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Best Practices in Exchanging Business Demographic Data Between State Governmental Agencies

CAPSTONE REPORT

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RUNNING HEAD: EXCHANGING BUSINESS DEMOGRAPHIC DATA

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Abstract

Exchanging data between government organizations can be painful. This annotated bibliography of 15 authoritative sources investigates the best practices of E-Government data exchanges by evaluating (a) Challenges of Data Exchange in E-Government, (b) Common Data Formats in Data Exchanges, (c) Designing Centralized Systems for Data Exchanges and (d) The Use of Service Oriented Architecture for E-Government. Government IT leaders will benefit from the discussion of technical and organizational challenges faced with creating governmental data exchanges.

Keywords: data exchange, data sharing, E-Government, interoperability, SBR, Service Oriented Architecture, standards, XBRL.

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Introduction to the Annotated Bibliography

Problem

Zhiguang and Ting (2010) define an E-Government system as a hierarchical network of disperse systems in a government environment. Coursey and Norris (2008) discuss several E-Government models which describe how implementations become progressively more advanced and feature rich as they evolve. On the primitive side, very basic implementations may simply be a collection of static government information made accessible through a website. More advanced systems hold the promise of engaging the general public through searchable knowledge bases and the sharing of agency data through web portals. Mature implementations facilitate online business-to-government transactions. The progression continues with use of shared data within an organization between its systems. The pinnacle of E-Government systems takes this concept a step further and involves the sharing and use of data across agencies in true government-to-government transactions such that all interactions are seamless (Coursey & Norris, 2008).

Electronic data exchange between government agencies has multiple benefits, but the exchange of data between governmental agencies is difficult (Gil- García, Schneider, Pardo & Cresswell, 2005). Gil-García, Schneider, Pardo and Cresswell (2005, p. 3) found four common barriers to data integration between state agencies: (a) Turf and Resistance to Change. Agencies typically want to preserve their autonomy and relevance while also controlling costs and mitigating risk; (b) Data Incompatibility. This includes mismatched data structures and conflicting data definitions; (c) Organizational Structure and Goals. Not all agencies have the necessary staffing, nor do they have goals that align with the desired integration; (d) Institutional Complexity. Outside influences such as legislative oversight and public scrutiny compound

integration issues by using political situations to influence approval (or disapproval) or withhold necessary funding.

While some of the organizational challenges in implementing data exchanges are unique or exacerbated in public agencies, the technical challenges are common across data exchange implementations and have existed for many years. Kumar and Crook (1999) summarize the technical challenges as follows:

Hardware and software infrastructure. All electronic data exchanges must have an electronic pathway in order for the exchange to occur successfully (Zhiguang & Ting, 2010, p. 280). This requires an agreed upon network infrastructure (public Internet, dedicated network) (Kumar & Crook, 1999, p. 32). The delivery mechanism must also be matched; for instance, the exchange of files through file servers, or exchange of records through a Service Oriented Architecture (SOA)) (Zhiguang & Ting, 2010, pp. 280-281). Use of common software must be identified and agreed on between participating members in the exchange as well (Kumar & Crook, 1999, p. 32). The management of this infrastructure is a pain point for those organizations that lack the technical sophistication (Kumar & Crook, 1999, p. 32).

Integration. Mapping data translations and configuring systems to communicate in the selected infrastructure requires expertise (Welch, Feeney, & Park, 2016, p. 395). Welch, Feeney, and Park (2016) indicate that effective management of an integration is a determination of success in the use of the data exchange.

Security standards. Members of a data exchange must agree on the level of security and trust (Kumar & Crook, 1999, p. 32). Deciding on encryption levels, virtual private networks (VPNs) and underlying security protocols all impact the security standards (Kumar & Crook,

1999, p. 33). Implementation and management of security measures requires technical sophistication (Shej & Cico, 2013, p. 91).

Technological sophistication. The ability to implement and manage all aspects of the technical issues found in a data exchange participation require the right personnel or 3rd party partners (Kumar & Crook, 1999, pp. 24, 29-30, 32).

One additional technical consideration involves data exchange formats. There are numerous data exchange formats dating back to the 1960s (Nurmilaakso, 2007, pp. 370-372). Electronic data interchange (EDI) is defined as the mechanism computers follow to exchange data in predefined standardized formats (Musawa & Wahab, 2012). Nurmilaakso (2007) describes the underlying need to exchange data electronically between organizations as “e-business” (p. 370). This concept includes business-to-government and by extension government-to-government exchanges of data (Nurmilaakso, 2007). Nurmilaakso (2007) makes a distinction between older EDI formats such as Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT) and ASC X12 versus EXTensible Markup Language (XML) format standards such as Electronic Business XML (ebXML) that are now popular. His analysis concludes that traditional EDI formats maintain a strong presence in established exchanges, especially where there is a focus on exchanging documents. In contrast, most new formats tend to be defined in XML. There is also a strong preference for XML-based formats when the data being exchanged defines transactions (Nurmilaakso, 2007, p.374).

Data maintained in a proprietary format in one application is difficult to liberate for use in another. According to Zhiguang and Ting (2010), E-Government systems should be open and integrated even within distributed, heterogeneous environments in order to exchange data

successfully. E-Government systems must also be sustainable, allowing for low (loosely) coupled systems with high scalability (Zhiguang & Ting, 2010).

Despite the myriad of technical issues that face an organization that is pursuing the exchange of data with another organization (Gil-García, Schneider, Pardo & Cresswell, 2005; Kumar & Crook, 1999; Zhiguang & Ting, 2010), there are strong potential benefits for state agencies who succeed at this endeavor (Welch, Feeney, & Park, 2016 pp. 395, 400). This research study focuses on the technical challenges that must be overcome when pursuing the exchange of data between organizations, with an emphasis on data exchange between state agencies.

Purpose Statement

While there are organizational and political challenges when endeavoring to implement data exchange between state agencies that require leadership from administration officials to overcome (Gil-García, Schneider, Pardo & Cresswell, 2005), the purpose of this annotated bibliography is to present literature that addresses the technical problems of exchanging business demographic data between state governmental agencies while acknowledging the need to preserve entity autonomy. For the purposes of this study, entity autonomy is defined as an entity or agency that is capable of managing its own data standards, software, and innovations (Douglass, Allard, Tenopir, Wu & Frame, 2014, p. 254). The research presented here focuses on historical issues that have arisen in the design of electronic data exchanges between government agencies and potential solutions to address the issues. One area of focus for this research is the exchange of business data.

Research Question

What are best practices in the exchange of business data between state agencies that preserve the autonomy of the agencies and their legacy systems?

Audience

Members of agencies in states throughout the United State that issue licensing and handle corporate filings are likely to benefit from this research. These individuals can benefit from the exchange of data between government agencies in order to reduce duplicate entry, expand the reach and convenience of services, and streamline internal processes and processes between agencies (Zhiguang & Ting, 2010). They will therefore benefit from information on potential solutions to implement electronic data exchanges. Technology leaders, particularly state and state-agency Chief Information Officers (CIOs) and Information Technology (IT) Directors should find inspiration to implement solutions that are congruent with those discussed here.

Search Report

Search strategy. Three key search strategies for this research study are presented here. The first strategy consists of general search techniques for both the University of Oregon library system for scholarly articles (<http://library.uoregon.edu/> option “Search Articles”) and Google Scholar (<https://scholar.google.com/>). When items are found through Google Scholar, the specific title is searched in the University of Oregon library system in order to retrieve the full-text.

The second approach is to use Google search for references to specific data formats and consortiums. For example, XML.org, a site hosted by the international, non-profit standards consortium OASIS, provides a focus area on the site for ebXML where one can obtain documentation regarding the ebXML format. Similarly, XBRL.org is a site hosted by XBRL

International, a global, not-for-profit enterprise that provides open data exchange standards for business reporting; the site provides documentation and information on the XBRL format. To find additional resources and references the word *wiki* is appended to the end of the search term.

The third approach is to search the Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE) articles through the University of Oregon library proxy. These two sources are selected because they are the top two independent journals for Computer Science (Times Higher Education, 2009).

Additionally, employees in the Nevada State Controller's Office contribute additional documents and links in response to a request for a government white paper they authored on the topic of a proposed data exchange built on XBRL. The white paper is sought because it suggests a demonstrable approach for a state agency to exchange business data with constituents and other state agencies by utilizing an international format standard.

Key terms. The research focus is on various keywords in order to retrieve specific and relevant articles. Key words are displayed below, specific to the search term and subsequent inspired searches:

- Google Scholar
 - *How to exchange "business demographic data" between state government entities?*
 - *nwproperty.net*
 - *exchange "business demographic data"*
 - *SBR*
 - *Standard Business Reporting*

- *eXtensible Business Reporting Language (XBRL)*
 - *data silos in state government*
 - *breaking down silos in state government*
 - *"e-government" "electronic data exchange"*
 - *electronic data interchange*
 - *electronic data interchange government*
 - *g2g xml transactions*
 - *"business demographics" e-government in the us*
 - *"corporate demographics" e-government in the us*
 - *XBRL Taxonomies*
 - *XBRL Taxonomies non-financial*
 - *XBRL Taxonomies us government non-financial*
 - *xml e-government*
- Google
 - *xbml "secretary of state"*
 - *using XBRL for statewide business reporting Nevada*
 - *XBRL for the Nevada Business Portal*
 - *XBRL*
 - *non authoritative data exchange versus centralized system*
 - *data silos in state government*
 - *ebXML*
- UO Library
 - *XBRL state of Nevada*

- *government electronic data exchange*
- *information sharing between local and state governments*
- *Rhode Island state government silos data*
- *eGovernment*
- Web of Science
 - *e-government data exchange*
- Science Direct
 - (direct document lookup)
- ACM
 - *"e-government" "electronic data exchange"*
 - *electronic data interchange*
 - *electronic data interchange government*
 - *g2g xml transactions*
 - *"business demographics" e-government in the us*
 - *"corporate demographics" e-government in the us*
 - *soa e-government*
- IEEE
 - *network government silos*
 - *government silos*
- Office of the Nevada State Controller

Documentation Method

Evernote is used to track references and search terms. Evernote is an application (app) with the ability to work seamlessly with the Chrome browser or as a stand-alone application. It is cloud-based so data is always available and current, regardless of which computer is in use. Evernote has the ability to save entire web pages, Portable Document Formats (PDFs) or just snippets in addition to notes. For reference tracking, a multi-column grid is created for each search engine used. The table is preceded by a label of the search engine. The first column is a list of search terms. The second column is a list of interesting sources found, noted with a brief textual reference and link to the resource. The third column is used to track inspired search terms that emanate from the previous search. Documents are downloaded to a Onebox shared folder that is specific to this AIM Capstone project. As documents are used for reference and citations, they are immediately added to the resource list of this bibliography.

Evaluation Criteria

Evaluating Information Sources by the Center for Public Issues Education from the University of Florida (2014) provides the evaluation criteria in use for this paper. It defines the criteria as authority, timeliness, quality, relevancy, and lack of bias (Center for Public Issues Education, 2014).

Authority. References are checked for association with a major university when the resource is from a higher education institution. Factors that increase confidence in the authority of a source include when the source is cited by other publications and if references are found in complementary resources.

Timeliness. While EDI systems have been around since the 1960s, E-Government has only been around since the mid 1990s with the birth of the world-wide-web (Coursey & Norris, 2008). Coursey and Norris (2008) reveal that the literature up to the publishing of their paper

was speculative and models could not be trusted as predictive tools. For this reason, newer references (newer than 2008) take priority over older references.

Quality. Sources are checked to ensure the absence of spelling, grammar, and punctuation errors. In addition, sources are selected with strong organization and flow.

Relevancy. With the exception of the white paper provided by the State of Nevada's Treasury office and sites dedicated to format specifications, resources are academic in nature for the core references. Sources that contain information on E-Government, the exchange of data between organizations, and specific format specifications for data exchange are selected.

Bias. Resources that display obvious bias as evidenced by efforts to sell or promote a product or service are not included in the paper. Resources that are associated with corporate studies are also not included in the paper. Resources that have academic bias may be included in the paper; however, in this case only the supporting evidence is referenced and not the conclusions.

Annotated Bibliography

Introduction

The following Annotated Bibliography presents 15 references that examine aspects of government data exchanges. References are selected to provide evidence that data exchanges are warranted in government-to-government (G2G) transactions, descriptions of common architectures that are found data exchange implementations, technical and non-technical challenges to establishing a successful G2G data exchange and potential methods to eliminate barriers. Sources that describe methods to eliminate barriers with regards to agencies' existing systems and common formats that G2G can utilize with an emphasis on business data are given priority. References are separated into the following categories: Challenges of Data Exchange in E-Government, Common Data Formats in Data Exchanges, Designing Centralized Systems for Data Exchanges, and The Use of Service Oriented Architecture for E-Government.

Each annotation consists of three elements: (a) a full bibliographic citation, (b) the original abstract that accompanied the resource, and (c) a summary. For summaries under the category *Challenges of Data Exchange in E-Government*, discussion focuses on *technical barriers* and *organizational barriers* to implementing data exchanges. For summaries under the category *Common Data Formats in Data Exchanges*, data formats are discussed with an emphasis on business data. For summaries under the category *Designing Centralized Systems for Data Exchanges*, lessons learned in the implementation of centralized systems architecture are presented. For summaries under the category *The Use of Service Oriented Architecture for E-Government*, lessons learned in the implementation of SOA architectures is discussed.

Challenges of Data Exchange in E-Government

Coursey, D., & Norris, D. F. (2008). Models of E- Government: Are they correct? An empirical assessment. *Public Administration Review*, 68(3), 523-536. Retrieved November 17, 2016 from <http://www.jstor.org/stable/25145630>

Abstract. Research into e-government is relatively new. Nevertheless, much contemporary thinking and writing about e-government is driven by normative models that appeared less than a decade ago. The authors present empirical evidence from three surveys of local e-government in the United States to test whether these models are accurate or useful for understanding the actual development of e-government. They find that local e-government is mainly informational, with a few transactions but virtually no indication of the high-level functions predicted in the models. Thus, the models do not accurately describe or predict the development of e-government, at least among American local governments. These models, though intellectually interesting, are purely speculative, having been developed without linkage to the literature about information technology and government. The authors offer grounded observations about e-government that will be useful to scholars and practitioners alike.

Summary. This article reviews five models from 2001 that explain and predict the evolution of E-Government implementations. The evaluated models suggested that E-Government adoptions would happen in a step-wise fashion. Each of the models were consistent in the definitions of their 5-6 phases, starting with a basic communication presence and evolving towards transactions and finally a seamless experience.

The analysis of this 2008 publication focuses on municipalities with a population of 10,000 or more and counties with council-manager or council-elected forms of

government. By limiting the size and county government types, variability is reduced in order to assess if the models are correct. The authors found: (a) E-Government tended to be a valued-added service rather than a transformation of services; (b) E-Government appears to be in constant evolution rather than following predetermined steps or phases; (c) implementations are not linear and later implementations can begin at a more sophisticated level than earlier adopters; (d) E-Government evolution may stagnate and may introduce negative consequences; (e) potential benefits of E-Government as predicted by the models reviewed were not based on past studies or observations; (f) E-Government is not likely to produce government reform or transformation; (g) advanced applications are likely to be added slowly; and (h) technology is not likely to be the primary barrier compared to organizational and political factors.

Coursey and Norris found that at the time of publication, despite the fact that the field of E-Government was only 12 years old, 96.2% of the evaluated local governments had some form of E-Government presence. However, they also found that the offerings were relatively primitive, very few had any transactional services, and there was little evidence to suggest that governments at the local level were evolving towards any type of transformation. For instance, only 8% of the local governments were found to offer business licensing as an online service.

The primary barriers found across respondents were financial (57% of respondents) and lack of technical staff (53% of respondents). Coursey and Norris also noted lack of demand by the public (23% of respondents) as a barrier to implementation. There was no support in the responses for the claim made in earlier literature that bridging inter-agency boundaries was a barrier to E-Government services; however,

Coursey and Norris suggest that this may be more symptomatic of larger, more complex implementations that most respondents had yet to attempt at the time of the survey.

This article is relevant for this study because it tests underlying assumptions of E-Government and the perceived barriers to entry and provides examples of the adoption of data exchanges between the public and intra-agency data sharing.

Douglass, K., Allard, S., Tenopir, C., Wu, L., & Frame, M. (2014). Managing scientific data as public assets: Data sharing practices and policies among full-time government employees. *Journal of the Association for Information Science and Technology*, 65 (2), 251-262.

Abstract. This paper examines how scientists working in government agencies in the U.S. are reacting to the “ethos of sharing” government-generated data. For scientists to leverage the value of existing government data sets, critical data sets must be identified and made as widely available as possible. However, government data sets can only be leveraged when policy makers first assess the value of data, in much the same way they decide the value of grants for research outside government. We argue that legislators should also remove structural barriers to interoperability by funding technical infrastructure according to issue clusters rather than administrative programs. As developers attempt to make government data more accessible through portals, they should consider a range of other nontechnical constraints attached to the data. We find that agencies react to the large number of constraints by mostly posting their data on their own websites only rather than in data portals that can facilitate sharing. Despite the

nontechnical constraints, we find that scientists working in government agencies exercise some autonomy in data decisions, such as data documentation, which determine whether or not the data can be widely shared. Fortunately, scientists indicate a willingness to share the data they collect or maintain. However, we argue further that a complete measure of access should also consider the normative decisions to collect (or not) particular data.

Summary. The authors report on the sharing of research data between agencies and researchers at the federal level. According to Douglass, Allard, Tenopir, Wu, and Frame, data can be repurposed by multiple agencies to increase citizen wellbeing. Additionally, open access to data fulfills obligations to taxpayers by providing access to data that was taxpayer funded. The focus is largely on Geographic Information Services (GIS) data and points to success in the that field where researchers were able to bring multiple agency data sets together to make informed decisions regarding opening and closing shellfish fisheries due to pollution models.

The authors highlight access issues of inter-agency competition and (lack of) interoperability of data. In their literary search, the authors found that poor interoperability was due to *program-centric* government organization. They found other issues including lack of standards that make data unusable among organizations. However, the authors suggest that much of the technical issues are really policy issues. Douglass, Allard, Tenopir, Wu, and Frame point to lack of stakeholder involvement as a major barrier to data sharing.

The authors presented their own findings of an electronic survey they performed which showed that the two biggest issues with inter-agency data sharing were lack of funding and insufficient time, the primary reason that data was not posted electronically.

The authors highlight these issues for facilitating data interoperability and suggest that more input is needed from administrators, lawmakers, and data managers to look beyond the technical issues and resolve the policy issues that serve to inhibit data exchange among government agencies.

This article is relevant for this study because it addresses data sharing between government agencies and the organizational barriers that prevent data from being shared.

Gil-Garcia, J. R., Schneider, C. A., Pardo, T. A., & Cresswell, A. M. (2005, January).

Interorganizational information integration in the criminal justice enterprise: Preliminary lessons from state and county initiatives. In *Proceedings of the 38th Annual Hawaii International Conference on System Sciences* (pp. 118c-118c). IEEE. Retrieved from <http://ieeexplore.ieee.org/document/1385478/>

Abstract. Traditional governmental structures have organized the capture, use, and management of information along agency lines. These "information silos" are not very useful in a dynamic environment. Information integration is considered one of the most significant ways to change the structure and function of public organizations. It has the potential to support the transformation of organizational structures and communication channels between and among multiple agencies working in different locations. This article contributes to this knowledge-building effort by examining the factors that influenced the success of selected criminal justice integration initiatives. Useful integration strategies are also identified.

Summary. This 2005 article describes the barriers to success when implementing a cross-agency governmental data exchange and methods of working past those barriers. It focuses on sharing of criminal justice data and uses state and county initiatives as examples by evaluating three projects: (a) Colorado Integrated Criminal Justice Information System (CICJIS); (b) Delaware Justice Information System (DELJIS); and (c) Commonwealth of Pennsylvania Justice Network (JNET).

The authors note that the desire to share data is relatively new for public agencies. The purpose is to allow multiple managers to work on the same data at the same time, even with data coming from disparate sources. The authors suggest that data exchange projects have one or both of the following objectives: (a) to address a specific need, and (b) to enhance capacity. These are further broken down as intra-organizational, inter-organizational, or inter-governmental projects, with inter-organizational and inter-governmental projects considered *complex* projects. The authors highlight three approaches to these types of problems: (a) comprehensive integration to bring many organizations together, primarily to enhance capacity; (b) selective integration to bring data from multiple agencies to solve one specific need; and (c) incremental integration, which adds capacity and function over time.

Gil-Garcia, Schneider, Pardo, and Cresswell suggest that benefits of an integrated system can be categorized as technical, organizational and political. Similarly, the barriers to implementation can also be categorized as: (a) turf and resistance to change. This barrier is further described as a lack of desire to bear the costs, a desire to reduce or control risk, and the need to preserve autonomy or protect an organization's position; (b) IT and data incompatibility in hardware, software and formatting; (c) differences among

organizations and their goals; and (d) environmental and institutional complexity, such as the formal hierarchy of an organization or government.

The authors indicate strategies that mitigated the barriers to successful cross-agency governmental data exchange implementations as: (a) retain autonomy of the involved agencies. For example, in the CICJIS implementation each agency maintained their legacy systems and controlled the data stored in them. This approach helps mitigate issues with turf and resistance to change as well as environmental complexity; (b) establish and exercise a governance structure. This process allowed partners to agree on data standards and established a policy that defined integration goals, mitigating technical and organizational diversity issues. CICJIS successfully employed a governance structure in migrating to a web service offering using an established XML standard for judiciary data; (c) secure strategic partnerships with other governmental agencies and external partners such as vendors and the public. This process limits IT and data incompatibility concerns. The authors suggest that disparate groups need to develop trust and understand cultural differences; (d) build on long range and comprehensive planning and develop an understanding of the business process. This approach mitigates turf and resistance concerns, IT compatibility issues, and environmental complexity; (e) develop an understanding of the business process, which helps mitigate environmental complexity and organizational diversity; (f) secure adequate financial resources to help mitigate turf concerns and IT compatibility issues; and (g) obtain and nurture executive leadership and legislative support in order to relieve tension and address resistance to change and environmental and institutional complexity concerns.

This article is relevant for this study because the authors discuss the organizational challenges associated with government data exchanges and highlights technical challenges governmental organizations face. The authors also offer examples of how governmental organizations have mitigated these issues.

Kumar, R. L., & Crook, C. W. (1999). A multi-disciplinary framework for the management of interorganizational systems. *ACM SIGMIS Database*, 30(1), 22-37. Retrieved from <https://doi.org/10.1145/342251.342258>

Abstract. Interorganizational information systems (IOS) are information technology (IT)-based systems that link multiple organizations. Management of these systems could be significantly more complex than managing IT within individual organizations. We explore the complexities of managing IOS using case studies and propose a multidisciplinary framework that includes collaboration, organization, and technology issues for the design and management of such organizations. Multiple case studies are presented to illustrate the proposed framework. Managerial and research implications are also discussed.

Summary. Kumar and Crook developed a management model for an inter-organizational system (IOS) based on literary research and a study of six organizations. They concluded that successful IOS implementation and management requires a three-pronged approach using: collaboration, including conflict management; organizational management; and technology management. The IOS implementation resulted in the exchange of data

through an electronic data interchange (EDI), though this term was used broadly and the article did not offer technical specifications.

According to the authors, collaboration was required to devise cost-sharing strategies, quantification of benefits, incentives, and frequency of transactions. Collaboration helps organizations become aware of market conditions and the competition and increase customer service, but also contributes to lock-in and switching costs. Champions were regularly identified to help promote successful conflict management; quality training programs and attentiveness by senior management were also identified as useful in encouraging effective conflict management.

Organizational factors were heavily influenced by the size of the operation, though management style was a major contributor to the success of the EDI project. All of the interviewed agencies had cultures that provided strong nurturing of champions and strong IT leadership.

The authors showed that technology factors influenced the success of implementation but they tended to be secondary. Technology concerns such as security and infrastructure are necessary IT considerations; however, the impact of the technology was at the organizational and collaboration levels. This confluence is where the management challenges are focused.

This article is relevant for this study because the authors highlight the challenges that agencies face in implementing an E-Government data exchange and propose a framework to mitigate those challenges.

Welch, E. W., Feeney, M. K., & Park, C. H. (2016). Determinants of data sharing in US city governments. *Government Information Quarterly*, 33(3), 393-403. Retrieved from <http://dx.doi.org/10.1016/j.giq.2016.07.002>

Abstract. Although the rise of big data, open government, and social media imply greater data sharing, expectations currently do not match reality as many consider data exchange in government to be inadequate. Based on prior research, Additionally, the paper distinguishes technical management capacity and technical engagement capacity effects on agencies' sharing behavior. We test hypotheses predicting sharing behavior of municipal government agencies with other agencies and with non-government organizations using data from a 2012 national survey of U.S. municipal government managers. We find that data sharing with both government and non-government organizations is more strongly determined by persuasive mechanisms and technical engagement capacity, although technical management capacity is also important for sharing with other government agencies. Conclusions provide insights for future research directions and practice.

Summary. Welch, Feeney, and Park developed and tested twelve hypotheses about the determinants of data sharing by local government agencies. The hypotheses and findings of the authors follow.

(H1) *City government agencies under greater pressure to coordinate and respond to external constituencies will be more likely to share data.*

(H1.a) *Stronger influence from external constituencies will increase the likelihood that an agency will share data.*

(H1.b) Agencies reporting regulatory requirements for greater openness of decision processes to external stakeholders will be more likely to report the use of data sharing

The authors found limited statistical support for the idea that coercion was a factor in causing agencies to share data. Outside influences seemed to not have any relevance in whether agencies shared data, while regular reporting requirements to external groups did increase the likelihood of data sharing.

(H2) Agencies that report greater participation of citizens and stakeholders in agency decision making will be more likely to share data

The authors found statistical support suggesting that inter-agency pressure for data sharing is more likely when it can be shown that public participants are interested in the data.

(H3) City government agencies with greater technical management capacity will be more likely to share data.

(H3.a) Agencies that use intranet technology are more likely to share data.

(H3.b) Agencies that have high levels of computer use will be more likely to share data.

(H3.c) Agencies with higher levels of ICT management capacity will be more likely to share data.

(H3.d) Agencies that have adopted data sharing policies and guidelines will be more likely to share data.

According to the authors, results show that one data sharing limiter is Information Communications Technology (ICT) management capacity and neither the use of intranet technologies, data sharing policies, or user sophistication have a bearing on an agency's likelihood of sharing data.

(H4) *City government agencies with greater technical engagement capacity will be more likely to share data.*

(H4.a) *Agencies that adopt open source technologies are more likely to share data.*

(H4.b) *Agencies that adopt social media technologies will be more likely to share data.*

The authors suggest that evidence shows that those with greater technical capacity, use of open source technologies and use of social media tend to be more likely to share data with other organizations in government. Welch, Feeney, and Park posit that this may be a result organizational culture that reflect organizations with the time, ability and desire to create data sharing opportunities, but that culture as a whole does not influence data sharing. The type of organization is a much stronger indicator of the likelihood of data sharing according to the authors.

This article is relevant for this study because the authors discuss the outcome of testing 12 hypotheses directly related to the challenges governmental organizations face in sharing data across organizations. The results showed weak support for the idea that coercion was a successful tactic in implementing data sharing between organizations, whereas persuasive tactics have strong support. The authors suggest that government agencies would benefit from understanding the benefits of data exchange rather than trying to force data exchange solely as a policy.

Common Data Formats in Data Exchanges

Chen, Y. C. (2012). A comparative study of e-government XBRL implementations: The potential of improving information transparency and efficiency. *Government information quarterly*, 29(4), 553-563. Retrieved from <http://dx.doi.org/10.1016/j.giq.2012.05.009>

Abstract. This study examines the e-government implementation of eXtensible Business Reporting Language (XBRL) to increase accountability and transparency in business and financial information. The business and financial information gathered in XBRL format is machine-readable and interoperable, thereby improving the ease of public dissemination and analysis. This study focuses on identifying and examining the determinants of successful XBRL implementation and draws from several bodies of literature: e-government, institutionalism, collaborative public management, regulatory compliance, and management information systems to identify determinants of successful implementation. This study selects four diverse implementations: The Netherlands, Australia, the United States, and Singapore. Empirical analysis follows a comparative case study method. The findings of this exploratory study underscore the importance of program goals and strategic alignment in achieving information transparency and efficiency, the advantage of strategies correlating to institutional setting, the critical need to provide incentives for adoption, and the usefulness of incremental implementation. The managerial and theoretical implications of these findings as well as future research opportunities are explored.

Summary. In this 2012 article, the author attempts to answer the research question “What are the determinants of successful XBRL/SBR implementation in increasing the potential of information transparency and efficiency in managing business and financial data?” He does so by investigating eXtensible Business Reporting Language (XBRL) / standard business reporting (SBR) implementations in Australia, the Netherlands, Singapore and the United States.

Chen states that XBRL/SBR can increase the efficiency of gathering business information by utilizing a single report to facilitate the filing requirements of multiple regulatory agencies. Additional efficiency can be realized as XBRL can be validated using automation. The key is to use standardized terms and precise taxonomy. Chen believes a global taxonomy will lead to more implementations utilizing all aspects of XBRL.

Successful E-Government projects start with strong management support according to Chen and the supporting literature. States with a high capacity of IT management have been shown to positively affect the implementation of E-Government transactions. As participants increase, change management as well as project management becomes critical. Skills branch beyond technology and into behavioral and social management. Chen states that phase-in implementation is a main strategy of change management and can increase the return on resources by focusing on high-value components in the first phase. Additional components can be phased in as the technology matures.

Strong political support is also critical, especially when multiple organizations are involved. Turf issues such as data ownership and control are major considerations. Chen suggests legal mandates that require the adoption of new information systems as a way to mitigate these issues.

Chen reported that the Netherlands started with the default XBRL taxonomy with the goal of improving efficiency, specifically cheaper, easier, high quality reporting. The implementation was led by a collaborative of multiple agencies. The first phase of

implementation was a four-year effort to refine the taxonomy. This effort became the SBR; the SBR reporting is voluntary.

Chen wrote that Australia's SBR program started in 2006. It is based on XBRL, which was chosen because it reduces the reporting burden of businesses. Australia regularly provides iterative updates of the taxonomy and aims to have the SBR interact with all levels of government. The reporting is voluntary, though more efficient and less burdensome for business.

According to Chen, Singapore's purpose for implementation is to improve efficiency, transparency, and accuracy of financial and business information reporting. This includes the development of a one-stop business portal. The XBRL standard was chosen due to support found in the software community. Businesses must use the system to report, but some reporting elements are voluntary.

The United States Securities and Exchange Commission (SEC) choose XBRL to improve data quality, efficiency, and transparency. The SEC is driving the initiative and chose to introduce a voluntary-to-mandatory phase-in approach to its implementation.

Chen concluded that transparency and efficiency are realized when those are the goals of the project from the outset. Chen suggests that not all potential benefits of XBRL will be realized in an implementation. For the benefit to be realized, it must be a stated goal of the project. Government-wide initiatives require strong political backing and a willingness to invest 3-5 years to reach a critical mass. Chen went on to suggest that mandatory reporting is necessary to properly incentivize adapters. Working with developers to lower software implementation costs is another of Chen's recommendations.

This article is relevant for this study because the author discusses an international format (XBRL) that is specific for sharing business data. This is a common data format for business-to-government and government-to-government data exchanges. The comparison of implementations gives guidance for potential future implementations.

Janssen, M., & Tan, Y. H. (2014, January). Dynamic capabilities for information sharing: XBRL enabling business-to-government information exchange. In *2014 47th Hawaii International Conference on System Sciences* (pp. 2104-2113). IEEE. Chicago

Abstract. Recent scandals have stressed the need for information sharing among companies and governments. The sharing of information is not easy as companies want to keep their administrative burden low, whereas governments need high information quality. These drivers have resulted in the initiating of programs for developing infrastructures for information sharing. In these programs public and private organizations work together to create infrastructures satisfying the needs of both companies and governments. The creation of business-to-government information sharing is complex and meets many organizational and technical challenges. Information sharing requires that existing information assets are used and combined, information sharing and processing capabilities are used. This would be need to be done repeatedly and rapidly in different sectors. This study investigates the dynamic capabilities necessary to realize the information sharing. Specifically, the capabilities for developing the infrastructure and the governance of the infrastructure are investigated. Our analysis shows that companies and public organizations need to create a different set of capabilities to enable information sharing. The creation of information sharing requires

extensive knowledge about the existing landscape. The infrastructure should be flexible enough to support the different situations and governance is necessary to ensure that information sharing arrangements are customized for the situation at hand and to make decisions concerning its further development.

Summary. The 2014 paper introduces the concept of *dynamic capabilities*, which the authors use to mean that an organization is adaptable to change. Organizations that have dynamic capabilities are able to adapt their resources and assets to changing environments. They are able to integrate, build and configure competencies as needed.

Janssen and Tan state that information sharing has many challenges including challenges related to management, technology, and policy. The authors report that in order to integrate government systems, interoperation of information systems is essential. The authors suggest that middleware offers the ability for interoperability and integration. The nature of heterogeneous systems and limited networking capabilities blocks integration adoption. Janssen and Tan posit that this barrier necessitates the capability to develop data exchanges. The authors further note that data exchanges require solid governance mechanisms that are adaptive and agile. Janssen and Tan suggest that this requirement infers that systems need to be modular in their design.

The need for modular dynamic capabilities lead the researchers to investigate Extensible Business Reporting Language (XBRL), with an emphasis on Standard Business Reporting (SBR). XML-based XBRL can be used to exchange business data including financial, statistical, and inspection data; taxes and more. Through the use of taxonomies, data can be customized into a one-stop-reporting system, which is the vision of SBR.

SBR is designed to collect data at the source. The data is then filtered to governmental agencies through the use of taxonomies. Governmental agencies only need to concern themselves with the creation of individual modules; the mapping of the data between systems is handled by the taxonomies. Janssen and Tan note that in addition to technical capabilities, governance plays a large role in the successful implementation of a SBR data exchange. Governance can help mitigate issues such as requiring information that does not add significant value that would be costly for participants to implement.

Janssen and Tan notes that XBRL implementations are inherently difficult. They reiterate that governance management is the mechanism to protect against failures such as requiring unnecessary data.

This article is relevant for this study because the authors discuss an international format (XBRL) that is specific for sharing business data. This is a common data format for business-to-government and government-to-government data exchanges.

Lampert, S. & Thompson, K. (2010). The importance of sharing information: Using NIEM to improve governance in developing countries. ICEGOV2010, Beijing, China, October 25-28, 2010. Retrieved from <http://dl.acm.org/citation.cfm?doid=1930321.1930351>

Abstract. This case study explores the importance of sharing information in developing countries, explains the role of standards as a critical step towards developing sustainable information exchanges, and examines the suitability of the National Information Exchange Model (NIEM) as a framework for building such exchanges. The US Government originally developed NIEM to support cross-jurisdictional information sharing between state and local governments and federal agencies. We review how the

US Government employed NIEM to facilitate reporting and improve transparency of the American Reinvestment and Recovery Act (ARRA) and propose lessons and next steps to encourage broader information sharing in general and the use of NIEM in particular. We call for the development of common standards that implementing partners and donor organizations can use -- and reuse -- in multiple countries and for multiple projects. Establishing standards is the first step to building systems that share information and enable countries to improve governance and collaborate across boundaries. Finally, we propose specific actions that the donor community can adopt to promote the emergence of these standards.

Summary. The authors of this article discuss a standard for sharing government data known as the National Information Exchange Model (NIEM). The authors use implementations in the United States as guides for developing nations. The authors claim that developing nations have a critical need to share information due to being the recipients of foreign aid. For example, they must coordinate with non-governmental organizations (NGOs), manage revenue from aid agreements, and develop means to manage and monitor aid programs. Much of the technical architecture in these countries' nascent and technical capacity is significantly limited.

The authors state that conformity is the first step to data sharing, but that in developing countries, the systems must support a wide range of technologies and partners. Lampert and Thompson highlight initiatives like International Aid Transparency Initiative (IATI) and Impact Review and Investment Standards (IRIS) as good first steps to establishing standards; they are specific solutions that do not establish a common framework. The US Department of Justice and US Department of Homeland

Security designed NIEM to develop information exchange standards that can be centrally maintained, easily discoverable, and promote reuse. In 2010, the US Government released guidance documents for all US federal agencies to evaluate the adoptions and use of NIEM in order to develop a cross-boundary information exchange.

NIEM has the ability to incorporate existing standards and charges and the governance of those standards is maintained outside of the NIEM structure. This federated approach allows NIEM to be extended. It uses eXtensible Markup Language (XML) and is able to incorporate the Global Justice XML Data Model (Global JXDM), US Department of Defense's Maritime Information Exchange Model (MIEM), eXtensible Business Reporting Language (XBRL), North American Industry Classification System (NAICS Codes) and the National Institute for Standards and Technology (NIST) geospatial standard to share location information.

Lampert and Thompson state that developers are able to customize exchanges to reflect the needs of the community while maintaining a common framework to support reuse between organizations and countries. Governance is built into the NIEM open standard. The authors believe that consistent use of NIEM results in cost savings due to its ability to reuse existing specifications.

The authors performed a case study that looked at how the Office of Management and Budget (OMB) established regular reporting on how funds for the American Reinvestment and Recovery Act (ARRA) were dispersed. According to Lampert and Thompson, the OMB chooses to utilize NIEM over XBRL for the following reasons: (a) Open standards and familiarity. Many organizations were already using NIEM and XML fit with OMB's current standards; (b) extensibility and flexibility as NIEM provides tools

for message exchange and transaction creation; (c) reuse and reconciliation. The NIEM-compliant XML aggregates data across multiple organizations.

Lampert and Thompson conclude that E-Government projects can be cost-effective, reusable and extensible by using NIEM. The authors state that projects should start with solid governance and aim to use existing standards. For successful projects, incentives and mandates need to be established. The projects should have a specific focus while also planning for reuse.

This article is relevant for this study because it defines the NIEM standard, which can be thought of as a superset of existing standards such as XBRL that provides a framework for data information exchanges.

Designing Centralized Systems for Data Exchange

Bharosa, N., Janssen, M., van Wijk, R., de Winne, N., van der Voort, H., Hulstijn, J., & Tan, Y.

H. (2013). Tapping into existing information flows: The transformation to compliance by design in business-to-government information exchange. *Government Information Quarterly*, 30, S9-S18. Retrieved from <http://dx.doi.org/10.1016/j.giq.2012.08.006>

Abstract. Transforming Business-to-Government (B2G) information exchange is a next frontier for reducing government spending while improving performance. This paper examines two different B2G information exchange architectures that reflect continuing transformations that empower some government agencies to do better compliance monitoring tasks with fewer resources. The win for the reporting companies is the lower cost of compliance. Instead of focusing on collecting compliance information from individual companies, the government agencies in this study focus on collecting

information on the supply chain level, allowing for automated data reconciliation. Our findings reveal that pushing controls (automated checks) upstream (in company software and data sources) results in more efficiency, higher information quality and reduces redundant controls. The examined architectures exhibit high levels of compliance by design, meaning that many control objectives are by default encompassed in the design. This requires a well-aligned combination of data standardization (using shared syntax and semantics) and automated information processing (using an intelligent gateway between businesses and government agencies). However, achieving such an alignment is a difficult challenge; especially when taking into account that such transformations require solid governance, trust and high initial investments — prerequisites that are rare in many public-private partnerships.

Summary. The paper examines two different data exchange Business to Government (B2G) architectures for XBRL processing. The first, a *financial reporting chain* is configured as a government gateway that has no long-term storage and routes (pushes) messages to the appropriate government entity based on reporting type. The system implements a “store once - report to many” system that is able to handle both one-to-many and one-to-one reporting relationships. The system uses a standardized XBRL taxonomy that is updated regularly. Compliance is the primary goal of the system and is built into the system by design. This “compliance by design” concept was reported to be a major challenge due to the complexities posed by the distinct workflows of the multiple agencies. The implementation utilizes a Service Oriented Architecture (SOA) with web services specific to the given process.

The second system, a meat supply chain, is a system that provides data to reporting agencies by piggy-backing off of existing supplied data. The system writes to a central system, which provides performance dashboards and makes the necessary semantic exchanges. Data is retrievable (pulled) by the reporting agencies as needed through a *single window* rather than having data arrive at the end point. The authors indicate that this approach makes the necessary semantic definitions difficult to maintain and extend, so scalability is a concern.

The authors recognize that these two architectures are merely just two examples from an array of potential arrangements. This article is relevant for this study because it compares and contrasts two different centralized architectures for exchanging business data in business-to-government data flow.

Büttner, F., Bartels, U., Hamann, L., Hofrichter, O., Kuhlmann, M., Gogolla, M., ... & Stosiek, A. (2014). Model-driven standardization of public authority data interchange. *Science of Computer Programming*, 89, 162-175.

Abstract. In the past decade, several electronic data exchange processes between public authorities have been established by the German public administration. In the context of various legacy systems and numerous suppliers of software for public authorities, it is crucial that these interfaces are open and precisely and uniformly defined, in order to foster free competition and interoperability. A community of such projects and specifications for various public administration domains has arisen from an early adopter project in the domain of data interchange between the 5400 German municipal citizen

registers. A central coordination office provides a framework for these projects that is put into operation by a unified model-driven method, supported by tools and components, involving UML profiles, model validation, and model-to-text transformations into several technical domains. We report how this model-driven approach has already proven to be effective in a number of projects, and how it could contribute to the development of standardized e-government specifications in various ways.

Summary. Büttner et al., (2014) describe a development model to follow when defining XML web services for government data exchanges, specifically the XÖV² (XÖV) specification. The model takes advantage of software development constructs such as metadata and XML schemas and software architecture modeling tools such as the Unified Modeling Language (UML) to define functions and relationships. This approach, known as Model Driven Engineering (MDE), is a mechanism to standardize specifications. The artifacts created from the MDE processes are (a) UML models and semantic references; (b) UML profiles defining domain-specific metadata and governance; (c) XGenerator, which validates the model and auto-generates the necessary specifications and files such as cursory documentation, XML schemas, and Web Service Description Language (WSDL) files; and (d) a web-based repository called XRepository to hold semantic models. The authors used the system to maintain the specifications for the XÖV-Government data exchange.

The authors recognize that project success and failure relies on many non-technical concerns. However, the authors believe that MDE has been a success based upon successful data exchange implementations that employed the MDE model. At the time of the writing several projects that followed the model were considered successful,

with 17 additional projects in the XRepository. Success was determined by the following: (a) early validation; (b) achieving XÖV conformance; (c) consistency between artifacts; and (d) efficiency.

This article is relevant for this study because the authors discuss a mechanism to create specifications for a centralized data exchange.

Wallin, K., Watson, L., & Gupta, S. (2009). *The State Business Portal (White Paper)*. Nevada: Office of the State Controller.

Abstract. Across the country, State governments are recognizing the need for streamlining the transactions and inter-agency interactions. This will help in avoiding losses, cutting costs and reducing the intricacies of setting up a business in the State, hence encouraging business.

The document outlines the contours of a “State Business Portal” application that can streamline the complete information workflow between different state agencies in a State. With the various State Agency systems, building their systems to support all inter-agency interactions and transactions with business & individual entities, one needs an integrated platform that will seamlessly integrate all their State Agency systems with minimum modifications. The purpose of this platform/portal will be to facilitate the interactions between Business Entities and all the State Agencies.

The portal will serve as a Single Access point for all business entities, right from setting up a business to obtaining licenses & permissions, to processing payments and other business transactions with the various Agencies in the State.

The portal will be built on a Service Oriented Architecture (SOA), and will seamlessly integrate the individual State Agency Information Systems, all built on different platforms using different technologies.

The document also provides a brief overview of a similar project “The Standard Business Reporting”, developed and implemented in Australia in Annexure I.

Summary. The authors introduce the concept of a one-stop state business portal (SBP) for conducting business with the state of Nevada. The authors suggest that the portal is a business-to-government and government-to-government platform based on eXtensible Business Reporting Language (XBRL).

The authors indicate that in building the portal, the first step will be to develop the taxonomy for all data, rules, policies and procedures. This is to be conducted by the taxonomy experts in collaboration with each participatory entity.

Based on the rules developed during the taxonomy phase, the workflows will be defined. The authors indicate that all registered businesses and state agencies with the proper permissions will be able to see the current status and guide business users to the next steps of the workflows.

The authors state that all interactions are logged in XBRL format and stored, allowing the system to generate reports for managing, monitoring, and viewing transactions. In order to integrate with the agencies, the authors state that a data map will be created for each state agency with one translation that converts XBRL data to the native agency format and a second that converts the native format to XBRL.

Wallin, Watson and Gupta suggest that the biggest hurdles to implementing the SBP are gathering the existing rules, policies and procedures and bringing the state

agencies together. In a section the authors title *Mass Collaboration of State Government*, they state that standardizing on a common taxonomy across multiple state agencies performing similar operations and business is possible by using the XBRL 2.1 standard as a base. This taxonomy includes concepts, functions, policies and rules.

This article is relevant for this study because it proposes state governmental data exchange. It also highlights the use of common XML/XBRL formats and an architecture to facilitate integration with state agencies.

Yang, T. M., Pardo, T., & Wu, Y. J. (2014). How is information shared across the boundaries of government agencies? An E-Government case study. *Government Information Quarterly*, 31(4), 637-652. Retrieved from <http://dx.doi.org/10.1016/j.giq.2007.09.010>

Abstract. This paper explores how information is shared across the vertical and horizontal boundaries of government agencies. Different types of information sharing are identified and discussed in terms of their strengths and encountered challenges. Centralized types of information sharing are found as a primary strategy adopted to facilitate interagency information sharing in the two dimensions. Particularly, influential determinants from type comparisons and government agencies are identified and discussed regarding what agencies may take into considerations when selecting certain types of information sharing. While there is no single type of information sharing that can satisfy all the needs and concerns of government agencies, most agencies still simultaneously employ several types of information sharing in different circumstances. A

competition-and-cooperation relationship exists among the different types of information sharing in both dimensions. The paper suggests that a balance between centralized and decentralized types of information sharing should be achieved to obtain advantages and diminish disadvantages. The similarities and differences between the types in the two dimensions are also compared and discussed. Lastly, the conclusion outlines the contribution and limitation of the current research and suggests future studies of the current work.

Summary. The article explores centralized and de-centralized data sharing between organizations in a government environment. The authors conducted interviews and a literature review. Yang, Pardo, and Wu found that sharing data between organizations is very important and that efforts are simultaneously hamstrung by separate and fragmented systems. The authors highlight that there are two primary boundaries in government data sharing. Vertical boundaries separate levels of government (local, state, federal), while horizontal boundaries exist between different agencies of the same level. Despite the need, sharing data between agencies is very challenging, not just technically, but organizationally, as the authors recognize factors including different goals, interests, values, origins, and cultures. Data sharing projects may generate resistance due to turf, budget and autonomy concerns.

Yang, Pardo, and Wu highlight four types of data sharing integration styles defined by Bekkers (2009): (a) centralization, where information is maintained and managed by a super-ordinated organization that facilitates data sharing to subordinated organizations; (b) interface connections, which are developed point-to-point with no direct access to the internal processes or database; (c) information broker (clearinghouse);

or (d) shared information infrastructure where agencies jointly interact with a single system as if it were their own.

The authors state that researchers indicate that decentralized systems result in heterogeneous environments and ambiguous governance. This, in turn, makes it difficult to integrate and can lead to duplication of resources and lack of cooperation. Conversely, centralized systems are said to facilitate cross-boundary information sharing. Yang, Pardo, and Wu claim that internet technologies such as web services are found to centralize government processes that are normally decentralized. The authors note that centralization, while technically efficient, is difficult to implement across agencies due to the divergent functions for which agencies are responsible. The authors also note disadvantages to government infrastructure centralization including not being responsive to diverse populations and shutting down innovation. Yang, Pardo, and Wu suggest that a blended approach is ideal.

This article is relevant for this study because the authors compare and contrast centralized and decentralized governmental data exchanges. They also highlight the challenges of sharing data in governmental organizations.

The Use of Service Oriented Architecture for E-Government

Iyer, L. S., Singh, R., Salam, A. F., & D'Aubeterre, F. (2005). Knowledge management for Government-to-Government (G2G) process coordination. *Electronic Government, an International Journal*, 3(1), 18-35. Retrieved from http://s3.amazonaws.com/academia.edu.documents/36600923/e-gov_2006.pdf?AWSAccessKeyId=AKIAJ56TQJRTWSMTNPEA&Expires=148013624

2&Signature=AefXD3QCAWyUDxluY5%2B2lu0AV00%3D&response-content-disposition=inline%3B%20filename%3DKnowledge_management_for_Government-to-G.pdf

Abstract. E-government is gaining momentum and has firmly established itself in addition to common terms such as 'e-commerce' or 'e-business'. Given that e-government services extend across different organisational boundaries and heterogeneous infrastructures, there is a critical need to manage the knowledge and information resources stored in these disparate systems. Semantic Web technologies have the potential to manage the knowledge and coordinate Government-to-Government (G2G) processes. Based on the foundations of Semantic Web, including ontologies, knowledge representation, multi-agent systems and web services; Knowledge Management (KM) and G2G processes, we present a vision for KM for G2G process coordination. The Semantic G2G integration can support the transparent flow of semantically enriched information and knowledge, including content and know-how and enable collaborative G2G processes within and across governmental agencies.

Summary. Iyer, Singh, Salam, and D'Aubeterre present a distributed knowledge management system for Government-to-Government (G2G) interactions built on web technologies known collectively as the Semantic Web. This system assumes existing knowledge is housed in disparate systems across multiple agencies, infrastructures and geographies. The authors define multiple facets of E-Government and focus on the inter-agency communications of G2G systems.

The premise of the Semantic Web is to bring meaning to knowledge such that automated intelligent agents can complete work autonomously. The infrastructure requires several key pieces: (a) structured collections of information and rules for a given knowledge base known as *knowledge representation*; (b) *ontologies* that formally define classes of objects and relationships; and (c) *agents* that are able to collect and exchange data. Semantic Web technologies make use of eXtensible Markup Language (XML), which Iyer, Singh, Salam, and D'Aubeterre highlight as being flexible and unambiguous and that promotes easy data exchange in heterogeneous platforms while adhering to strong standards. By leveraging existing formats such as ebXML and RosettaNet, common vocabularies built for E-Government can be leveraged. Web Ontology Language (OWL) is a formal mechanism to define ontologies and rules with an interface utilizing the common web service architecture known as Simple Object Access Protocol (SOAP).

Intelligent agents are self-contained applications that are able to retrieve, extract, organize and search data and make decisions in order to fulfill a specified goal through automation. A side benefit of these systems is that through web services they are able to talk to each other, extending their collective ability in a multi-agent environment.

Iyer, Singh, Salam, and D'Aubeterre state that because of the complexities behind E-Government, simply modeling workflows is not enough. Interoperability is necessary as documented in the European Commission's European Interoperability Framework and the Federal Enterprise Architecture (FEA). Iyer, Singh, Salam, and D'Aubeterre discuss web service architectures such as the Web Digital Government (WebDG) and the XML Government Markup Language (GovML) as means to standardize government processes

and data. The paper suggests that multi-agent systems and web services can support these G2G processes within and across governmental agencies.

This article is relevant for this study because the authors discuss web and SOA technologies as applied to the exchange of data between governmental agencies. They also highlight several format specifications that are specific to government and business data.

Jain, V., Srivastava, R., Kumar, R., Upadhyay, R., Kamal, K. K. (2011, September). *Breaking barrier to technology: E-governance messaging middleware*. In Proceedings of the 5th International Conference on Theory and Practice of Electronic Governance. (pp. 273-276). ACM. New York

Abstract. Service Oriented Architecture (SOA) has emerged as a successful technology paradigm for interconnecting applications in heterogeneous environments. National e-Governance Service Delivery Gateway (NSDG), a SOA based messaging middleware, routes messages across government departments thereby enabling cross state and cross domain service delivery, overcoming challenges of interoperability and integrations while delivering services to citizens through a single window. This paper discusses the relevance of standard based messaging middleware for integrating services at national, state and local government, and interoperability and testing challenges for such kind of implementation.

Summary. The authors of this article discuss how a Service Oriented Architecture (SOA) was developed for the National e-Governance Service Delivery Gateway (NSDG or simply Gateway) for the government of India. The authors state that the Indian government systems are heterogeneous in nature and spread across diverse geographic

regions, each with its own varying state of automation. One goal the government of India is to improve collaboration between government officials at local, state and national levels. The Gateway then becomes a middleware to act as a common platform for service delivery and reduces the effort needed to integrate with the myriad of existing applications.

According to the authors, the Gateway is built on common World Wide Web Consortium (W3C) standards including XML, Web Services Interoperability (WS-I), and Simple Object Access Protocol (SOAP). These communications technologies resolve the interoperability, integration, and scalability issues. The authors indicate that the Gateway may actually be a system of Gateways that they call the Gateway Constellation as deemed necessary at the state level. Those resources that are not offered by the local Gateway would fall back to the national Gateway. This approach avoids the tightly coupled mesh network that was necessary before the implementation of the Gateway.

The authors claim this configuration gives one-stop service access to consumers through one interface. It includes strong authentication by using W3C security measures. It is interoperable at the national level given real-time access at the local level. It has a higher degree of data integrity built into the system. The system is also transactional and includes logging and auditing.

The authors describe how SOAP is used for messaging, which includes strong security provisions and the ability to digitally sign at the block-level through XML. For the implementation, several technical issues were discussed: (a) NULL values for some data types, (b) XML Array Incompatibility, and (c) language binding for pointer-type data types.

This article is relevant for this study because the authors discuss SOA technologies as applied to the exchange of data between governmental agencies. They also highlight potential issues with XML of which developers need to be aware and introduce a multi-tier gateway architecture.

Zhiguang, W., & Ting, Y. (2010, April). A security E-government model based on service-oriented architecture. In *E-Health Networking, Digital Ecosystems and Technologies (EDT), 2010 International Conference on* (Vol. 1, pp. 280-283). IEEE. Retrieved from <http://dx.doi.org/10.1109/EDT.2010.5496582>

Abstract. Internet-based E-government has become a new work model of government departments. But due to heterogeneous and autonomous between different business systems, there are barriers in E-government systems when they are interoperating. To eliminate information silos, building a unified information-sharing platform is a necessary choice for the work of the government's information. This paper studies service-oriented application integration for E-government system and proposes a security model based on identity authentication.

Summary. In this paper, the authors explore how security can be added to a Service Oriented Architecture (SOA). The authors show that the mechanisms of SOA are well suited for E-Government. For instance, E-Government systems inherently need to be open, heterogeneous and concurrent because distributed applications need to be able to communicate with one another. Security for E-Government systems needs to be tight and have sufficient control to manage access to information. SOA meets these criteria because it is loosely coupled and hides underlying structures through web-services. It is

standards-based, relying heavily on SOAP and WSDL standards. The state-less nature of SOA allows it to operate in a modular fashion and operate as a shared service. Zhiguang and Ting state that SOA is an ideal solution for E-Government systems. Service Oriented Architecture facilitates process automation, connection pooling, exchange of information, service integration, service logic, security, and the service description.

E-Government security systems can be viewed from three levels: (a) network level, which focuses on secure communications between devices by providing encryption; (b) application and service level security, which looks at the data flow from endpoint to endpoint between applications; and (c) business integration, which can be broken into three sublevels: security and integrity; identity authentication; and non-repudiation.

As SOA uses web services, it is not uncommon for it to utilize transport-level security through SSL. Additionally, WS-Security defines a mechanism to sign and encrypt at the application level.

This article is relevant for this study because the authors discuss how security can be enabled in a Service Oriented Architecture for E-Government systems.

Conclusion

This study presents common technical and organizational challenges with the exchange of business data among governmental agencies, along with potential solutions. The Annotated Bibliography section of this paper provides sources that suggest best practices which CIOs, IT Directors and other technical government leaders will appreciate as guides for their own data exchange projects. The Annotated Bibliography is structured in four organizational themes: (a) Challenges of Data Exchange in E-Government, (b) Common Data Formats in Data Exchanges, (c) Designing Centralized Systems for Data Exchanges, and (d) The Use of Service Oriented Architecture for E-Government.

Challenges of Data Exchange in E-Government

Organizational diversity (differences between organizations) and turf are key challenges in creating data exchanges between government organizations (Chen, 2012; Gil-Garcia, Schneider, Pardo, & Cresswell, 2005; Yang, Pardo, & Wu, 2014). Even amongst data scientists who typically have a willingness to share, Douglass et al. (2014) found that program-centric organizational structures were a primary reason for poor interoperability. Gil-Garcia et al. (2005) state that government agencies tend to capture and manage information specific to their environment and that these silos of information are not very useful in promoting successful data exchange with other state agencies. In their 2008 article, Coursey and Norris found that the promise of E-Government had fallen short of the assumption that it would transform government. They posit that technology is not likely to be the primary barrier compared to organizational and political factors.

When trying to devise solutions that allow organizations to share data, Welch, Feeney, and Park (2016) noted that coercive tactics do not appear effective. Although several authors promoted legislative solutions (Chen, 2012; Douglass et al., 2014; Gil-Garcia et al., 2005), others suggest that legislative solutions take the form of supporting data sharing initiatives and clearing hurdles in a more persuasive tact (Douglass et al., 2014; Gil-Garcia et al., 2005; Welch, Feeney, & Park, 2016).

Gil-García et al. (2005) also noted that data-sharing governance should respect the autonomy of organizations. There is widespread agreement among researchers that a strong governance structure will help to bridge the diversity among organizations (Büttner et al., 2014; Gil-García et al., 2005; Jain, Srivastava, Kumar, Upadhyay, & Kamal, 2011; Janssen & Tan, 2014; Lampert & Thompson, 2010; Yang, Pardo & Wu, 2014).

Common Data Formats in Data Exchanges

Data exchanges have existed since the 1960s, but E-Government is a more recent phenomenon and is tied to web technologies (Coursey & Norris, 2008). Variations of XML standards are found in many E-Government exchanges such as the Colorado Integrated Criminal Justice Information System (CICJIS) to handle legal exchanges (Gil-Garcia et al., 2005); eXtensible Business Reporting Language (XBRL) for business data (Janssen & Tan, 2014); and the National Information Exchange Model (NIEM), an E-Government platform (Lampert & Thompson, 2010).

The United States Securities and Exchange Commission (SEC) choose XBRL, which is based on eXtensible Markup Language (XML), to improve data quality, efficiency, and transparency (Chen, 2012). Australia was an early adopter of XBRL, creating standard business

reporting (SBR) in 2006 to reduce the reporting burden to businesses (Chen, 2012). Janssen and Tan (2014) reported that the need for modular dynamic capabilities lead the researchers to investigate XBRL, with an emphasis on SBR. XBRL can be used to exchange financial data, statistical data, inspection data, taxes and more. The modularity and extensibility of XML in general and XBRL specifically are demonstrated in NIEM's ability to include multiple XML standards, including XBRL, Global JXDM, MIEM, and NAICS Codes (Lampert & Thompson, 2010).

The biggest challenge with XBRL implementations is making sure the taxonomy is correct; much of the effort when initially implementing an exchange built with languages like XBRL is spent addressing this challenge (Bharosa et al., 2013; Chen, 2014; Janssen & Tan, 2014; Lampert & Thompson, 2010).

Designing Centralized Systems for Data Exchange

The state of Nevada proposed a "State Business Portal" that would provide agencies and filing businesses with a single system to log-in and monitor the status of transactions with the state (Wallin, Watson & Gupta, 2009, p. 2). In this scenario a central system maintains and logs XBRL directly. This approach is similar to the "single window" system that Bharosa et al. (2013) describe that requires agencies to "pull" data (pp. S15-S16). A challenge with this system is the difficulty in maintaining and extending its semantic definitions (Wallin, Watson & Gupta, 2009).

Alternatively, Bharosa et al. (2013) describe a centralized system based on routing (pushing) data in a "store once, report to many" solution that focused on compliance and had many automated checks built into the system (p. S12). This system also has challenges due to the

multiple workflows that had to be considered in the real-time collection of data (Bharosa et al., 2013). These concerns are also reflected by Yang, Pardo, and Wu (2014), who highlight four types of data sharing integration styles defined by Bekkers (2009): (a) centralization; (b) interface connections; (c) information broker (clearinghouse); or (d) shared information infrastructure. Decentralized data sharing systems with loose governance result in potential duplication of data and lack of cooperation among participants (Yang, Pardo & Wu, 2014). The centralized systems are more efficient but are difficult to implement across agencies and have a tendency to not be responsive to user needs and to limit innovation (Yang, Pardo, & Wu, 2014). The balanced/blended approach advocated by Yang, Pardo, and Wu (2014) addresses these concerns.

Büttner et al. (2014) describe a Model Driven Engineering approach for developing government data exchanges. This approach allows the automatic generation of schemas, documentation and interfaces. The UML models fit well with existing software development methodologies and web technologies such as XML and WSDL.

The Use of Service Oriented Architecture for E-Government

Government agencies tend to have heterogeneous environments that need to be bridged to implement data sharing (Jain et al., 2011; Yang, Pardo, & Wu, 2014; Zhiguang & Ting, 2010). Service Oriented Architecture (SOA) is ideally suited to act as a middleware between these types of systems (Zhiguang & Ting, 2010). Additionally, security can be applied to SOA on multiple layers such as SSL at the transport layer or WS-Security at the application level, which is advantageous because the layers can complement each other.

The state-less nature of SOA allows it to operate in a modular fashion and opens the possibility of using semantic web technologies to automate knowledge gathering and sharing (Iyer, Singh, Salam, & D'Aubeterre, 2005). Systems built with SOA as the middleware are flexible and unambiguous and promote easy data exchange in heterogeneous platforms, while adhering to strong standards (Iyer, Singh, Salam, & D'Aubeterre, 2005; Zhiguang & Ting, 2010).

Summary

E-Government data exchanges have technical challenges, but government IT leaders also need to be cognizant of the organizational challenges when developing government-to-government data exchanges (Jain et al., 2011; Yang, Pardo, & Wu, 2014;). Government technology leaders should consider the natural heterogeneous environments and collaboratively build infrastructures that accommodate agencies' desires and needs to act autonomously and independently (Gil-Garcia et al., 2005). Service Oriented Architecture is well suited for these types of environments because it is an effective way to combine loosely coupled services and it provides built-in security features that are well established on the World Wide Web (Zhiguang & Ting, 2010).

Several models of push-routing versus single window pulling of information will need to be considered by IT leaders when investigating technologies to use to establish data exchanges between state agencies (Bharosa et al., 2013). XML has been well established to compliment SOA and eases interface development in heterogeneous environments (Iyer, Singh, Salam, & D'Aubeterre, 2005), and there are many XML implementations from which to choose (Lampert & Thompson, 2010).

The use of international standards can ensure compliance and improved extensibility (Lampert & Thompson, 2010). IT leaders working to establish E-Government data exchanges should investigate international standards such as XBRL as they start with a base taxonomy that can be extended (Lampert & Thompson, 2010). The initial work of setting up a thorough taxonomy and governance is critical to the success of intra-agency data exchange projects and has been shown to be very complex (Bharosa et al., 2013; Chen, 2012). However, the time required to establish these foundational E-Government data exchange components can be lengthy; IT leaders should not underestimate the effort (Chen, 2012).

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