the Department of Health and Human Services. The Health and Human Services Division (HHS) "Virtual Gateway" is a web-based portal where citizens can enter data and access information from a centralized location for multiple HHS services, such as Medicaid and WIC benefits. Launched in 2004, there are now 13 different services centralized on the Gateway, and HHS has processed more than 750,000 requests submitted by users.[35] The initiative began several years earlier, and was driven by frustration with the "stovepiped" nature of existing systems: HHS wanted to deliver an ability to provide personal information once, and deliver the data on the back end to multiple systems. The business case that drove the initiative

was savings from eliminating duplicated efforts to enter and maintain user information. HHS selected standards in which they "were confident." Built-in, mandated standards were the "key" to the success and in the end, some of these standards were open standards, but many were not. Specifically, HHS adopted several well established open frameworks for handling data, but kept many of the existing proprietary standards for the data they already had. The resulting project consisted of a hybrid of both open and proprietary standards. If the standard was not sufficient for the level of reliability and security demanded by a system storing sensitive personal information within the Department of Health and Human Services, it was not adopted, despite the mandate for open standards in the Commonwealth.

Both of these initiatives in the Commonwealth of Massachusetts had explicit public welfare objectives. The open standards initiative was motivated to pursue ODF to ensure future access to information; the HHS gateway was designed to provide citizens a single point of access to the Commonwealth's services. Public welfare was not the primary factor, but the decision makers we spoke with believe these outcomes enhanced public welfare. And while we can think of open standards in Massachusetts as strategic, the approach to open standards in Brazil, where public welfare and beliefs dominate the perspective, is more aggressive: It is a comprehensive mandate for open standards at a tactical level and a strategic level.

Brazil's e-PING interoperability standards for e-government were adopted in 2006. These standards became "mandatory" for all subsequent IT purchases and upgrades by the federal government.[36] The official document contains an exhaustive list of specifications, and a classification system indicating if the standard has been adopted for use by the government.[37] It goes beyond the technical, however, addressing organizational issues, promoting open standards, and advocating the use of open source software. The standards have an "explicit commitment to ensure the alignment of the e-PING architecture with the needs and interests of the society as a whole, as well as with the evolution of relevant markets and technologies."[38] Similar to the Massachusetts open standards, the goal of the e-PING project is to enable information sharing and communication within the government and with the citizens of Brazil. However, it is evident that this effort was preceded by the government's move toward transparency. The mandate for interoperability was motivated by public welfare and beliefs, leading to mandates

for open standards without regard for whether proprietary or hybrid standards would be more effective.

By contrast, one IT decision maker we spoke with said: "I can't go with open standards as the primary driver of decisions…if it wasn't secure, accurate and private, that would be the wrong business driver. I can make it a part of the decision process, but…these decisions can't be based on a purist approach."[39] As hybrid becomes the new norm, mixed open and proprietary environments are likely to prevail in the public sector across software and standards, and interoperability requirements will become increasingly important. The establishment of standards is central to this debate. Decision makers with a mandate to enhance public welfare may foreclose on viable options if they give preferential treatment to standards based on whether they are proprietary or not.

Making Data Freely Available

Public welfare gains from open data efforts are more straightforward to identify, even when economic value is hard to quantify, as they are most directly tied to open government. However, decision makers face a similar set of challenges when mandating open data as they do for open standards, namely, that these mandates must be explicit about the behavior they are trying to encourage and the public welfare enhancements they expect to accrue.

A highly successful, small-scale project within the Commonwealth of Massachusetts illustrates the point. In 2009, an Open Data Initiative was launched by Massachusetts. One of the most visible projects that resulted has been the release of data from the Department of Transportation ("MassDOT"). The MassDOT project was the result of a directive by the Secretary of Transportation to find new and innovative ways to improve transportation for citizens with minimal (or, ideally, zero) cost. As a result of this constraint, implemented projects had to leverage either existing assets, community development, or both – a concept referred to as "no-cost procurement." The MassDOT identified potentially useful internal data sources and made them publicly accessible using an open standard, but relied on the community to convert those raw data feeds into a usable end product. Projects implemented so far include tools to predict bus arrivals, determine wait time at Registry of Motor Vehicles branches, and plan public transit

trips. As the project continued, other departments saw the results and suggested additional data feeds that might be integrated. The cost to the Commonwealth for all of these projects was minimal, primarily limited to the time investment to make the data available and automatically updated online. By encouraging a community of developers to create applications based on data from the Operations Technology Department, MassDOT has put real-time bus and rail schedule information into the hands of commuters at little cost to the Commonwealth. The MassDOT project began (and has successfully expanded) precisely because of the benefits to citizens of having accurate information about transit services.

Developers who have built applications on the MassDOT data are confident that their applications can be successfully deployed even beyond Boston, because the location data they rely on adheres to a standard GPS data format, commonly used by departments of transportation in the U.S. In Boston alone, more than 10,000 users have downloaded an app to access the MassDOT data. Scaling this up to other cities nationwide is an attractive option for developers, because as one developer estimated, 80% of the work necessary to build the application is reusable for other cities. For those developers who provided their applications as proprietary software, this standardization of data enables them to gain further revenues from future commercialization.[40]

The desire to open data to citizens was framed as a business decision: opening routing and bus tracking feeds would arguably drive transit use because of the added convenience. Even when there is no directly obvious business position, governments have pushed to make data open and accessible on the non-economic argument that the data should be open because the citizens are entitled to access it. On a larger scale, the recent Data.gov initiative by the federal government in the U.S. is driven by the same set of beliefs. Yet MassDOT and Data.gov are explicitly not mandates for open source software or open standards.[41] Openness in data is a distinct policy choice as compared to the use of open source technologies to accomplish the work of government.

Broad Mandates for Open Source, Open Standards, and Open Data

Finally, we examine two contrasting approaches to the establishment of broad mandates meant to encourage "openness" as a public good. We can distinguish these from our other case studies, where changes to the IT ecosystem were intended to have a broader impact. Here, the IT ecosystem was only a part of the move toward open government. When broad mandates toward open precede specific IT decisions, we find that the perception of open source solutions may be different, but achieving a successful outcome is no less challenging.

The City of Vancouver shares a similar vision to that of the Massachusetts' Open Data Initiative, but on a larger scale. In 2009 the City Council approved a motion by Councillor Andrea Reimer entitled, "Open Data, Open Standards, and Open Source."[42] Implementation of the "Open3" motion has entailed a comprehensive roadmap and assessment of the IT infrastructure of the city, and fundamental changes to IT procurement and contracting. The motion requires that open source be considered on equal footing with proprietary solutions. It then goes beyond the traditional scope of procurement decisions, incorporating mandates for open standards and data in an effort to share data with citizens and foster a more engaged and interconnected community.[43]

Vancouver's Open3 motion is an "experiment" in technology and government and a leading example of what we mean by the public sector moving toward open in order to improve public welfare. The goals of this initiative are much broader than any individual IT decision. The goals are explicitly to encourage open government.

The expected benefits to external stakeholders are not just access to data and information, but the ability to more fully participate in government, and to engage both internal and external stakeholders more actively. The city has placed this participatory element of the move to "open" front and center of their initiative. The next phase in Vancouver, one that is still in process, is to tie the availability of information and data to broader economic goals. In terms of economic development, the demonstration of commitment by the city government to open data and standards is part of a broader image of Vancouver as technologically savvy and entrepreneurial.

Not tied to open source software per se, and not even tied to an IT purchasing decision, this move toward open by the city government is seen as positive both in substance and image.

In Vancouver, the push towards "open" has begun with open data, and while open source software is part of the Open3 motion, in practice, the priority is clearly access to data. The Open3 motion mandates that data be made publicly available – unless there is a compelling reason not to make it public – but departments have not been given additional resources to do this.[44] One department we spoke with described how they reallocate already scarce resources to meet the requirement, and prioritize the release of data along the dimensions of "low cost/complexity" and high "public value." The IT staff is making the city's data available using standards and technologies which enable the broadest use of these data, regardless of whether they are open source. Particularly in Vancouver, where public welfare motivations dominate traditional IT concerns, the outcomes will almost certainly be hybrid, not solely open source or based on open standards. An architect of the Vancouver initiative says that this push met resistance in many parts of the government which are "afraid" of openness, but that the Open3 resolution has forced them to accept it. For example, the City of Vancouver Archives wanted to launch a project to make the archives available online to citizens, but was defeated by the city's IT policy. The only tailor-made software suite suitable for the project was an open source package, and the city's IT department was hostile to software without, as one interviewee put it, "someone's throat to strangle" if something went wrong. Once the Open3 motion passed, however, the project's proponents were able to cite its requirements to push forward with their initiative. Aside from the requirement to consider open source software on an equal playing field, according to one interviewee, Open3 means that "When you make the conversation about sharing data with citizens you change the context, and it is harder for people to say no."

Finally, we provide a current perspective on the open source initiatives in Brazil that have been in place for almost a decade. President Lula first made open source a part of his platform in 2003, not surprisingly because the promise of low/no cost software had broad appeal.[45] Brazil mandates the government use of open source solutions, encouraging open source software use as a foundation for the economic growth and development of the country. Numerous initiatives to encourage the adoption of open source, and to foster a community of open source developers,

have been established and are supported by the federal government.[46] Some state and local governments have also begun their own initiatives, implementing policies with similar goals. The federal government, as the largest consumer of IT in Brazil, is in a position to steer the country towards open source, although the pace has not been rapid and the outcomes are mixed.

There is significant rhetoric around the adoption of open source in Brazil, linking this strategy with "software libre," issues of sovereignty and national security, and the development of the IT sector of the economy, in addition to the cost savings. Much that is written about the Brazilian experience with open source ties this rhetoric directly to the success of open source in Brazil, and more broadly, to the success of the open source movement.[47] A closer look identifies other factors which may be motivating behavior far more than the government policies that are often cited, and in some cases, imitated.[48]

In Brazil, the government is using its purchasing power to promote open source, is encouraging the growth of the software sector through market intervention, and has a policy of "digital inclusion" for all its citizens. The public sector, technical, and academic communities in Brazil have participated in federally sponsored initiatives such as "Software Publico," and generally supported open source alternatives for many reasons. The opportunity to cut costs related to licensing and acquiring proprietary software remains the most common reason (even if, as one interviewee acknowledged, these costs are to a good extent displaced to other points in the software lifecycle, as costs related to training, maintenance and customization grow). The belief that open source software enables digital inclusion and economic development (relatively more than proprietary) is another.

However, Brazil is in a slightly different position relative to technology. It faces two challenges: a less developed IT sector in the broader economy and a wide disparity in the relative use of technology within different government sectors and state geographies.[49] As a result, their challenges are not about replacing systems but concern migrating from paper to digital in many instances. For example, the system for filing individual income taxes online, "Receitanet," is a success story in Brazil and rightly so: According to one estimate, 97% of total income tax returns were received through the system.[50] This is remarkable given the low rate of internet

penetration. The government has committed to making technology available at libraries, banks, and other public sector locations to provide citizens access to Receitanet and technology broadly speaking. Interestingly, Receitanet is also a mixed environment: The software is java-based, but security and encryption are still handled by proprietary software.[51]

The process of adopting open source is "maturing slowly" in Brazil. Since 2007, the federal government has supported a centralized open source software exchange. Today, the "Software Publico" portal has grown to an estimated 50,000 active users. More than 5,000 applications have been submitted to the portal and implemented throughout the public sector in Brazil.[52] Participation by external stakeholders is both driving and limiting this adoption: institutions and individuals outside of the federal government are fulfilling unmet IT needs, but primarily in ways that also allow them to commercialize their work. The public sector push for open source solutions is driven in part because they do not have sufficient resources – monetary or technical – to internally develop some of the software that is necessary for the administration of government.[53] The federal government is looking to the public to contribute time and talent to this effort.[54] In Brazil, encouraging specific behavior by external stakeholders is seen as enabling government, supporting the local economy, and providing IT solutions that are alternatives to traditional proprietary software.

Conclusion

Why have examples of public-private partnerships, such as Brazil, the MassDOT, and Vancouver generated so much attention, both within the government and the broader community? We believe it is because they have successfully leveraged outside innovation. Their projects relied on existing data and standards, and with some creative and dedicated project management, successfully engaged the developer community to truly meet a need in the broader community. Open government, broadly speaking, embodies this concept. However, not all of these projects required that the applications built were open source. The developers we spoke with had heterogeneous motivations: Some were concerned with issues of open data and wanted to create free solutions; others saw opportunities to commercialize their applications (or in the case of Brazil, where there is a mandate for open source, they can commercialize their support

services for the software). This is fully understood by the parties. As discussed by the project leaders in the Commonwealth example, this was encouraged because allowing motivated developers to commercialize their work enlarges the set of available solutions. The process also results in a lower cost to the Commonwealth (in this case, close to zero), often higher-quality programming, and externally provided solutions that are more creative and responsive to the needs of citizens.

The difference in these approaches is the importance of beliefs about open source. Whereas Massachusetts has found success through inclusion of any vendor that can comply with the standard, Brazil's promotion of open source has limited the set of available solutions (but may, on the other hand, facilitate collaborative improvement of existing solutions). Similar to Vancouver, however, the benefits to open government may outweigh the costs, from their perspective.

While the French and German Parliaments are promoting open source software, Massachusetts is promoting open standards and open data, and Vancouver and Brazil are promoting the benefits of openness, all are using their purchasing power *and* their ability to influence behavior to achieve these goals. There are many competing factors in each case, and a complex set of tradeoffs to be considered [See exhibit: Case Studies and the Decision Making Framework]. This fact becomes immediately obvious when talking with the decision makers themselves. It is less obvious when reviewing the academic literature and popular press which often view these decisions as "wins" or "losses" for open source, conflating decisions about software, standards, and data, and often ignoring that these IT decisions are means to an end.[55]

Much of the fervor around public-sector adoption of open source software technology is centered on promoting competition and creating a level playing field between long-standing proprietary technology vendors and the promise of royalty-free open software not owned by any particular party. The fervor has largely faded as open source adoption decisions are increasingly made based on cost and technical considerations, but the effect on competition remains. Our vendor interviews revealed that open source software is often used as a bludgeon to reduce prices from the proprietary solution provider. Strategically, public sector CIOs threaten the adoption of open

source to drive their own software acquisition costs down, even if they have no intention to follow through on the threats. And even if acquirers do not act strategically this way, the availability of open source solutions and examples of their successful implementation improve acquirers' negotiation position vis à vis sellers of proprietary software. Hence, a viable open source stack can create price pressures and reduces acquisition costs, whether it is a serious contender or not.

Initial experience in the public sector with large-scale open source software deployment showed that, despite the absence of license fees, it rarely came for free in either the short, or the long term. A major driver of these decisions was often the presence of commercial open source interests that advocated various products and services and tipped the balance in favor of open source technologies. While the software may have been nominally free, with little to no software licensing fees, the public sector did have to contend with customization, feature development, (re)training, service, and maintenance fees. Indeed, now both private and public sector decisions to purchase software in general are focused on issues of TCO, i.e., not just the initial price, but all of the short and long term costs associated with the deployment. Depending on the specific purchasing context, the TCO of open source vs. commercially developed software has been shown to be higher, lower, or at par. It is beyond the scope of our paper to analyze the various TCO arguments. However, from a public sector perspective, an explicit TCO analysis done by public sector staff is essential to understanding the cost profile of any software acquisition regardless of its licensing arrangement.

Ex-ante TCO calculations for software acquisitions, however, have to be done in light of the capabilities and competencies of the IT organization that will be responsible for the installation. As it stands, IT organizations have to manage a complex environment consisting of various software and hardware systems that need continuous monitoring and updating. In the case of proprietary software, the burden of identifying, prioritizing, and executing updates is often driven by the vendor responsible for the software. However, the inherently distributed nature of open source software development means that the burden of integrating updates across various projects falls on the user organization and/or hired commercial support. Depending on the use case and the supporting IT organization, this may or may not be an attractive option. Hence, a

public sector organization that has intense computational and algorithmic needs may already have a very capable IT staff who can manage and execute changing use and software development requirements, and thus may prefer the flexibility in modifying and customizing source code that open source software offers for their scientific applications. Open source may also be preferred in less demanding application requirements if the supporting IT staff is sufficiently skilled and advanced.

The reality in most organizations is that skilled IT talent is a rare and prized asset that is prone to high turnover, while most user needs are quite stable. In this case, both users and IT staff might prefer an integrated end-to-end solution that a commercial proprietary software vendor may provide. This may especially be true beyond the desktop and in the back-office setting where databases, application and web-servers are to be seamlessly integrated for both internal public sector use and citizen usage. Hence, the cost and technology factors in IT decision making need to be assessed in light of the available talent pool in both the IT staff and the potential users. The experiences of the French and German Parliaments provide backing for both the costs and benefits to be considered in such assessments.

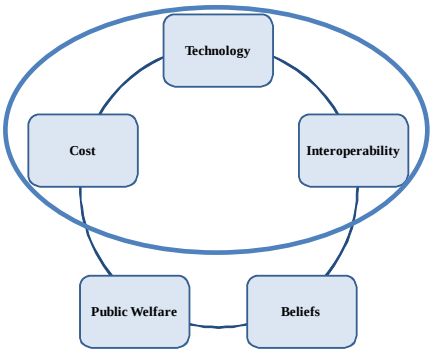
Our case research also revealed that some desired public welfare outcomes are hard to quantify, such as enhanced local technical capabilities, independence from foreign companies, and economic development. In contrast, the effect of public open source adoption on related technical entrepreneurship, job creation, tax revenues, and competition could be measured. However, while it seems feasible to trace new firms, jobs, and taxes to, say, the Bundestag's adoption of open source, one must take care in evaluating the counterfactual. That is, to what extent would these goals have been achieved if proprietary vendors had been selected, which do have local content and presence in various countries? Furthermore – beyond the choice between open source and proprietary software – could it be that more direct subsidy-based programs targeting those goals may have an effect that is bigger, and more efficiently obtained, than the side benefits of open source adoption? Also, given that open source deployment leads to the creation of service-oriented rather than product-oriented software firms, governments may ask themselves if this is the type of software industry they want to nurture.

On the plus side, the information externality that a pioneering open source deployment in the public sector has on potential imitators – by demonstrating feasibility and challenges of an open source solution – does appear to have a positive welfare effect, even if a precise quantification is again difficult. In either case, there is no systematic data that compares how the public welfare and belief goals underlying public sector IT decision making in favor, or against, open source software are actually instantiated.

The public sector will, we believe, act more and more like the private sector when evaluating cost, technology, and interoperability in their IT decision making. However, public welfare and belief arguments will continue to be important drivers of decision making in the public IT sector. Measuring the achievement of these less tangible goals in a quantifiable way is challenging. While it is undisputed that the advent of viable open source solutions has increased competition and put pricing pressure on proprietary vendors,[56] for other of these less tangible goals there is little evidence or research indicating that they are actually and concretely achieved. We undertook this research project to understand why this was the case, and we created this framework to address this concern in a pragmatic way.

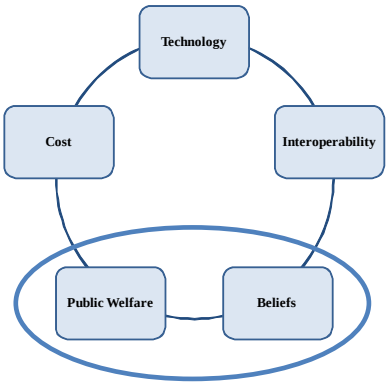
"Open government" is perhaps the largest and most influential goal in the public sector today. Whether or not IT decisions enable progress toward this goal is dependent on clear articulation of the associated motives, choices, and expected outcomes of these decisions by the policymakers who are responsible for doing so.

Exhibit A: The Decision Making Framework and Critical Questions



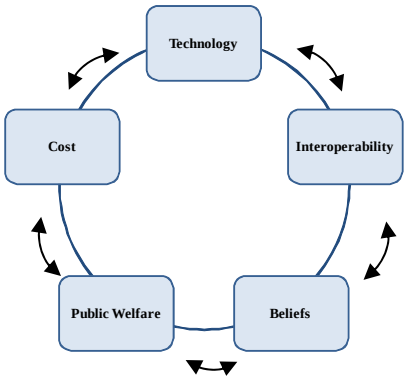
Key Questions:
Cost - Technology - Interoperability

✓ For each potential software solution, have multiple viable technology options been considered?
✓ Have the technical requirements been articulated from multiple perspectives: IT staff? Policy makers? Users? Citizens? How will competing requirements be reconciled?
✓ Have the necessary changes to the knowledge base of the IT staff been articulated? What new skill sets are required? Are others made obsolete? Have the cost of these changes be quantified?
✓ Have the interoperability requirements been articulated? Are there conflicts with existing systems that need to be reconciled? Is there software- or standard-specific "lock-in" that will prevent interoperability in the future?
✓ Have the risks associated with each potential software solution been clearly and objectively identified and compared?
✓ Have the switching costs be articulated, in terms of time, money, and risk?
✓ For each potential software solution, has the total cost of ownership been evaluated?[57] Is there confidence that acquisition and maintenance costs for open, proprietary, and hybrid solutions have been quantified? Does the option set include doing nothing?



Key Questions:
Public Welfare - Beliefs

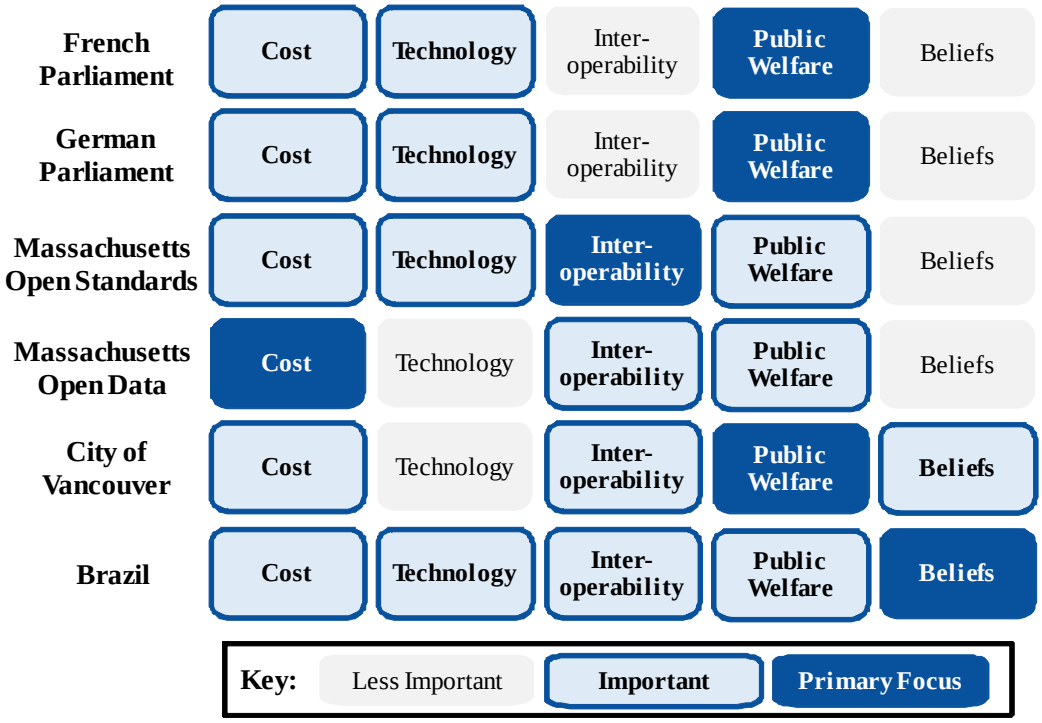
✓ What broader policy mandates does the decision need to adhere to? If there are conflicts, what are they, and how will they be reconciled?
✓ Have the benefits to public welfare from this decision been articulated? Have all perspectives been taken into account: IT staff? Policy makers? Users? Citizens? Has a process for reconciling competing goals been established and followed?
✓ How will benefits to public welfare be estimated ex ante, and measured and communicated ex post? Where these benefits have been quantified, has it been on a comparable basis across all potential software solutions?
✓ Have any potential biases of decision makers been identified, discussed, and addressed?
✓ If the decision is preceded by an open government mandate, is it clear how the software purchase fulfils the mandate?



Key Questions: Tradeoffs

✓ Which factors, or specific aspects, are “make or break” for this decision?
✓ Are public welfare benefits the driving factor for this decision? If so, is there confidence that they are achievable? Have alternatives, potentially more efficient, been identified?
✓ Are there outside partners or resources that can be engaged in ways that decrease total cost of ownership, increase public welfare, or both? Have these solutions been considered?

Exhibit B: Case Studies and the Decision Making Framework



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[5] The other defining aspect of open source software - the accessibility of code - does not appear to be important to most decision makers. One widely cited survey reported that "access to source code" is last on the list of motivating factors for potential users, with only 7% of respondents mentioning it. Datapro Survey, cited in Kenwood, Carolyn A., "A Business Case Study of Open Source Software," *MITRE*, July 2001, p. 19, available at <http://www.mitre.org/work/tech_papers/tech_papers_01/kenwood_software/kenwood_software.pdf>.
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[9] The CSIS database of government open source policies appears to be the most comprehensive source available, containing an annotated list of 275 open source policy initiatives. Available at <http://csis.org/files/media/csis/pubs/0807218_government_opensource_policies.pdf>.
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