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Web 2.0 applications in government websites: prevalence, use and correlations with perceived website quality

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Abstract

This paper investigates the extent to which Web 2.0 applications are prevalent in government websites, the ways in which Web 2.0 applications been used in government websites, as well as whether the presence of Web 2.0 applications correlate with the perceived quality of government websites. Divided equally between developing and advanced economies, a total of 200 government websites were analyzed using content analysis, and multiple regression analysis. The order of prevalence of seven Web 2.0 applications to be as follows: RSS, multimedia sharing services, blogs, forums, social tagging services, social networking services and wikis. Websites in advanced countries adopt Web 2.0 applications more commonly than those in developing countries. The presence of Web 2.0 applications was found to have a correlation with the overall website quality, and in particular, service quality. This paper only covers government websites in English. Emerging genres of Web 2.0 applications such as mashups and virtual worlds have not been included. Also, data were drawn completely from the public domain. Decision makers and e-government web developers may benchmark their own efforts in deploying Web 2.0 applications against this study. The numerous exemplars cited here serve as a springboard to generate more ideas on how Web 2.0 applications could be used and harnessed to improve the overall quality of government websites. This paper represents the effort to dovetail two strands of research interests, namely, Web 2.0 and website quality. It also extends current works by investigating the suite of Web 2.0 applications found in government websites globally.

1. Introduction

The advent of the Internet not only revolutionizes the way governments collect and disseminate information from citizens but also redefines public expectations of government agencies and their services. To a large extent, the interactions between governments and their citizens are shaped by e-government initiatives, which refer to a slew of efforts ranging from creating an online presence, allowing citizens to transact with government electronically to integrating scattered systems at different levels and for different services (Layne & Lee, 2001).

To move in tandem with the growing sophistication of their citizens, governments from different countries are striving to offer high quality online experiences via their websites. A number of government agencies such as those in Singapore are undergoing fundamental shifts in the way they see their citizens and in how they offer their services (Chan, et al., 2008). Rather than treating them as mere consumers, citizens are being recognized as partners and co-creators of information and services. Riding on the wave of Web 2.0, the thrust is to engage citizens on multiple fronts including soft issues such as public relations and public service announcements as well as core internal tasks such as intelligence services and patent reviews (Osimo, 2008). Such novel approaches of connecting with citizens through Web 2.0 applications create conditions for improving transparency and fostering innovation (Meijer & Thaens, 2010).

Web 2.0 represents an emerging suite of applications that are interactive, context-rich and easy-to-use (O' Reilly, 2007). The explosion of user-generated content on the Internet points to the immense potential of Web 2.0 in enriching communication and enabling collaboration in an unprecedented scale. Nonetheless, little work has been done hitherto to examine the extent to which the suite of Web 2.0 applications has been implemented in government websites globally. While extant works have examined Web 2.0 in e-government, they either tend to be confined to a local context of inquiry (e.g. Brandao & Batista, 2009; Kalnes, 2009) or focused on a singular Web 2.0 application such as blogs (Koop & Jansen, 2009), video-sharing service (e.g. Carlson & Strandberg, 2008) or wikis (Decman, 2009). Meanwhile, amid the ongoing research on the quality of government websites, the correlation between the implementation of Web 2.0 applications and the quality of government websites has yet to be established.

For these reasons, this paper seeks to address the following three research questions: (1) To what extent are Web 2.0 applications prevalent in government websites? (2) In what ways have Web 2.0 applications been used in government websites? (3) Does the presence of Web 2.0 applications correlate with the perceived quality of government websites?

This paper represents the effort to dovetail two strands of research interests, namely, Web 2.0 and website quality. It also extends current works by investigating the suite of Web 2.0 applications found in government websites globally. Thus, decision makers and e-government web developers may benchmark their own efforts in deploying Web 2.0 applications against this study. The numerous exemplars cited here serve as a springboard to generate more ideas on how Web 2.0 applications could be used. In addition, decision makers in government agencies may better appreciate how Web 2.0 applications can be harnessed to improve the overall quality of their websites.

2. Literature Review

2.1 Web 2.0 Applications

Web 2.0 can be seen as a shift in both technology and usage paradigms. Unlike traditional information systems, its key technological features are light-weight programming techniques, many-to-many networks as well as personalization of data and services. A distinct departure from the traditional provider-consumer model, Web 2.0 has reformed the usage on the web so that any user can become both sender and receivers of information (Meijer & Thaens, 2010). As a result, Web 2.0 characteristics include social networks formation, rich and interactive interface, high user control and mass participation (Lai & Turban, 2008).

As the technical infrastructure of the Web matures, it becomes increasingly easy to create new applications by modifying existing applications or integrating smaller ones. This leads to a proliferation of Web 2.0 applications. One classification scheme organizes Web 2.0 applications into the ways in which they have been used. These include information sharing which allows content such as documents and video to be exchanged; grassroots mobilization which facilitates bottom-up participation in spreading news and opinions; community building which enables users to socialize and meet new friends as well as the creation of new services such as the digital marketplace where buyers and sellers are drawn together (de Kool & van Wamelen, 2008).

Another classification scheme specifies seven categories of Web 2.0 applications (McDermott, 2007). Publishing platforms allow users to disseminate their content; social networking services forge social relationships amongst users; democratized content networks enable user to add, edit or rate content; virtual networking platforms offer an environment within which users interact with each other through personalized avatars; information aggregators collect headlines on a single topic from a collection of Internet sources; edited social news platforms allow users to read, submit and comment on news stories; content distribution services enable users to create, share, tag and search for content.

A third classification scheme considers the domains of usage in the context of government activities and concerns (Osimo, 2008). They are regulation, cross-agency collaboration, knowledge management, political participation, service provision and law enforcement. The underlying patterns of usage in these domains are characterized by the ease with which user-generated content is shared and managed.

For the purpose of this paper, a classification scheme based on the information-intensive services rendered by government agencies is proposed. Sharing a similar perspective with an earlier work that organizes different Web 2.0 applications for libraries (Chua, et al., 2008), it is anchored on the classical dimensions of information work, namely, information acquisition, information dissemination, information organization and information sharing (Harvey, et al., 1997; Bates, 1999). These dimensions differ from other major processes in the information lifecycle such as creation, processing and use (Detlor, 2010) in that they allow for explicit observation on government websites.

Information acquisition refers to the gathering of information from sources external to government agencies. Web 2.0 applications that support information acquisition include discussion forums and wikis. For example, discussion forums hosted by the Federal Motor Carrier Safety Administration were used to solicit opinions, experiences and feedback for improving land transport safety (Stanley & Weare, 2004). Intellipedia, a wiki-based platform allows analysts from different agencies to share intelligence data and collaborate (Osimo, 2008).

Information dissemination refers to the unilateral distribution of information by government agencies to their users. Blogs and Rich Site Summary (RSS), known also as 'Really Simple Syndication', are Web 2.0 applications that support information dissemination. Usually written in a personal voice, blogs can make the workings of government agencies more accessible to anyone interested (Chavan, 2004). They may also facilitate feedback from the public by allowing threaded comments. RSS can be used to keep users informed of changes made to Web content without requiring them to re-visit the website.

Information organization refers to the representation of content to facilitate subsequent search and retrieval. Web 2.0 applications such as social tagging services, known also as folksonomies, support information organization by allowing users to annotate websites using freely assigned keywords to categorize Web content (Goh, et al., 2009). The Canadian Government's Business and Consumer website, for example, leverages on folksonomies to package information to specific audiences (Richard, 2009).

Information sharing refers to the multi-way flow of information among government agencies and their users. Unlike information dissemination process in which government agencies largely play the role of information sources, information sharing opens the possibility for citizens to become producers and architects of information. Applications which support information sharing include multi-media sharing, discussion forums and social networking services. For example, law enforcement agencies are able to promote greater citizenry participation in reporting traffic offences by allowing users to upload photos of cars parked illegally (Osimo, 2008). They have also been able to encourage citizens to identify alleged criminals by posting surveillance footage of crimes on video sharing service YouTube (Maxcer, 2007). Through discussion forums and freely available social networking services such as MySpace and Facebook, government agencies can endeavor themselves to citizens, raise awareness about government policies and broaden their contact base.

Table 1 highlights examples of Web 2.0 applications that support the various dimensions of information work in government agencies. It also lays the theoretical foundation to address the research questions.

Table 1: Examples of Web 2.0 applications that support information work in government agencies

Information work	Description	Examples of Web 2.0 applications
Information acquisition	Gathering of information from sources external to government agencies	Discussion forums Wikis
Information dissemination	Distribution of information by government agencies to users	Blogs RSS
Information organization	Representation of content to facilitate subsequent search and retrieval	Social tagging services
Information sharing	Bilateral flow of information between government agencies and users	Multimedia sharing services Social networking services

2.2 Website Quality

Research interest in developing evaluation approaches for websites have gone unabated for almost a decade. Much of the initial efforts have been focused largely on the quality of e-commerce websites. For example, WebQual (Barnes & Vidgen, 2002) specifies three categories of quality, namely, usability, information quality and service interaction quality. Likewise, e-SERVQUAL (Zeithaml, et al., 2002), which measures e-service quality provided by online retailers, comprises four dimensions,

namely, efficiency, reliability, fulfillment, and privacy. LibQual+ (Sessions, et al., 2002), which serves similar purposes for libraries, have been adapted for library websites. A total of 10 quality factors including ease of use, ease of access, aesthetics and linkage have been identified (Hernon & Calvert, 2005).

As more e-government websites emerge, attention has been trained on the extent to which government-related information and services have been efficaciously provided. For example, in studying users' perception of e-government services offered in Thailand, Sukasame (2004) elicited five factors namely, content, linkage, reliability, ease of use, and the provision of self-service. Papadomichelaki, et al. (2006) highlighted service, content, system and organization as the four key dimensions which influence the quality of e-government services. Eschenfelder, et al. (1997) investigated how United States Federal Government websites achieve their mission of reaching out to the public in terms of two major aspects, namely, information content and ease of use. An extension to Nielsen's usability heuristics, g-Quality (Garcia et al., 2005) which was developed to analyze e-government websites, comprises five criteria, namely, cognitive effort, tolerance, reach, physical effort and trust. Teo, et al. (2008) further found that citizens' trust in government affected the perceived quality of e-government websites, which in turn affected satisfaction and continued usage intention. Building on the above models, this paper proposes a quality framework for evaluating websites. Keeping the principle of parsimony in view, the framework covers three aspects of quality. These are system quality, information quality and service quality (Teo, et al., 2008). Collectively, they have implications on intention to use, actual use and user satisfaction, resulting in benefits such as improved decision-making and productivity (Delone and McLean, 2003; Petter, et al., 2008).

System quality can be conceived as a measure of a website's functionality. It comprises four dimensions, namely, usability, responsiveness (Delone and McLean, 2003), ease of access (Lee, et al., 2010) and privacy (Zeithaml, et al., 2002). Usability is an attribute that describes how easily and quickly a website can be used. It is influenced by the way the website is organized, labeled and navigated (Nielsen, 2000; Rosenfeld & Morville, 2002). Responsiveness refers to the speed at which information from a website is retrieved and downloaded. Unacceptably poor downloading speed is likely to deter users from revisiting a given website (Helander, 2000). Ease of access refers to the extent to which a website can be easily located using common search engines such as Yahoo! and Google. Privacy pertains to the protection of personal information against leakage, and the implementation of online security features to ensure a safe experience for users (Friedman, et al., 2000; Garcia, et al., 2005).

Information quality is defined as the measure of the value which the information provides to a user (Halaris, et al., 2007). More specifically, information quality can be conceived in terms of four dimensions: accuracy, dependability, coverage and ease of use (Kahn, et al., 2002; Blooma, et al., 2008; Eschenfelder, et al., 1997). Accuracy refers to the extent to which information is error-free, complete and consistently represented. It is influenced by the clarity of the information, as well as the reliability of the sources from which information is drawn. Dependable information is current, reliable and given in an appropriate manner. Broken links and orphan pages, for example, undermine the reliability of the information (Olsina & Rossi, 2002). Coverage refers to the breadth of the information presented, including the availability of both current and archival materials (Dragulanescu, 2002). Ease of use of information pertains to its accessibility and ease of manipulation (Strong, et al., 1997; Kahn, et al., 2002).

The concept of service quality focuses on the gap between users' expectations and the service delivered (Mitra & Gupta, 2008). In the context of government websites, service quality not only encompasses system quality and information quality dimensions (Zeithaml, et al., 2002) but also four others, namely, empathy, interactivity, playfulness and aesthetic appeal. Empathy is the extent to which individualized information and attention have been given to the users. It is evoked from a sense of emotional connections through the provision of communication channels including email, chats, and mailing lists (Chen & Yen, 2001). Interactivity is the extent to which users can exercise control and exchange information on a website (Hoffman & Novak, 1996). The higher the level of interactivity afforded by a website, the greater the users' overall satisfaction (Teo, et al., 2003). Playfulness, which represents the degree of cognitive spontaneity in online interactions (Webster & Martocchio, 1992), has the potential to sustain users' attention through fun and enjoyment. Examples of applications on

a website which can offer playful activities include online games and software downloads. Aesthetic appeal is related to the choice of colors, fonts, graphics and overall layout on a website. Websites which are visually attractive tend to influence users' perception of their usefulness and ease of use (van der Heijden, 2003).

Summarized in Table 2 is a quality evaluation framework for government websites. This framework is used in conjunction with findings from the Research Question 1 to address Research Question 3.

Table 2: The quality evaluation framework for government websites

Aspects of quality	Dimensions	Description	References
System quality	Usability	Ease with which users can use website easily and quickly	Delone & McLean (2003); Nielsen (2000); Rosenfeld & Morville (2002) Lee, et al. (2010)
	Responsiveness	Speed of accessing and downloading information from website	
	Ease of access	Ease with which website can be located using search engines	
	Privacy	Protection against personal information leakage and the prevention of identity fraud	
Information quality	Accuracy	Extent to which information is error free, complete and consistently represented in website	Eschenfelder, et al. (1997); Bloom, et al. (2008)
	Dependability	Extent to which information on the website is current, reliable, and given appropriately	Olsina & Rossi (2002)
	Coverage	Breadth of the information presented on website	Dragulanescu (2002)
	Ease of use	Accessibility and ease of manipulation of information on website	Strong, et al. (1997); Kahn, et al. (2002).
Service quality	Empathy	Extent to which individualized information and attention have been given to users	Chen & Yen (2004)
	Interactivity	Extent to which users can exercise control and exchange information on website	Hoffman & Novak, (1996); Teo, et al. (2003)
	Playfulness	The degree of cognitive spontaneity in online interactions	Webster & Martocchio (1992)
	Aesthetic appeal	The use of fonts, colors, layout, and graphics on the website	van der Heijden (2003)

3. Research method and procedure

3.1 Selection of government websites

The selection of government websites was done via a two-step approach. The first involved identifying countries from The World Economic Outlook Database 2009 (<http://www.imf.org/external/pubs/ft/weo/2009/01/weodata/index.aspx>) published by the International Monetary Fund which lists a total of 180 countries. The second step involved using search engines such as Google, Yahoo! and MSN to trawl the websites of five common government agencies in each country, namely, education, environment, financial, health and justice (Lenk & Falken-GroBer, 2009). Countries without an official website in English for any of these agencies were excluded.

Out of 45 countries (21 advanced and 24 developing) which met the selection criteria, 40 countries (20 advanced and 20 developing) were randomly chosen as shown in Table 3. With five government agencies' websites drawn from each country, a total of 200 websites was yielded for further analysis.

Table 3: Developing and advanced countries selected

Advanced countries		Developing countries	
<ul style="list-style-type: none"> • Australia • Canada • Denmark • Finland • Germany • Iceland • Ireland • Japan • Korea • Malta 	<ul style="list-style-type: none"> • Netherlands • New Zealand • Norway • Singapore • Slovakia • Slovenia • Sweden • Switzerland • U.K. • U.S.A. 	<ul style="list-style-type: none"> • Brunei Darussalam • Estonia • Fiji • India • Jamaica • Kazakhstan • Latvia • Lithuania • Mauritius • Montenegro 	<ul style="list-style-type: none"> • Pakistan • Papua New Guinea • Philippines • Poland • Rwanda • South Africa • Sri Lanka • Swaziland • Thailand • Zimbabwe

3.2 Methods of data analysis

The websites selected were analyzed during a four-month period between January 2010 and April 2010 using a three-step content analysis (Krippendorff, 2003). The aim of the first step was to determine the presence of the various Web 2.0 applications. Three graduate assistants (henceforth known simply as coders), who held qualifications in information systems and were familiar with Web 2.0 applications, independently analyzed a pilot set of 35 websites randomly selected out of the original 200. Content on the websites as well as hypertext links such as 'government services', 'news', 'publications' and 'resources' were accessed to check for the availability of Web 2.0 applications. Where dedicated search functions were available on the websites, keywords such as "blogs," "wiki," and "tagging" were entered to retrieve Web pages that may not have been linked to the home page. To augment website-specific search, specific government agencies' names were entered as search terms in popular search engines including Google, Yahoo!, and MSN. Searches were also done directly on major social networking sites such as FaceBook, LinkedIn and MySpace to locate the official accounts which bore the agencies' names.

Informed by Table 1 presented earlier, the coding scheme covered four dimensions of information-related work, which are further divided into seven variables, namely blogs (B), wikis (W), rich site summary (RSS), social tagging services (STS), multimedia sharing services (MMS), discussion forums (F) and social networking services (SNS). The variables were coded either as 'yes' or 'no' to denote the presence or absence of the respective Web 2.0 application. For each Web 2.0 application found, a second step of analysis was done to study how the application was used. Messages in text, sound and video format delivered via a given Web 2.0 application were broken into themes using content analysis to better understand the discourse surrounding the type and nature of information and services offered. Additionally, intended addressees and the intent of the Web 2.0 application in relation to government services were studied.

The final step of the analysis involved the evaluation of the websites using the quality framework developed in Table 2. All three coders familiarized themselves with the framework and sought to forge a consistent frame of understanding on each quality dimension. Thereafter, they independently rated the 35 websites using a 5-point Likert-scale (1 = strongly disagree, 5 = strongly agree) to denote the extent to which they agreed with whether a given quality dimension could be observed. A copy of the scoring sheet can be found in Appendix 1.

The findings had to be checked for intercoder reliability since multiple coders were involved. In particular, Cohen's kappa was used to establish the reliability of the coding for the presence of Web 2.0 applications as well as the ratings for the quality dimensions. The pair-wise Cohen's kappa fell

within the range of 0.82-0.91 and 0.71-0.86 respectively, suggesting acceptable inter-coder reliability values. The reliability of the findings on the use of Web 2.0 applications, which was qualitative in nature, was checked in a face-to-face meeting among the coders. The coders took turns to share their findings on each website and consensually resolved differences among them. Finally, the coders divided the rest of the 165 websites equally among themselves and repeated the process of (1) determining the presence of Web 2.0 applications, (2) studying how the applications were used and (3) rating the websites' quality.

4. Findings

4.1 Prevalence of Web 2.0 applications

All four categories of Web 2.0 applications, namely those that support information acquisition, dissemination, organization and sharing could be found. Shown in Table 4, RSS services are most popular (97/200 = 49%), followed by multimedia sharing services (75/200 = 38%), blogs (51/200 = 26%) and forums (40/200 = 25%). Web 2.0 applications which are less prevalent include social tagging services (34/200 = 17%), social networking services (30/200 = 15%) and wikis (5/200 = 3%).

Table 4. Number of websites featuring Web 2.0 applications by country economic status

Country economic status	Information Acquisition		Information Dissemination		Information Organization	Information Sharing	
	F	W	B	RSS	STS	MMS	SNS
Advanced	25	3	34	68	30	56	23
Developing	15	2	17	29	4	19	7
Total (N = 200)	40	5	51	97	34	75	30

F = Forums; W = Wikis; B = Blogs; RSS = Really Simple Syndication; STS = Social tagging services
MMS = Multimedia sharing services; SNS = Social networking services

In terms of country economic status, government websites in advanced countries were found to adopt Web 2.0 applications more commonly than those in developing countries. Chi-square analyses indicate the differences in prevalence to be statistically significant for blogs [$\chi^2(1, N = 200) = 7.606$, Cramer's $V = .195$, $p < .05$], RSS [$\chi^2(1, N = 200) = 30.447$, Cramer's $V = .390$, $p < .05$], social tagging services [$\chi^2(1, N = 200) = 23.955$, Cramer's $V = .346$, $p < .05$], multimedia sharing services [$\chi^2(1, N = 200) = 29.205$, Cramer's $V = .382$, $p < .05$] and social networking services [$\chi^2(1, N = 200) = 10.039$, Cramer's $V = .224$, $p < .05$]. Furthermore, Cramer's V statistic reveal that three Web 2.0 applications which show strong associations with the country economic status are RSS, multimedia sharing services and social tagging services. Conversely, the prevalence of discussion forums [$\chi^2(1, N = 200) = 3.125$, Cramer's $V = .125$, $p = .075$] and that of wikis [$\chi^2(1, N = 200) = 1.846$, Cramer's $V = .096$, $p = .184$] were not statistically significant.

Table 5. Number of websites featuring Web 2.0 applications by agencies

Agencies	Information Acquisition		Information Dissemination		Information Organization	Information Sharing	
	F	W	B	RSS	STS	MMS	SNS
Education	13	1	12	17	9	15	9
Environment	9	1	13	20	7	19	13
Finance	6	2	9	20	5	14	3
Health	7	1	10	21	7	16	3
Justice	5	0	7	19	6	11	2
Total (N = 200)	40	5	51	97	34	75	30

F = Forums; W = Wikis; B = Blogs; RSS = Really Simple Syndication; STS = Social tagging services
MMS = Multimedia sharing services; SNS = Social networking services

Shown in Table 5 are the results tabulated by agency type. The differences in the prevalence of Web 2.0 applications among the government agencies appear less stark than those between developing and advanced countries. While no particular agency consistently embraced all categories of Web 2.0 applications most extensively, environment agencies' lead in the prevalence of social networking services vis-à-vis the rest was found to be statistically significant [$\chi^2(4, N = 200) = 18.039$, Cramer's $V = .300$, $p = .001$]. On the other hand, the prevalence of discussion forums [$\chi^2(4, N = 200) = 6.250$, Cramer's $V = .177$, $p = .181$], wikis [$\chi^2(4, N = 200) = 2.051$, Cramer's $V = .101$, $p = .726$], blogs [$\chi^2(4, N = 200) = 3.000$, Cramer's $V = .122$, $p = .558$], RSS [$\chi^2(4, N = 200) = .921$, Cramer's $V = .068$, $p = .922$], social tagging services [$\chi^2(4, N = 200) = 1.559$, Cramer's $V = .088$, $p = .816$] and multimedia sharing services [$\chi^2(4, N = 200) = 3.627$, Cramer's $V = .135$, $p = .459$] were not statistically significant.

4.2 Use of Web 2.0 applications

Discussion forums are used to build online communities of like-minded individuals whose threaded discussions could provide clues into their collective thought processes. The Department of Education, Employment and Workplace Relations in Australia, for example, hosts dedicated youth discussion forums to solicit opinions and suggestions on a range of themes such as schemes for new long-term disability care and support as well as ideas to commemorate the Anzac centenary. New Zealand's Ministry of Education uses discussion forums to draw ideas on topics such as literacy and pedagogy in an effort to validate and improve its education system.

Wikis represent another means by which governments can tap subject-specific expertise of their citizens. The Ministry of Education in Singapore offers wikis related to different themes such as the Racial Harmony Day which attracts contributions pertaining to the various festivals celebrated locally. The U.S. government hosts a wiki collection called "ColabWiki" with covers diverse subject matter ranging from space exploration to federal spending.

Traditionally confined within the sphere of personal expressions, blogs are now used as a medium to disseminate government information and public policies to citizens. To exemplify, the U.S. Department of Justice hosts a 'Justice Blog' where updates on judicial matters are regularly uploaded while the Danish Ministry of Education features blogs for policy makers to interact with students on a range of education topics. Increasingly, blogs are also being exploited by individual officials to give the government a personalized voice. The Singapore Health Minister, for one, frequently shares his views on local healthcare issues through his blogs while the Environment Protection Minister of Australia champions the cause of the endangered whale population via Twitter, a micro-blogging service.

To keep citizens abreast of the latest government decisions, policies and services, several government websites syndicate their content via RSS feeds. For example, the Sweden Ministry of Justice provides RSS feeds for the current legal news including newly enforced legislations while the Finland Ministry of Finance offers RSS feeds for press releases, speeches and publications as a way to address emerging concerns on financial markets. RSS feeds are also used to meet citizens' information needs. The Ministry of Finance in Montenegro offers RSS feeds for a wide range of finance-related topics including press releases, interviews, annual reports and budget announcements. Likewise, the Fiji Ministry of Health features RSS feeds for blogs, videos and articles related to health.

Social bookmarking tools are used in websites of government agencies to help citizens tag, share and search for Web resources. For example, the ministry of education and culture in Finland offers a list of social bookmarking tools such as Delicious, Digg and StumbleUpon to allow citizens to bookmark and share the content of its web pages. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety in Germany uses a specially designed notepad that enables citizens to compile a list of links and thereafter open, print or email the content. The Ministry of Justice and the Police in Norway has a similar feature except that citizens need to enter both a personal email address and that of the recipient's.

The use of multimedia sharing services not only gives government agencies a more dynamic web presence but enlivens the interactions with and among citizens. For example, Japan's Ministry of Education, Culture, Sports, Science and Technology has a dedicated channel called "MEXT Ch" on Youtube, a video sharing service, which hosts videos related to sports, education and culture. Citizens can respond by posting comments to each video clip. Similarly, Fiji's Ministry of Health provides health-related videos on topics such as H1N1 and HIV Aids which can be subscribed as iTunes Podcast feeds, shared via the email, and commented by citizens. On the other hand, Environment Canada uses Flickr, an image and video sharing service, to display and solicit responses to photos on conferences, ministerial trips and meetings related to environmental issues.

Government agencies use social networking services to build social connections with citizens and engage them at a personalized level. The US Department of Justice uses its account on Facebook, a social networking service, to share legal news and publications as well as foster feedback. Likewise, Environment Canada uses Facebook as a platform to discuss environmental concerns. The Singapore Ministry of Health has a presence in Facebook in which Minister for Health shares both personal insights and official views with citizens. Germany's Federal Ministry of Education and Research, Swiss Federal Department of Finance and New Zealand Treasury have accounts in LinkedIn, a business-oriented social networking service. While agency-related information is scanty, citizens can establish contacts with government employees listed thereon.

4.3 Correlations between Web 2.0 applications and perceived website quality

Scores for system quality, information quality, and service quality were calculated by taking the average of the scores from their constituent dimensions, yielding a minimum value of one and maximum value of five. The overall quality was computed by adding the scores of the three aspects of quality, yielding a minimum value of three and a maximum value of 15.

Shown in Table 6 are the averages and standard deviations of the quality of government websites. The ANOVA results show statistically significant differences between the website quality of advanced countries and those of developing countries ($F=10.505$, $p < 0.01$, df 198). However, website quality across the five government agencies shows no statistically significant differences ($F = .468$, $p=.75$, df 4).

Table 6. Quality of government websites

	Advanced Countries				Developing Countries			
	System quality (a)	Info quality (b)	Service quality (c)	Quality (a+b+c)	System quality (a)	Info quality (b)	Service quality (c)	Quality (a+b+c)
Education	3.39 ±.82	3.8 ±.93	3.29 ±1.12	10.48 ±2.65	2.08 ±.61	2.6 ±.86	2.01 ±.55	6.69 ±1.42
Environment	3.51 ±.86	3.86 ±1.02	2.98 ±1.06	10.35 ±2.76	2.38 ±.74	2.83 ±1.2	2.41 ±1.01	7.61 ±2.37
Finance	3.24 ±.86	3.89 ±1.09	2.88 ±1.06	10 ±2.77	2.23 ±.64	2.66 ±1.16	1.93 ±.88	6.81 ±2.33
Health	3.25 ±.96	3.58 ±1.08	2.76 ±1.35	9.59 ±3.22	2.45 ±.71	2.43 ±.8	2.11 ±1.03	6.99 ±2.18
Justice	3.39 ±.75	4.06 ±1.12	2.81 ±.94	10.26 ±2.15	2.20 ±.59	2.19 ±.46	1.7 ±.66	6.09 ±1.52

Multiple regression was used to check for the correlation between the presence of Web 2.0 applications and the quality of government websites. Four regression models were constructed, each comprising seven independent variables, namely, F, W, B, RSS, STS, MMS and SNS while the dependent variables were Quality (Q), System Quality (SysQ), Information Quality (InfoQ), and Service Quality (SvcQ) respectively.

Model 1 in Table 7 shows that the combined effect of all seven independent variables account for 67.1% of the variability of the dependent variable Q. There is statistical evidence to support the

correlation between the presence of Web 2.0 applications and the overall website quality [$F(7, 192) = 55.882, p < .001$]. Except for SNS, all independent variables were found to be statistically correlated with Q ($p < .05$). The strength of correlations of the independent variables in Model 1 in descending order is as follows: RSS (.362), MMS (.273), B (.146), F (.128), STS (.123) and W (.092).

In terms of the specific aspects of website quality as shown in Models 2, 3, and 4, the independent variables have the strongest influence on SvcQ ($R^2 = .645$), followed by SysQ ($R^2 = .561$) and InfoQ ($R^2 = .491$). Moreover, there is statistical evidence to support the correlations between the presence of Web 2.0 applications and SysQ [$F(7, 192) = 34.982, p < .001$], InfoQ [$F(7, 192) = 26.418, p < .001$] and SvcQ [$F(7, 192) = 49.773, p < .001$].

More granularly, Model 2 shows independent variables (B, F, RSS, STS and MMS) and dependent variable (SysQ) to be statistically correlated ($p < .05$) while Model 3 shows independent variables (RSS, MMS and SNS) and dependent variable (InfoQ) to be statistically correlated ($p < .05$). Model 4 shows independent variables (B, F, RSS, STS and MMS) and dependent variable (SvcQ) to be statistically correlated ($p < .05$).

Thus, on a given government website, the presence of individual Web 2.0 applications generally appear to correlate with its overall quality. Specifically, RSS and multimedia sharing services consistently correlate with all three different aspects of quality, namely, system quality, information quality and service quality. On the other hand, blogs, discussion forums and social tagging services correlate with system quality and service quality but not information quality; social networking services correlates with information quality while wikis does not correlate with any specific aspects of quality.

Table 7. Regression models

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.	R Square	F
		B	Std error					
1 ^a	Constant	24.376	.707		34.480	.000	.671	55.882
	B*	3.883	1.511	.146	2.570	.011		
	F*	3.693	1.298	.128	2.844	.005		
	W*	6.801	3.286	.092	2.070	.040		
	RSS*	8.375	1.094	.362	7.659	.000		
	STS*	3.779	1.477	.123	2.557	.011		
	MMS*	6.511	1.225	.273	5.314	.000		
	SNS	3.493	1.814	.108	1.926	.056		
2 ^b	Constant	8.408	.263		31.960	.000	.561	34.982
	B*	1.483	.562	.174	2.639	.009		
	F*	1.391	.483	.150	2.879	.004		
	W	2.211	1.223	.093	1.808	.072		
	RSS*	2.429	.407	.326	5.969	.000		
	STS*	1.629	.550	.164	2.962	.003		
	MMS*	1.734	.456	.226	3.803	.000		
	SNS	.097	.675	.009	.143	.886		
3 ^c	Constant	9.455	.359		26.306	.000	.491	26.418
	B	1.121	.768	.103	1.460	.146		
	F	-.033	.660	-.003	-.051	.960		
	W	2.070	1.670	.068	1.239	.217		
	RSS*	3.748	.556	.397	6.742	.000		
	STS	.722	.751	.057	.961	.338		
	MMS*	1.825	.623	.187	2.929	.004		
	SNS*	2.297	.922	.174	2.491	.014		
4 ^d	Constant	6.513	.277		23.536	.000	.645	49.773
	B*	1.279	.591	.128	2.162	.032		
	F*	2.336	.508	.215	4.595	.000		
	W	2.519	1.286	.090	1.959	.052		

	RSS*	2.198	.428	.252	5.135	.000		
	STS*	1.428	.578	.123	2.469	.014		
	MMS*	2.925	.480	.328	6.155	.000		
	SNS	1.100	.710	.090	1.549	.123		

- a. Dependent variable: Q
- b. Dependent variable: SysQ
- c. Dependent variable: InfoQ
- d. Dependent variable: SvcQ

* p <.05

5. Discussion

Three main findings can be culled from the data collected. First, the adoption of Web 2.0 applications in government websites is generally limited. Except for RSS which can be found in nearly half of all government websites analyzed, the rest of the Web 2.0 applications are featured sparingly. Nonetheless, government websites in advanced countries lead in the adoption of information dissemination applications (i.e. blogs and RSS), information organization application (i.e. social bookmarking services) and information sharing applications (i.e. multimedia sharing services) when compared to their counterparts in developing countries. This may well be a reflection of the three distinct aspects of digital divide, namely, a divergence of internet access between advanced and developing economies, a gap between the information rich and poor, and a difference between those who do and do not use digital means to engage in public life (Helbig, et al., 2009). In fact, as of 2010, the internet penetration rates of North America, Oceania/Australia and Europe stand at 77.4%, 61.3% and 58.4% respectively, while those in Latin America, Asia and Africa lag at 34.5%, 21.5% and 10.9% (<http://www.internetworldstats.com/stats.htm>). Thus, in response to the expectations of their technologically sophisticated citizens, governments in advanced countries not only embrace Web 2.0 applications to a greater extent but also host websites of higher quality vis-à-vis those in developing countries.

Across government agencies, the disparity in Web 2.0 adoption is less stark. Only the difference in the prevalence of social networking services was found to be statistically different among the agencies, with the Environment agencies showing the highest rate of adoption. Moreover, compared to the rest, Environment agencies tend to lead in information dissemination applications, namely, blogs and RSS, as well as information sharing applications, namely, multimedia sharing services and social networking services. One possible reason could be the widespread recognition of global warming which led to climate intervention policies such as the Kyoto Protocol. Common ways to generate public awareness of environmental issues include education (Strife, 2010) and public engagement (Monroe, et al., 2009), both of which lend themselves to be well supported via Web 2.0 applications.

Next, the ways in which Web 2.0 applications are used in government websites both in advanced and developing economies suggest a citizen-centric orientation in information and services delivery. For example, discussion forums, blogs and wikis have been structured thematically according to citizens' concerns and needs, as seen from the websites of education agencies in countries such as Australia, New Zealand, Singapore and Denmark. Furthermore, governments which have usually been shrouded in an air of secrecy and formality, are using Web 2.0 to put a human face on their officials. When the element of humanity is infused into government websites, it helps develop an emotive connection between governments and citizens. This engenders trust, which has been found to be a crucial factor in influencing the perception e-government website quality (Teo, et al., 2008). Consequently, usability and acceptance of e-government services are likely to increase (Schmidt, et al., 2010). For example, high-ranking government officials such as Singapore's Health Minister, Australia's Environment Protection Minister and Canada's Environment Minister reach out to their citizens by sharing personal thoughts through blogs and multimedia sharing services. Yet, at the other end of the spectrum are governments which appear cautious towards using Web 2.0. Agencies such as Swiss Federal Department of Finance and New Zealand Treasury subscribe to social networking services without overt attempt to engage citizens with dynamic and updated content. This

quandary could well be attributed to the unique constraints governments face, including political considerations, bureaucracies and institutional hurdles (Mergel, et al. 2009).

Third, the presence of Web 2.0 applications was found to have a correlation with the overall quality of government websites. Of the three aspects of website quality, the correlation is strongest with service quality. From being passive consumers of information and services, Web 2.0 applications enable citizens to be active co-creators of information and services with government officials through a range of experiences including rich interfaces, mass participation, formation of social networks and high user control (Lai & Turban, 2008). These affordances could have contributed positively to service quality dimensions such as empathy, interactivity, playfulness and aesthetic appeal. Thus, citizens are likely to gain a sense of connection with government websites that incorporate Web 2.0 applications. Nonetheless, while service quality leads to user satisfaction, there is little support to suggest that it also invariably leads to continued usage intention (Teo, et al., 2008). In other words, the presence of Web 2.0 applications in government websites could appeal to users but in themselves may not be sufficient to draw repeated visits to the websites.

On the other hand, the correlation between the presence of Web 2.0 applications and information quality was found to be the weakest. In particular, information acquisition applications such as discussion forums and wikis do not correlate with information quality. While Web 2.0 applications collectively represent a platform that supports interaction, improved citizenry engagement does not necessarily lead to high-quality user-generated content. The onus still lies with government officials to provide content that is accurate, dependable, of good coverage and easy to use (Eschenfelder, et al. 1997; Kahn, et al., 2002). In addition, as the body of user-generated content continues to grow, government officials have to constantly remove inappropriate, erroneous or unwanted content using approaches including manual moderation and automated strategies (Heymann, et al., 2007). This is particularly important given that information quality leads to continued usage intention (Teo, et al., 2008) and it has also been consistently found to be strongly associated to user satisfaction (Petter, et al., 2008).

6. Conclusion

To meet the rising expectations of citizens, governments can no longer establish their web presence merely by relying on websites with static content and transactional capabilities. Instead, they are expected to provide multi-way collaboration so that citizens and government officials become partners and co-creators of information and services. Even as the explosion of user-generated content points to the immense potential Web 2.0 brings, little scholarly attention has been trained on Web 2.0 in government. Thus, this paper seeks to investigate the prevalence and use of Web 2.0 applications on government agencies' websites. It also tries to examine whether the presence of Web 2.0 applications correlate with the quality of government websites.

Across all 200 government websites, the order of prevalence of seven Web 2.0 applications is as follows: RSS, multimedia sharing services, blogs, forums, social tagging services, social networking services and wikis. In terms of country economic status, government websites in advanced countries were found to adopt Web 2.0 applications more commonly than those in developing countries. The differences in prevalence were found to be statistically significant for blogs, RSS, social tagging services multimedia sharing services and social networking services. However, the disparity among the five government agency types is less stark. While no particular agency consistently embrace all categories of Web 2.0 applications most extensively, environment agencies' lead in the prevalence of social networking services vis-à-vis the rest was found to be statistically significant.

Discussion forums are used to build online communities of like-minded individuals while wikis are a means by which governments can tap subject-specific expertise of citizens. Blogs not only represent a means to disseminate information and policies but are also being exploited by officials to give the government a personalized voice. Government websites adopt RSS to keep citizens abreast of the latest government decisions, policies and services. Social bookmarking tools are used to help citizens tag, share and search for web resources while multimedia sharing services are used to enliven interactions among citizens and officials. Social networking services are used by government agencies to build social connections with citizens.

In addition, the presence of Web 2.0 applications was found to correlate to the overall quality of government websites. In terms of the specific aspects of website quality, the strength of correlation is strongest to service quality, followed by system quality and information quality. This implies that as government agencies continue to ride on the various Web 2.0 applications, the perceived quality of their websites is likely to improve.

Three limitations in this paper must be acknowledged. The selection of government websites was restricted to those whose content was given in English. As an extension to this work, non-English government websites can be included as part of the dataset. Two, a sample of seven common Web 2.0 applications were chosen for analysis. Future work can look into other genres of Web 2.0 applications such as mashups, virtual worlds, microblogging as well as other applications designed for mobile devices. Finally, data was collected completely from the public domain. The intended use and implementation considerations for each of the Web 2.0 applications in each government agency could not be studied. Hence, interested researchers may carry out user studies among citizens and government officials to uncover the nuances of the use of Web 2.0 applications, as well as their influence on citizens' perception of website quality.

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Appendix 1: Scoring for e-Government websites

1 – Strong Disagree 2- Disagree 3 – Neutral 4 – Agree 5 – Strong Agree

System Quality		1	2	3	4	5
1	Ease with which users can use website easily and quickly	☐	☐	☐	☐	☐
2	Speed of accessing and downloading information from website	☐	☐	☐	☐	☐
3	Ease with which website can be located using search engines	☐	☐	☐	☐	☐
4	Protection against personal information leakage and the prevention of identity fraud	☐	☐	☐	☐	☐
Information Quality						
5	Extent to which information is error free, complete and consistently represented in website	☐	☐	☐	☐	☐
6	Extent to which information on the website is current, reliable, and given appropriately	☐	☐	☐	☐	☐
7	Breadth of the information presented on website	☐	☐	☐	☐	☐
8	Accessibility and ease of manipulation of information on website	☐	☐	☐	☐	☐
Service Quality						
9	Extent to which individualized information and attention have been given to users	☐	☐	☐	☐	☐
10	Extent to which users can exercise control and exchange information on website	☐	☐	☐	☐	☐
11	Degree of cognitive spontaneity in online interactions	☐	☐	☐	☐	☐
12	Effective use of fonts, colors, layout, and graphics on the website	☐	☐	☐	☐	☐