Introduction

Governments and public institutions have embraced the fruits of technology in a reluctant and uncomfortable manner. This is not altogether surprising, given that technology is an area that is often outside of the core competency of many policy makers. Such reluctance and lack of expertise are untenable among policy makers, however, because technology, and information technology in particular, is an important part of daily life and increasingly is the medium through which citizens interact with government. This book attempts to empower policy makers with the knowledge and judgment to make decisions related to the deployment of information technology, particularly open source software (OSS), in public institutions. The ultimate goal is to ensure that citizens are empowered to deal with governments in an effective and cost-efficient manner, with reliable and complete information and with enhanced confidence in government processes.

The openness of code and the OSS development process help to encourage the transparency regarding how the system works that is crucial for helping to empower citizens. OSS was developed as a method of software distribution and testing and has become a method of software production that is

accompanied by flexible licensing and a potential means of invention and social aggregation that is characterized by growth and open diffusion. OSS was initially dismissed by media and academics as nothing more than a fad, but the open source phenomenon has grown, mutated, and rapidly been adopted by private and public organizations to the extent that it is difficult to find any area of software development in which OSS is not in use (Fitzgerald 2006). One intriguing facet of the open source phenomenon is the effect it has had on fields and methods of organizing information outside of software development—for example, crowdsourcing of ideas, the move toward open collaboration as a better form of innovation, open government, and open standards. The degree of diffusion of OSS can be perceived, for example, in flourishing public Web-based code repositories, such as SourceForge and Apache, which were created to control and manage software and provide information, articles, news, references, and forums to help those who use or are about to use OSS.

The widespread diffusion of OSS has been driven by five socioeconomic factors: (1) the establishment of large OSS communities of individuals who fulfill specific user requests, (2) potential reductions in the costs of licenses and the constraints posed by commercial software products, (3) the support of companies such as Sun and IBM that have adopted OSS as a new business model they use to compete against firms that sell proprietary software products or defend their hardware products, (4) the expansion and dissemination of OSS through extensive creative licensing, and (5) the perceived interest of public institutions that have limited budget and resources and that make use of OSS to maintain and update their information technology (IT) infrastructure. Favorable

circumstances and a favorable environment, including new instruments of social communication over the Internet—chat, forum, and social networks—and fast connections, have done the rest. OSS is distributed through the Web and has become a reality in the IT market, and users who initially perceived OSS as a novelty perceive it as a new opportunity.

Does all of this potential qualify OSS as an innovative technology? Is OSS a new viable alternative for individuals, firms, and public organizations? There is an ongoing debate about this issue (Fuggetta 2003). The major point of discussion is whether OSS is an innovation, because it is not an invention that originated with identifiable new ideas. In other words, OSS products are not inventions solely because they are open source. In fact, being open source is not a new idea. In its earliest manifestations, software was open, although not as a commercial good. Furthermore, being open source does not mean that the software has been generated as a result of new ideas. The majority of the OSS products were developed from ideas similar to the existing products of their proprietary counterparts. In terms of their overall functionality, Linux and Apache offer an alternative to existing proprietary software. In addition, the collaborative and distributed approach of OSS development dates back to the 1960s (Feller and Fitzgerald 2002) and was already evident in the early 1980s. At that time, collaborative ferment permeated research centers and inspired people such as Richard Stallman, the founder of the free software philosophy, which is an integral part of OSS, during his time at the Massachusetts Institute of Technology and Barry Boehm, the creator of the win–win spiral development, a collaborative method that has been adopted by many software firms.

However, whether OSS is an innovation depends to a large degree on how one defines and understands the concept of an innovation. The work of van de Ven, Polley, Garud, and Venkataraman (2008) distinguishes an invention from an innovation. An invention is a new idea, and an innovation is a broader concept that includes both the development and implementation of a new idea. This work stresses that an innovation need not be new to everybody and might even be seen as a copy, but it must be novel to at least some stakeholders. Van de Ven and colleagues' definition encompasses both product and process ideas concerning novelty (technical artifact and practice-related/procedural issues). That definition is similar to the widely accepted definition of Trott (1998). Trott identified innovation as the combination of theoretical concept, technical invention, and commercial exploitation, in which ideas are transformed into inventions, and innovation is the overall process that transforms ideas into market objects (Myers and Marquis 1969). The primary distinction between these definitions is the commercial exploitation element. According to Trott, "The process to convert intellectual thoughts into a tangible new artefact . . . is invention. This is where science and technology play a significant role . . . Innovation depends on inventions but inventions need to be harnessed by commercial activities before they can contribute to the growth of an organization" (Trott 1998). Trott defines *new* as what is perceived to be new by individuals and not what is determined by the elapsed time of discovery (Rogers 1962; Rogers and Shoemaker 1972). Neither invention nor innovation need to be determined by ideas that are new in terms of time. Given these premises, OSS is innovation. The main merit of OSS is that it is a catalyst for skills and good

practices relating to quality software development and provides a novel mechanism for competition among IT providers. The five case studies presented in chapters 3 through 7 show that the actors and organizations took into account how a novel tool or application would be incorporated into organizational practices.

If innovation is the process of introducing objects to the market, then adoption is the process of introducing an object from the market into organizations. As is true for innovation, technology adoption is a complex process that is affected by social, economic, and technical factors, and OSS is no exception. In addition, complexity can be amplified with OSS, because OSS has not traditionally supplied information on its technical or business standards. OSS communities typically focus on specific technical support for installing and configuring their tools, but they do not seek to provide standards, documentation, manuals, and case studies that can help users and managers involved in the adoption of the technology.

Gallivan (2001) proposed a framework for the adoption of technological innovations within organizations. His framework acknowledges that, within organizations, authoritarian decisions of technology adoption are more common than allowing users to choose adoption. This derives from Weberian (Weber 1948) ideas of bureaucracy to which most public organizations (and most private companies that grow beyond a certain manageable size) adhere.

Relatively few works have tackled the acceptance and adoption of OSS to date (e.g., Gallego, Luna, and Bueno 2008; Ozel et al. 2007) or have explored OSS diffusion within specific organizations, such as public administrations (e.g., Ozel et al. 2007; Fitzgerald and Kenny 2003; Rossi et al. 2006b; Russo,

Braghin et al. 2005; Ven, Van Nuffel, and Verelst 2006). The limited amount of research highlights one important fact: OSS is a strategic challenge that enables public organizations to modernize within limited budgets and with limited resources (Russo, Succi, and Zuliani 2003; Rossi et al. 2006a). There is a related concern regarding long-term costs of OSS—that costs are being transferred from proprietary software products to software services, which become increasingly expensive over the long run.

The implementation of strategies of innovation is not straightforward, and OSS is no exception. The discrepancy between a strategic decision and its strategic implementation—which is known as the *assimilation gap*—can be substantial. For example, one factor that is known to cause this gap in OSS is the negative attitude of potential adopters regarding such a technology, particularly if the adoption is mandated by management. Potential adopters might believe that mandating the use of the cheaper open source technology lowers the value of their work because "management does not invest in their work." This negative attitude creates resistance and can even determine whether the adoption project fails (Fitzgerald 2009).

This book presents a framework for OSS adoption based on Gallivan's (2001) work and applies it to five public organizations (see chapter 2 for an explanation of Gallivan's framework). This framework can be used to determine which factors enable or inhibit the implementation of strategies for OSS adoption within public organizations. Actual experiences involving mass OSS adoption and diffusion are presented in chapters 3 through 7. The traditional theory of technology diffusion specifies that mass adoption is known as *secondary*

adoption when it becomes the concrete implementation of the strategic decision to engage in adoption, which is known as *primary adoption*. Secondary adoption is a complex process that Gallivan (2001) conceptualizes as involving both individual and organizational aspects. Secondary adoption also requires lengthy, extensive investigation because it relates to the prolonged process of absorption and acceptance of a technology by a variety of users. The assimilation gap measures the misalignment between primary and secondary adoption (Fichman and Kemerer 1997, 1999). This book focuses on analyzing OSS as a diffusion phenomenon in terms of secondary adoption in public organizations. However, before moving onto the framework and case studies, it is important to outline the basic features that distinguish public administration organizations from private companies. This will contextualize the case studies and highlight the need for and relevance of this book.

FACETS AND FEATURES OF PUBLIC ADMINISTRATION

The case studies in chapters 3 through 7 show that examples of OSS adoption by public administrations share some common features. Governments link the idea of open source to pertinent issues of democracy through openness, public accountability through greater transparency, greater competition through increased vendor choice, reduction of vendor lock-in, increased access to citizens and vice versa through open and easier methods of communication and collaboration, online supply of services to citizens, and greater efficiency of public services through delivery involving open source and open standards.

There is a belief that the more open a government is, the better the democratic processes work. Indeed, governments often appear more democratic if they provide interactive forums for discussion between the elected and the governed. Ideas regarding open source have expanded to include such forums but should be treated cautiously by both public employees and citizens. Citizens need to understand whether promises made in discussion with public employees are valid and believable. Is the citizen's information safe and secure when shared in such forums? Public employees must consider the words they use carefully when they are in online contact with citizens. The greater the volume of communication between public employees and citizens, the greater the possibility of conflict, misunderstanding, and the possibility of promises being made that may not be kept.

On the other hand, there is the very real potential that more democratic procedures and vibrant market competition will emerge when open source ideas, interoperable software, and standards are adopted. Greater collaboration and transparency can lead to more trust between governments and their citizens. There is a possibility that long-term relationships can be built and that governments can find out more about what the citizens really want and need in their communities. It is also a good tool for campaigning and outreach.

The related issue of public accountability has been well researched in the fields of e-government and new public management. This book will touch on it lightly simply to show how transparency in the legal system, openness of documents, and access of citizens to increased amounts of information can lead to a sense of better public accountability.

The manner in which this is implemented in practice varies, and access to information is a complicated issue that raises concerns regarding how much information is enough, the need for security versus privacy, who holds this information and how it is held, how quickly it is updated, whether there is unfettered access to information across different software applications, and so forth. All of these concerns can be manipulated in favor of governments that want to hold on to information should they be so inclined. These are real concerns that can become problematic when openness is encouraged in public organizations.

Openness and transparency are linked to accountability and, in a more general sense (moving beyond public organizations), are regarded as key elements of open source and other forms of innovation. The question then arises: what are the driving factors behind incentivizing innovation in public organizations?

INNOVATION IN PUBLIC ORGANIZATIONS

Is innovation as important in public organizations as it is in private ones? Some people would argue that it depends on what sorts of services are being offered by the public organization. If there is a need for stability in the organization, then innovation might produce more problems than advantages. If there is agreement that innovation is a good thing, then it is both important and relevant to assess how, when, why, and in what way public organizations can be encouraged to innovate.

It has been argued that public organizations lack a culture of innovation because change is not seen in a good light by

employees or by citizens who need to develop liaisons with public organizations. There is even less incentive to innovate because promotion ladders are not linked to innovation, unlike in private organizations. Private organizations work on the basis of profit and often anticipate that new ideas might lead to increased revenues and profits. Public organizations need to deliver services, and the degree of efficiency with which this is done is usually not open to question. There are also differences in the mindsets of public employees in comparison with private sector employees. In many countries, public jobs are jobs for life, which usually means that complacency can creep in and dampen the desire for change. Finally, innovations have implications for change in legal structures, standards, and so forth, which are not straightforward or easy to achieve in short order. The question of how to encourage innovation in public organizations thus does not have a straightforward answer.

PUBLIC VERSUS PRIVATE ORGANIZATIONS

The central aim for public organizations is service delivery, while for the private sector it is competition and profit. Thus, the use, motivation for adoption, implementation styles, and encouragement of innovation practices differ for these sectors. A great deal of literature has focused on the private sector's adoption of OSS. However, the growing importance of the need of openness in government indicates that this subject merits scrutiny. On the one hand, the commercial application of OSS helps perpetuate the use and adoption of OSS beyond small hacker circles. On the other hand, the adoption of open

source by public organizations promises to keep the original ideology of OSS and its development style alive.

OSS adoption by commercial organizations centers on emerging business models and how to adapt these models to allow for profit-making with a product that requires one to release the secret sauce of the product along with the product. Even so, there is significant competition among various suppliers of open source products, such as Red Hat Linux, Fedora, and CentOS. Exclusionary patterns of competition are emerging among them. Public organizations, as the case studies described in chapters 3 through 7 show, are at the other end of the spectrum, where giving away the source code and adoption by other public administrations are encouraged and imperative.

The commercial application and adoption of OSS has hybridized how open source is developed, shifted licenses (many new licenses are introduced every few months), tilted the balance in favor of company-employed hackers in communities instead of volunteers, and evolved practices of communication and governance that are more in keeping with the sort of control found in private companies. Some academics (Asay 2006; Roberts, Hann, and Slaughter 2006) debate the idea that there may soon be a day when open source as we know it will no longer survive the rigors of commercial adoption. On the other hand, when public organizations adopt OSS, they tend to do so in a manner that is close to the original open source ideology, which stresses openness, transparency, communication, and collaboration. These motives are the source of many of the slogans of open government initiatives around the world today.

OPENNESS AND INCREASED PARTICIPATION IN PUBLIC ADMINISTRATION: LESSONS AND RISKS

Openness is an idea that goes beyond software (be it OSS or proprietary) and encourages a more participatory form of communication. The case studies in this book reveal some interesting qualities that can help governments reach out to the citizenry. The cases show that adopting OSS or openness on any level is not easy. There are financial issues involved when implementing a new system, regardless of whether a license is involved. While the total cost of ownership diminishes over time for OSS, the short-term costs of moving away from legacy systems are substantial and are similar for both OSS and proprietary software projects.

OSS raises new and novel legal issues. While it is true that OSS involves open licensing, legal systems (which are notoriously slow to change and adapt in most countries) need to keep abreast of the amendments that are necessary for coping with OSS. This impacts public administration procedures. It can slow down the acceptance of new products and practices and make it difficult to innovate in either area. Major barriers are cultural differences and acceptance (this is made clear in the comparative analysis in chapter 8). The implications of such risks are often harder to assess in public administrations due to the complex nature of the interactions between such organizations and with the private sector. This complexity is linked to the insular nature of decision making in public organizations. Citizens may find this caution annoying, but it often stems from legitimate reasons: privacy concerns, legal systems, and cumbersome decision-making procedures.

Increased participation within a public organization, let alone with citizens, necessarily entails a need for time and patience before anything can be accomplished. Collaboration is important but brings with it coordination issues and a need for privacy (at some level) balanced with transparency. Who should be included in decision making? It is impossible to take into account every possible opinion. How are opinions judged, how are views collected, and how is structure brought to bear on the many points of view? Public employees are often evaluated on single-author contributions to reports, so how can they be encouraged to contribute to forums and group discussions? Does this entail a new system of evaluation, and, if so, how quickly and efficiently can it be rolled out across all public organizations? How standardized are such evaluation systems in the sense that public employees will feel that they are being measured using sound standards and that they are able to move across public organizations should they choose to do so? Do citizens or public employees feel left out if their ideas are not incorporated? These and other issues plague public administrations that attempt to move toward greater openness and participation through OSS and open standards.

GOALS OF THIS BOOK

The primary goal of this book is to trace the adoption of OSS in different public organizations and to present how and why people adopted OSS and what consequences followed. In particular, the book discusses which factors can affect the decision to adopt OSS and who benefits from OSS adoption.

The second goal of this book is to collect the contemporary best practices and lessons for specifying, evolving (i.e., when to use open source and how such adoption should adapt and increase over time), and governing OSS secondary adoptions using sound and proven case studies (see table 8.1). The third goal of this book is to feed an insatiable curiosity about successful OSS adoptions, investigating questions such as: "How did they do that?" and "What was distinctive about their adoption practices, process, or motivation?" Exposing the story of adoption by studying its facilitators and inhibitors on the individual and organizational levels can help offer inspiration to managers and practitioners who want to build upon the experiences of well-defined OSS adoption processes.

This book uses a strong, theoretically grounded framework for analyzing five significant real-world cases of OSS adoption. It is first of its kind; conventional wisdom has yet to emerge in this area, and, thus, no other material exists that can help guide practices in this area. In addition, the mix of a theoretical framework and real-world applications allows the global research community to build on this work while also providing practitioners with advice and information about best practices.

The framework defined in chapter 2 serves as a useful structuring framework that allows the stories of OSS adoption in chapters 3 through 7 to be told in a similar way, although each case study draws on different aspects of the framework (as might be expected). Chapter 8 draws out these differences and points out the major motivations that have driven organizations to implement and adopt OSS.

This book is written for managers, public officials, and scholars who seek inspiration from sound and proven OSS

secondary adoption experiences beyond their current domain of expertise and who want to learn about contemporary best practices for specifying, evolving, and managing OSS in public organizations.

ORGANIZATION OF THIS BOOK

This book is organized into eight chapters. Chapter 1 introduces basic terminology needed to follow the remaining chapters, including standard definitions of terms regarding the open source domain and technology adoption. In addition, the chapter contains a brief introduction to the history of open source and its evolution. This chapter cites major references that can be consulted for additional information and briefly summarizes OSS products considered in the following chapters. Chapter 2 introduces the framework for OSS adoption. Chapters 3 through 7 present five case studies, and chapter 8 is dedicated to a comparative analysis of these studies with different domains, contexts, and OSS products. It identifies and illustrates differences in motivation, strategies, technologies, and socioeconomic aspects.