

# The Semantic Web, E-Government and the Digital Divide

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## Abstract

Deployed e-Gov systems and intended users' access are analyzed. Included are national and local e-services, e-voting and a local e-Gov system presenting information integration and security concerns. Semantic Web-based improvements are suggested to resolve security issues, provide an integration platform and facilitate use. Expected outcomes are user-centric e-Gov development, a reduced socio-technical digital divide and greater e-Gov success.

## Introduction

E-Government (e-Gov) development includes aspects of human-computer interaction (HCI), software/systems engineering, and Web and Web service design. If all citizens are to have access to e-Gov there are also "digital divide" issues that must be considered. We have no doubt that the Semantic Web (SW) can enable citizen users, facilitate e-Gov processes and resolve many HCI and access problems related to the digital divide. We believe our research results may be applicable in these areas.

We have background in behavioral modeling, knowledge representation and systems theory. This catalyzed our interest in the Semantic Web, for we always seek applications of formal research results to practice. In our professional capacity and as a community member we also have interest in e-Gov, having observed it developing locally. As a professional computer scientist we have conducted ethnocentric software studies, observing "everyday people" accessing public computing facilities (Fass 2004, 2005). These include citizens seeking information and Web services, and public employees whose work involves information technology and the Web. As a participant in civic activities and government processes we have used governmental computing systems, assessing their successes and identifying problems to-be-solved. Our observations and experience have enabled us to provide first-hand advice, guiding system development in a more user-oriented direction. The goal has been to influence policy and suggest emphases for developers who might improve e-Gov system design.

We have researched other deployments and initiatives to extend our knowledge of e-Gov concerns beyond our immediate area, and have consulted with a number of e-Gov experts. As a result we have identified considerations that we find crucial in general e-Gov system development. These include: determining the nature of services to be provided; stakeholders' participation in design; efficiency and economic advantages of systems; education and training issues related to users (citizens or government

employees/officials); access issues (including ease of use); and the ubiquitous computing issues of security, privacy and trust. These areas should benefit from SW technology.

## E-Government, Applied

There is a wide range of e-Gov services that we have discovered locally and through our research, and even more available in the locations to which we have been referred by experts in the field. The variation in technology and offerings is sometimes due to financial issues. But a user-centric analysis indicates some sites are "giving the people what they may want or need".

E.g., the Pacific Grove, California (PG) site [www.ci-pg.ca.us](http://www.ci-pg.ca.us) includes a "Search PG" capability to direct users to the proper places based on their simple input queries. An "Access" capability enables users to submit complaints or requests and track their resolution online. This popular feature was designed by a young fellow as a school project (Reynolds 2005) and then expanded into a marketable "feedback manager" system used in numerous locations. (The designer is now a "software mogul" at age 17.) The system is advertised as beneficial to the citizenry and public administrators, as an aid to "increasing confidence" in government. Public employees laud it as learnable, with an interface that is easy to use. This demonstrates that in a "real world" (rather than a "think tank" or industrial laboratory) environment, by observing what people really need to know about or from government, one can design an e-Gov system that works satisfactorily.

A more sophisticated feedback system is used by New York City (NYC) where, compared with PG, life can be complex and (millions of) citizens and public employees can be demanding. Paul D. Epstein, a government performance expert, directed us to [nyc.gov](http://nyc.gov), with a link to "My Neighborhood Statistics" (NYCMNS 2005). The site is embellished with a Geographical Information System (GIS) enabling citizens to identify conditions and service levels for community districts. They can make geographic and historical comparisons of teacher certification, student attendance, health services, "acceptably clean" streets, emergency service calls, drug-related arrests, "rodent reports" and much more. Born and raised in NYC, we can say this e-Gov site is suitable for the population's needs.

A multipurpose needs-motivated e-Gov site, [www.-carmelcalifornia.com](http://www.-carmelcalifornia.com), is maintained by the village of Carmel-by-the-Sea, California (CbyS). The site balances interests of civic-minded residents, community emphasis on artistic pursuits and an economy dependent on tourism.

For the civic-minded, the site has typical government-related information such as searchable municipal codes, commission agendas and meeting minutes. There are e-mail links to officials and public employees, deemed sufficient for monitoring government performance in the small town (about 2000 full-time residents; about 65 public employees). Crime statistics are not online. However, when we checked the public safety links we found a locale-appropriate “banner” alerting citizens to fire danger caused by high winds. The CbyS site does boast a GIS system with interactive maps, for locating properties and obtaining driving directions to destinations of interest to many tourists. Site services include the online facility to pay parking fines and a link to the village’s cultural center, enabling online theatre ticket purchases. A link to the village library site allows users to access its catalogue, browse new acquisitions and renew borrowed items, by logging on from anywhere in the world. Many high-tech persons live in or near the community, and this e-Gov site has been developed and revised with the current and “cutting edge” interests and needs of its users in mind.

Not many California venues are as e-Gov-oriented as CbyS or even PG. A state analyst office recommended evaluating future proposals, considering e-Gov features to be worth initiating (LAO 2001). But a state fiscal crisis intervened. State and local governments are restricted by financial concerns related to the up-front costs of developing software systems, upgrading hardware and training employees and citizens.

An annual report issued by Darrell M. West’s research team at Brown University (Brown 2005) indicates that e-Gov progress has been made. But no U.S. state is an example of fully successful and operational e-Gov, nor is the U.S. Federal government. E.g., West’s team found every agency failed on issues of site quality control (content, search and design). We, ourselves, found the U.S. Presidential e-Gov Initiative site (OMB 2005) to be illegible. We had to change text size, or copy and edit, to learn what it said. Most citizens might not take such measures.

Convincing people to use e-Gov and its services is another issue we noted. E.g., we found citizens do know they can use e-Gov online services to pay their U.S. income taxes by accessing a specific government site. But the U.S. Official Web Portal (FirstGov 2005), while legible and informative, has rarely been accessed by anyone we’ve interviewed. We believe this to be related to matters of education and of Internet/Web “indispensability” in current culture (Hoffman, Novak & Venlathesh 2004). It also relates to a user-centric suggestion of e-Gov expert Lyle Wray (Wray 2001), that websites be organized “around what the citizen wants rather than how government departments are organized”.

The U.K. and E.U. have paid much attention to developing e-Gov facilities and services. E.g., the U.K. National Projects (Deputy Prime Minister 2005) aim to ensure interoperability and shared technological advances

among all local councils. The E.U. (eEurope 2005) understands that individual localities have individual needs but can learn from each other in the transmittal of technical e-Gov progress. On the European level they seek to address issues of interoperability, privacy, security and accessibility for all. Their e-Gov outlook apparently reflects social, political and economic interactions of the various entities throughout the geographic region.

Lyle Wray views e-Gov as having four stages (PSG 2005): information, interaction, transaction and transformation (of how government “business is done”). He has indicated to us (private communication, 2005) that in most areas, governments are only just beginning to achieve such e-Gov goals. Michael Gurstein, an expert with particular interest in digital divide issues, has examined the impact of enabling technologies throughout the world (Gurstein 2000). Wray and Gurstein each directed us to comparative e-Gov progress surveys by global firm Accenture ([www.accenture.com](http://www.accenture.com)), placing Canada as the world leader. Gurstein has informed us (private communication 2005) that Fairfax County, Virginia, U.S. is considered to be “the poster child” on the sub-national level. There (Fairfax Co. 2005) e-Gov features multiple access channels “[to address] the digital divide for ... constituents and businesses”. Included are a county website, multi-media kiosks (with touch-screen interaction), interactive voice response and mobile access. Kiosks and Internet connections are accessible throughout the county, and use of county computers is free. This admirable policy can resolve digital divide issues based on economic factors. We have found that there is a digital divide based on socio-technical issues, and this is where the SW can help.

## Two Cases of Note

Relationships between HCI and software/systems engineering have been the concern of an International Federation of Information Processors group that meets periodically to discuss potential improvements [e.g., (Kazman, Bass & John 2004)]. They confirm our view that no matter how sophisticated or economically accessible a system may be, it isn’t justified unless the “everyday people” for whom it was intended can and do use it. Two case studies we have completed reveal successes and failures of e-Gov deployments and indicate potential applicability of the SW. Both involve e-Gov systems installed by local authorities and effects of these innovations.

One case involved Internet, Web and Web service access and use at a public library. In this example a city attempted to provide ubiquitous, free access for all citizens to meet their online research and government-interaction needs. The library equipment was accessible to any person wishing to use it. But the system was also used for official matters by a staff of city employees. All administration databases (acquisitions, personnel, payrolls) could be accessed from the system of machines. Within the system information about an item (e.g., an environmental impact

report) could be retrieved in many ways: a catalogue item found by a citizen; a response to a query at the reference desk; an item recorded or reserved at the circulation desk; a document available in the county exchange database; an item available in the database for state-wide loan. With open access, including Internet portals, the installation faced issues of information integration, privacy and security. Citizens innocently reading e-mails or information from sites could (and did) unleash security threats disabling all library computational functions. Staff could do the same, just doing their jobs.

Eventually the system had to be divided into multiple systems. Different groups of employees were given different levels of permissions for use (e.g., reference staff could interact with the Web; circulation staff could not). Internet/Web access became limited to some carefully regulated terminals. Free Internet access for citizens was eliminated; a fee was initiated to defray system security costs. Some security and privacy problems still exist on the Internet-access shared system (e.g., machines left on "auto complete" can pass "private" information from a user to others, as can "cookies" that are planted on these public machines) but there are far fewer e-Gov system disasters.

HCI difficulties persist with the library's city system, as they do everywhere. Many citizens (and some staff) lack sufficient training to use the machines. Many novice users cannot complete simple Web searches that require "thinking of some keywords". Some citizens are unable to use complex machine keyboards; others require audio, rather than visual information shown on screens. Thus a major portion of the library employees' time is spent acting as intermediaries between the citizens and the machines.

Our second case study involved a county-level attempt to replace punch-card ballots with "computerized" voting machines. A claim was that electronic-ballot counting would be more accurate, and a real motivation was reduced election costs. With so much publicity about e-voting security problems, we need not discuss such here. But we can say there were HCI issues, not unlike the library e-Gov access problems just described. With many citizens in their 80s, 90s or even 100s in election precincts, e-voting machines were considered too confusing and difficult to use (*even though* they were touch-screen). After two experiments, e-Gov electronic elections were abandoned. The county then returned to the use of old-fashioned paper ballots with which citizens felt more comfortable. A new e-voting experiment (with paper receipts) was more successful. But state officials just banned many such e-voting machines due to renewed security concerns.

### **Conclusions: How the SW May Help**

We have described some of the innovations that experts find notable, some successful examples and some problems that can arise once e-Gov processes are deployed. We believe there will be fewer e-Gov problems and more successes, with the initiation of the SW.

Many [e.g., (Wray 2001)] believe successful e-Gov should link all parts of an organization so that effective, efficient responses may be given to citizen concerns. But the library example shows that security problems can develop from such linkage. The SW can provide a platform for information integration (II), affiliating appropriate access permissions with appropriate levels of users. As (Gugliotta *et al* 2005) have shown II may employ SW middleware between users and services. (A citizen may submit an online change-of-address form. An e-Gov system may then update library records, school registrations, tax assessments, etc.) Analysis of links among different types of data sources (Fournelle and Tierno 2005) can be applied for SW technology here.

Some security and privacy problems associated with public machines can be resolved by the SW. Our library case has led us to propose that decisions should be made about how software "behaves", based on *where* it is deployed. It shouldn't be difficult for a SW agent to decide if a machine accessing Web-based software is public, and then cause the software to "act appropriately". E.g., tracking cookies related to online credit card purchases (perhaps to pay fines in CbyS) must decide they will *not* implant on public machines. Serious homeland security issues can also be managed. The SW can help create portals for information-sharing (Hendler 2005) by government employees with "the need to know". Trustworthiness of e-Gov information and its providers can be assessed with SW inference mechanisms (Ding *et al* 2005). At a panel held in connection with (Yen & Popp 2005), Teresa Lunt described a "privacy appliance", to be installed as a firewall between data and those who access it. There too (Sweeney & Gross 2005) noted privacy concerns changing with ubiquitous technologies; they have developed "de-identification" techniques to protect innocent bystanders in image datamining. The "appliance" and "de-identifier" can reside in SW middleware. Also, SW technology can aid in integrating legacy databases (Janssen 2005) for any e-Gov system, not only for security.

SW technology should help resolve socio-technical digital divide issues that we have observed, by "giving the people what they may want or need" and by addressing HCI problems. If analyses of user online activities can determine necessary features (and suitable semantic links) the former goal may be achieved. Some more obvious HCI problems can be alleviated with the SW. For example, citizen novice users, unable to make keyword queries of a website, might be able to make natural language (NL) queries with a SW interface. E.g., a citizen now using Search PG may insert the keyword "potholes" and obtain street repair information, but cannot get an answer to a query "how do I get the street fixed at 17th and Pine?". For many citizens the latter would be an easier interaction. But, in addition to NL processing, it would require a site to determine the government agencies that must be contacted. (Lu, Zhu & Chen 2005) suggest a means of SW service

composition that may make such queries possible. Furthermore, some citizens may not know that if they need one government service, they may need another that is related. Wray (private communication 2005) refers to such as “service clusters”. The SW can provide such clustering by incorporating Web-service discovery and Recommender Systems, as in (Buczak *et al* 2005), into e-Gov processes. Other interface features may also be incorporated (pictorial links, audio) through SW service compositions. There may always be citizens who need e-Gov intermediaries. But the more user-centric e-Gov development becomes, the lesser the socio-technical digital divide and then, the more successful e-Gov can be.

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