# AUTHOR QUERY FORM

| | | |
|---|---|---|
| ELSEVIER | **Journal: GOVINF**<br><br>**Article Number: 754** | **Please e-mail or fax your responses and any corrections to:**<br>**E-mail: corrections.essd@elsevier.spitech.com**<br>**Fax: +1 619 699 6721** |

Dear Author,

Any queries or remarks that have arisen during the processing of your manuscript are listed below and highlighted by flags in the proof. Please check your proof carefully and mark all corrections at the appropriate place in the proof (e.g., by using on-screen annotation in the PDF file) or compile them in a separate list.

For correction or revision of any artwork, please consult http://www.elsevier.com/artworkinstructions.

Any queries or remarks that have arisen during the processing of your manuscript are listed below and highlighted by flags in the proof. Click on the 'Q' link to go to the location in the proof.

| Location in article | Query / Remark: click on the Q link to go<br>Please insert your reply or correction at the corresponding line in the proof |
|---|---|
| Q1 | The country name has been inserted for the first, second and third author's affiliation. Please check, and correct if necessary. |
| Q2 | Research Highlights should consist of only 85 characters per bullet point, including spaces. However, the research highlights provided for this item exceed the maximum requirement. Kindly provide the necessary corrections. For more information, please see Guide for Authors. |
| Q3 | The citation "UTC, 2009" has been changed to match the author name/date in the reference list. Please check here and in subsequent occurrences, and correct if necessary. |
| Q4 | "(8)" was changed to "(Eq. (8))". Please check if appropriate and amend if necessary. |
| Q5 | Uncited reference: This section comprises references that occur in the reference list but not in the body of the text. Please position each reference in the text or, alternatively, delete it. Any reference not dealt with will be retained in this section. Thank you. |

Thank you for your assistance.

Contents lists available at ScienceDirect

Government Information Quarterly

journal homepage: www.elsevier.com/locate/govinf

# Research highlights

Government Information Quarterly xxx (2011) xxx–xxx

## Benchmarking e-Government: A comparison of frameworks for computing e-Government index and ranking

Abebe Rorissa [a,*], Dawit Demissie [b], Theresa Pardo [c]

[a] Department of Information Studies, University at Albany, State University of New York, Draper Hall, Room 113, 135 Western Avenue, Albany, NY 12222, USA
[b] Department of Informatics, University at Albany, State University of New York, 7A Harriman Campus, Suite 220, 1400 Washington Avenue, Albany, NY 12222, USA
[c] Center for Technology in Government, University at Albany, State University of New York, Suite 301, 187 Wolf Road, Albany, NY 12205, USA

► Benchmarking is used by decision makers in devising ICT policies. ► Current benchmarking and e-Government ranking tools have limitations. ► We assessed strengths and limitations of six frameworks for computing e-Government index. ► Frameworks that include all features and functionality of e-Government sites are preferred.



0740-624X/$ – see front matter. Published by Elsevier Inc.
doi:10.1016/j.giq.2010.09.006

Please cite this article as: Rorissa, A., et al., Benchmarking e-Government: A comparison of frameworks for computing e-Government index and ranking, *Government Information Quarterly* (2011), doi:10.1016/j.giq.2010.09.006

Government Information Quarterly xxx (2011) xxx–xxx

Contents lists available at ScienceDirect

Government Information Quarterly

journal homepage: www.elsevier.com/locate/govinf

# Benchmarking e-Government: A comparison of frameworks for computing e-Government index and ranking☆

Abebe Rorissa [a,*], Dawit Demissie [b], Theresa Pardo [c]

[a] Department of Information Studies, University at Albany, State University of New York, Draper Hall, Room 113, 135 Western Avenue, Albany, NY 12222, USA
[b] Department of Informatics, University at Albany, State University of New York, 7A Harriman Campus, Suite 220, 1400 Washington Avenue, Albany, NY 12222, USA
[c] Center for Technology in Government, University at Albany, State University of New York, Suite 301, 187 Wolf Road, Albany, NY 12205, USA

ARTICLE INFO

Available online xxxx

*Keywords:*
Benchmarking
e-Government index
e-Government ranking

ABSTRACT

Countries are often benchmarked and ranked according to economic, human, and technological development. Benchmarking and ranking tools, such as the United Nation's e-Government index (UNDPEPA, 2002), are used by decision makers when devising information and communication policies and allocating resources to implement those policies. Despite their widespread use, current benchmarking and ranking tools have limitations. For instance, they do not differentiate between static websites and highly integrated and interactive portals. In this paper, the strengths and limitations of six frameworks for computing e-Government indexes are assessed using both hypothetical data and data collected from 582 e-Government websites sponsored by 53 African countries. The frameworks compared include West's (2007a) foundational work and several variations designed to address its limitations. The alternative frameworks respond, in part, to the need for continuous assessment and reconsideration of generally recognized and regularly used frameworks.

Published by Elsevier Inc.

## 1. Introduction

International organizations, such as the United Nations and the World Bank, regularly undertake significant studies to produce rankings of countries on a wide range of features, including information and communications technology. The benchmarked facets include healthcare (World Health Organization, 2000), education (Dill & Soo, 2005), press freedom (Reporters Without Borders, 2009), corruption and governance (World Bank, 2009), e-readiness (Hanafizadeh, Hanafizadeh, & Khodabakhshi, 2009), e-responsiveness (Gauld, Gray, & McComb, 2009), peace (Institute for Economics and Peace, Economist Intelligence Unit, 2010), happiness (New Economics Foundation, 2009), sports (e.g., FIFA, 2010), and – of primary importance to this paper – e-Government (United Nations, 2010, 2008, 2005, 2004, 2003; West, 2007a; UNDPEPA, 2002). The rankings draw on various types of indices, such as the human development index (UNDP, 2009; Haq, 1995), the e-readiness index (United Nations, 2005), the global peace index (Institute for Economics and Peace, Economist Intelligence Unit, 2010), and the e-Government index (UNDPEPA, 2002).

Benchmarking indices and indicators are generally quantitative in nature, and collectively form a framework for assessment and ranking. Some frameworks are based on measurable characteristics of the entities; others use one or more subjective measures; a few employ a combination of both. Frameworks based on grounded and broadly applicable measures tend to attract fewer criticisms. Those based on subjective measures often result in controversies and complaints, especially from those countries or institutions who believe that they were not accurately characterized. To maximize the acceptability of results, rankings should be based on well understood and supported frameworks and indices, and sound computational procedures.

e-Government indices are benchmarking and ranking tools that retrospectively measure the achievements of a class of entities, such as government agencies or countries, in the use of technology. Policymakers and researchers use e-Government benchmarking studies to help monitor implementation of e-Government services, using the information to shape their e-Government investments (Heeks, 2006; Osimo & Gareis, 2005; UNDPEPA, 2002). The results of benchmarking and ranking studies, particularly global projects conducted by international organizations, attract considerable interest from a variety of observers, including governments (ITU, 2009). e-Government benchmarks are used to assess the progress made by an individual country over a period of time, and to compare its growth against other nations.

Among the first organizations to propose an e-Government index and rank countries on the basis of their e-Government service delivery was the United Nations Division for Public Economics and Public Administration (UNDPEPA, 2002). The United Nations followed up revisions and other proposals (United Nations, 2010, 2008, 2005, 2004, 2003; UNDPEPA, 2002). Others have also contributed proposals for

☆ This is a revised and extended version of the paper "Toward a common framework for computing e-Government index" which the authors presented at the 2nd international Conference on theory and Practice of Electronic Governance (Cairo, Egypt, December 1–4, 2008) (pp. 411–416). New York, NY: ACM.

* Corresponding author.
*E-mail address:* arorissa@albany.edu (A. Rorissa).

0740-624X/$ – see front matter. Published by Elsevier Inc.
doi:10.1016/j.giq.2010.09.006

benchmarking e-Government (West, 2007a, 2007b, 2004; Bannister, 2007; Ojo, Janowski, & Estevez, 2007) and e-readiness (United Nations, 2008; Bakry, 2003).

Despite their wide use, the current procedures for computing e-Government indices have significant limitations. For instance, they do not differentiate between websites that provide static information and those that are full-service portals (e.g. highly interactive). Further, the frameworks tend not to account for the stages of e-Government development and whether websites are proportional to the nation's level of development.

In this paper, we propose a number of procedures for computing e-Government indices, expanding the current frameworks by introducing techniques that account for the stages of development of e-Government services, as suggested by Al-adawi, Yousafzai, and Pallister (2005); Affisco and Soliman (2006), and others United Nations (2010, 2008); UNDPEPA (2002); Layne and Lee (2001). As a foundation for our presentation, we review various classification models of e-Government development, then discuss benchmarking generally and in terms of e-Government. The article continues with an overview of the sample data. We then present and compare six separate frameworks for computing e-Government indices, each accounting for slightly different factors. Finally, we offer some conclusions and recommendations for future work.

## 2. Background

This section provides a definition for e-Government as it will be used throughout the article. Following this definition, e-Government service development classifications are explained. The final two sub-sections address benchmarking e-Government and West's framework.

### 2.1. e-Government defined

The definition of e-Government varies from the very generic—"use of ICTs and its application by the government for provision of information and public services to the people" (Curtin, 2007); "any use of ICT in public administration and services" (Bannister, 2007, p. 172) – to the more specific – "the delivery of government information and services online through the internet or other digital means" (West, 2004, p. 16); the "delivery of government services over the internet in general and the Web in particular" (Bannister, 2007, p. 172). For this effort, we adopt West's (2004) definition – the delivery of government services over the internet – because it focuses on "front-office" services, specifically, those available over the World Wide Web. Even in the context of this slightly narrower conceptualization, the implementation of e-Government services can take various forms ranging from a single website with contact information (address, telephone and fax numbers, email address, etc.) to an interactive, consolidated gateway to integrated services at all levels of government, from local to federal/national. To adequately discuss benchmarking, the definition of e-Government must be supplemented by a classification of e-Government service development.

### 2.2. e-Government service development classifications

Several classifications for e-Government development have been proposed, but four of the most prominent studies are discussed here. One of the earliest e-Government development classifications, created by Layne and Lee (2001), featured four stages: (1) cataloging, (2) transaction, (3) vertical integration, and (4) horizontal integration. At the cataloging stage, the website provides an online presence with cataloged information (e.g., phone numbers and addresses) and downloadable forms. A transaction stage website offers online transactions, supported by a database (e.g., citizens may renew their licenses and pay fines on-line). A website at the vertical integration stage links local and higher-level systems (e.g., a drivers' license registration system at a state department of motor vehicles is linked to a national database of licensed truckers). At the final horizontal integration stage, the website assimilates different functions and services across government agencies (e.g., a business can pay its unemployment insurance to one state agency and its state business taxes to another state agency, using the same interface or without uploading information several times).

In their studies, the UNDPEPA (2002) and the United Nations (2008) described e-Government service development in five stages: (1) emerging (an official government online presence is established), (2) enhanced (government websites increase; information becomes more dynamic), (3) interactive (users can download forms, email officials, and interact through the website), (4) transactional (users pay for services and conduct other transactions online), and (5) seamless (e-services are fully integrated across administrative boundaries). In their 2010 e-Government survey, the United Nations (2010) merged "interactive" with "transactional," and renamed "seamless" as "connected," establishing a four-stage order of emerging, enhanced, transactional, and connected.

The four-stage, e-Government service development presentation of Affisco and Soliman (2006) and Al-adawi et al. (2005) creates the following order: (1) publishing (web presence), (2) interacting, (3) transacting, and (4) transforming (integration). According to this classification, a website at the publishing stage presents only static information, while one at the interacting stage has features such as form download, search, and simple data collection. At the transacting stage, the website features online task processing without a requirement that citizens travel to the relevant offices. At the transforming or integration stage, a single-point portal integrates all e-Government services by all branches of government at all levels. The first two stages are "relatively easy to achieve, as supplying information, application forms and email addresses online involves no great effort or any change in existing operations. The development of the real transaction services, however," is more difficult, requiring significant investments in back-office systems (Kunstelj & Vintar, 2004, p. 133).

In all the classifications discussed above, the technological and organizational complexity and the integration of services and functions increase as the websites move from lower to higher stages. In general, as e-Government websites advance through the stages, "they pass through many thresholds in terms of infrastructure development, content delivery, business re-engineering, data management, security and customer management" (United Nations, 2008, p. 14). We chose Affisco and Soliman (2006) and Al-adawi et al. (2005) four-stage model because it captures the essence of most of the models in Table 1 and it is one of the most cited.

### 2.3. Benchmarking e-Government

Benchmarking compares two or more institutions or entities using a set of indicators. It has long been used to evaluate and improve businesses. The first benchmarking activity was conducted at Xerox, leading to the adoption of processes that helped the company lower costs and improve performance (Watson, 1993; Camp, 1989).

Over the years, benchmarking methods and frameworks devised for businesses have been adopted by and/or applied to public sector and

**Table 1**
A comparison of classifications of the stages of e-Government development.

| (Layne & Lee, 2001) | (United Nations, 2008; UNDPEPA, 2002) | (United Nations, 2010) | (Affisco & Soliman, 2006; Al-adawi et al., 2005) |
|---|---|---|---|
| Cataloging | Emerging | Emerging | Publishing (web presence) |
| | Enhanced | Enhanced | |
| Transaction | Interactive | Transactional | Interacting |
| | Transactional | | Transacting |
| Vertical integration | Seamless/networked | Connected | Transforming (integration) |
| Horizontal integration | | | |



Please cite this article as: Rorissa, A., et al., Benchmarking e-Government: A comparison of frameworks for computing e-Government index and ranking, *Government Information Quarterly* (2011), doi:10.1016/j.giq.2010.09.006

government institutions. National and international researchers in both the private and public sectors have created a variety of benchmarking mechanisms to evaluate the progress of e-Government at the local, national, regional, and global levels (e.g., United Nations, 2010, 2008, 2005, 2004, 2003; UNCTAD, 2009; West, 2004, 2007a).[1]

Although Heeks (2006) asks the foundational question "why benchmark e-Government?", the value of benchmarking e-Government is recognized by many. A focused assessment of e-Government (and other initiatives such as e-commerce, e-education, e-health, and e-science) is essential if a country is to make substantial progress (Ojo et al., 2007). Kaylor, Deshazo, and Van Eck (2001) point out that "an important aspect of the development of e-Government is assessing the trajectory it takes" (p. 304). Benchmarking serves as such an assessment tool.

Benchmarks "can have a significant practical impact, both political and potentially economic" (Bannister, 2007, p. 171) and can influence the development of e-Government services (Kunstelj & Vintar, 2004). Rankings that result from benchmarking studies have been used by some countries to justify spending on e-Government initiatives (Janssen, Rotthier, & Snijkers, 2004). At the international level, information and communication technology (ICT) indicators (part of e-Government benchmarking), "are critical to cross-country comparisons of ICT development, to monitoring the global digital divide and to establishing policy-relevant benchmarks," as long as they are comparable (UNCTAD, 2009, p. iii). Public policymakers can use benchmarking indicators to design ICT policies; businesses can use them to compare their products and services to those of their competitors; researchers can use them to assess the impact ICT use has on productivity; and the international community can use them for cross-national or cross-country comparison of adoption and implementation of ICT (UNCTAD, 2009). The United Nations (2008) uses the Web measure index, another e-Government benchmark, in the hope that it "provides Member States with a comparative ranking on their ability to deliver online services to their citizens" (p. 15) and that it "could be [a] useful tool for policy-planners as an annual benchmark" (UNDPEPA, 2002, p. v).

Benchmarking can help governments and other institutions responsible for the implementation of e-Government services monitor the efficiency and effectiveness of public spending (ITU, 2009; United Nations, 2010). In some instances, benchmarking plays a "quasi-regulatory" role, especially for members of the European Union where benchmarking is routine (Codagnone & Undheim, 2008).

In the end, benchmarking e-Government serves both internal (where the beneficiary is the individual or organization conducting the benchmarking) and external (which benefits users of benchmarking studies) purposes. Its benefits fall into three categories: (1) to measure retrospective achievement (which helps policymakers compare how their country or agency ranks in terms of e-Government); (2) to chart prospective direction/priorities (which policymakers can use to make strategic decisions and identify appropriate courses of action) and to measure e-Government progress/development; and (3) to make governments and their agencies accountable for the investments in e-Government (Curtin, 2006; Heeks, 2006; Gupta & Jana, 2003).

Despite the general agreement on the value of benchmarking e-Government and ranking countries on the basis of their e-Government service delivery, controversy exists over the best methods and practices. One critic of benchmarking based on web measures dismiss it because: (1) it does not account for internal re-organization, national context and priorities, and the users' perspective, (2) it is not reliable (different benchmarks produce different ranks even for the same country) and the methodologies used are not revealed by individuals and organizations conducting the benchmarking, and (3) the stages of e-Government service development used in the computation of e-Government benchmarking indices often do not reflect actual e-Government service use and linear progression (Codagnone & Undheim, 2008).

Other commentators view content analysis of service outlets such as websites favorably when benchmarking e-Government (Kaylor et al., 2001). According to UNDPEPA (2002), a country's level of progress with respect to e-Government is partly dependent on the presence or absence of specific website features and services. e-Government benchmarking studies that focus on online service delivery, sometimes called supply-side or front-office studies, rely on indicators such as the number of online services available to citizens and businesses, and the percentages of government departments with websites and websites that offer electronic services (Janssen et al., 2004). As long as these factors account for the stages of e-Government service development, they present a straightforward and objective assessment of a country's online sophistication (UNDPEPA, 2002).

e-Government benchmarking methods become more problematic, and the critics' views more telling, when they move beyond objective, supply-side criteria (e.g., services offered via websites) to include calculated indices, psychometric measures, or other subjective indicators (e.g., human development index and internet use). The more sophisticated tools require expensive data collection and complex processing. For that reason, more e-Government benchmarking studies focus on supply-side not back-office (Janssen et al., 2004). In the case of the EU, its e-Government benchmarks are simple, inexpensive, fairly transparent and replicable, and widely accepted and used (Codagnone & Undheim, 2008).

### 2.4. West's framework

West (2007a) contributes to the discussion of benchmarking by proposing an e-Government index measuring the output or supply side of a government's web presence—the extent to which particular national websites provide a number of features and executable services. West's framework is considered among the more holistic because it accounts for the contents of e-Government websites and the e-Government services provided (Panopoulou, Tambouris, & Tarabanis, 2008). This more comprehensive nature addresses one of the recommendations made by Kunstelj and Vintar (2004)—avoiding piecemeal evaluation. Given the overall strength of West's framework, it is the first one analyzed in this article, and it forms the basis for the alternative frameworks considered below.

On the other hand, West's framework does not account for the stages of e-Government service development and the level of citizen/user usage or satisfaction of citizens. Our alternative frameworks address those shortages, in part, by assigning weights proportional to the country's stage of e-Government service development. This methodology builds on the work of Accenture (2004, 2003) and Bui, Sankaran, and Sebastian (2003), and is an alternative to the approach of the United Nations (2008) and UNDPEPA (2002), which does not consider weights proportional to the stages of development of e-Government. A weight proportional to the stage of development rewards countries who provide a fairly sophisticated set of online services. It must be noted, however, that the process of assigning weights undercuts objectivity—it is mainly a subjective process dependent on the judgment of the individual doing the evaluation. We believe that this concession to subjectivity is more than offset by the overall improvement in the reliability and usefulness of the alternative frameworks.

## 3. Data

Two sets of data are used in this article. The first is test data specifically designed to illustrate the difference among the frameworks. This data –

[1] The United Nations (UN) and the International Telecommunication Union (ITU) currently lead the way in benchmarking studies that are wider in scope and longitudinal in nature. This is due to their greater mandate, role, and capacity to collect, analyze, and disseminate the relevant data and results. The ITU produced the 2009 ICT development index in response to calls by member states to "provide policy makers with a useful tool to benchmark and assess their information society developments, as well as to monitor progress that has been made globally to close the digital divide" (ITU, 2009, p. 1).



Please cite this article as: Rorissa, A., et al., Benchmarking e-Government: A comparison of frameworks for computing e-Government index and ranking, *Government Information Quarterly* (2011), doi:10.1016/j.giq.2010.09.006

detailing one country (A) with five websites and another (B) with one website – is entirely hypothetical. It is summarized in Table 2.

For each website i (1–5 for country A and 1 for country B), three designations are given: $f_i$ counts the number of features, $x_i$ totals the number of online executable services, and $w_i$ represents the stage/level of e-Government service development. The features counted in the value $f_i$ are publications, databases, audio clips, video clips, foreign language access, not having ads, not having premium fees, not having user fees, disability access, having privacy policies, security policies, allowing digital signatures on transactions, an option to pay via credit cards, email contact information, areas to post comments, option for email updates, option for website personalization, and PDA (personal digital assistant) accessibility (West, 2007a). As for $x_i$, an online service is counted as executable if it allows users to complete transactions without physically visiting service centers. An example of an online executable service would be renewing a driver's licenses via a DMV website. Finally, the stages of e-Government service development ($w_i$) are drawn from the work of Affisco and Soliman (2006) and Al-adawi et al. (2005).

With the frameworks fully described using, in part, the hypothetical data, we move on to analyze the frameworks in the context of a second set of data, drawn from the e-Government websites of 53 African countries. To build this dataset, we identified legitimate e-Government websites as determined by international organizations such as the UN. We reviewed the websites and coded the contents from December 2008 to May 2009. Our search yielded a total of 582 e-Government websites (an average of 11 per country). Because a fair number of benchmarking studies make national e-Government their main focus (Heeks, 2006), we too compiled our data at the national level.

With the help of native speakers of languages other than English and the Google translation facility (http://translate.google.com/translate_t?hl=en), we conducted a content analysis of each website based on coding dictionaries developed by both the authors and others (e.g., West, 2007b). We focused on identifying the type of services and features available on the websites, and the stage of development of nation's e-Government services.

After initial coding was completed, a random sample of roughly 20% of the websites was coded a third time by a knowledgeable graduate assistant. Coding reliability was measured using percent agreement and Cohen's (1960) Kappa—all the values for both measures were above the often-recommended minimum of 0.70 (Neuendorf, 2002).

## 4. Frameworks for computing e-Government index

In this section, we introduce the six frameworks for computing e-Government indices. Based on the hypothetical data presented in Table 2, we show how the values of these indices differ depending on the contents of the websites examined.

Before proceeding, we want to emphasize that the frameworks considered in this paper are solidly grounded in current practices and have similarities with other existing measures. For instance, the "Web Measure Index" (United Nations, 2008) – one of the most widely used frameworks – accounts for the contents of e-Government websites much the same way West's (2007a) e-Government index (framework 1) does.

**Table 2**
A profile of two hypothetical countries and their e-Government indices according to the six frameworks.

| Country | Website | $f_i$ | $x_i$ | $w_i$ |
|---|---|---|---|---|
| A | 1 | 7 | 7 | 2 |
| | 2 | 6 | 1 | 2 |
| | 3 | 7 | 2 | 2 |
| | 4 | 8 | 8 | 3 |
| | 5 | 5 | 0 | 1 |
| B | 1 | 7 | 2 | 1 |

Additionally, three of our six frameworks (frameworks 4 through 6) compute relative e-Government indices in a fashion similar to other frameworks used by the United Nations (2004, 2010), including the "Telecommunication Infrastructure Index."

On the other hand, our frameworks have their own unique features. As noted below, West's (2007a) e-Government index (framework 1) does not account for stages of e-Government development. Although the Web Measure Index does reflect the level of sophistication of a UN Member State's online presence (United Nations, 2008), it uses a five-stage model (emerging, enhanced, interactive, transactional, and seamless/networked) of development. Our frameworks employ a four-stage approach. Other variations and enhancements are detailed in the individual framework sections.

### 4.1. Framework 1

We start with West's method of computing an e-Government index (2007a), hereafter referred to as framework 1. West follows a two-step process. First, a value (between 0 and 100) is computed for each website sponsored by a country. These individual website e-Government index values are then averaged to compute a single index for the country. Eqs. (1) and (2) encapsulate West's procedures (2007a).

$$\text{e – Government index for website i, } e_i = 4f_i + x_i \quad (1)$$

where,

$f_i$ = The number of features present on website i, $0 \le f_i \le 18$
$x_i$ = The number of online executable services on website i, $0 \le x_i \le 28$

$$\text{e – Government index for country j, } E_j = \frac{\sum_{i=1}^{n} e_i}{n} \quad (2)$$

where,

$e_i$ = e-Government index for website i (computed using Eq. (1)), $0 \le e_i \le 100$
n = Total number of websites for country j, $n \ge 1$.

On the positive side, West's e-Government index is based on objective measures and is quite straightforward. On the other hand, West's approach has a number of limitations:

- Uneven Multiplication: By choosing to multiply $f_i$ by four while not doing so to $x_i$, West significantly values website features over online executable services. Given that websites with more executable services are likely to provide higher levels of e-Government service than those with only simple features, weighting features over services appears inappropriate.
- Feature Limits: With $f_i$ set at a maximum value of 18, Eq. (1) cannot account for a website with more than 18 features.
- Service Limits: With $x_i$ set at a maximum value of 28, Eq. (1) cannot account for a website with more than 28 online executable e-Government services.
- Quality or Functionality Ignored: No weight is given to the quality or functionality of the e-Government service websites. Each website is afforded the same weight in the indices whether it is a static page with very little information or a fully fledged portal.

Using the hypothetical data from Table 2 (see Table 3), West's approach results in identical e-Government indices for the two countries (30). This equivalence comes despite the equal or higher website e-Government index value for three of country A's websites (websites 1, 3, and 4). Country A's superior and more numerous websites are undermined by its two subpar websites.



Please cite this article as: Rorissa, A., et al., Benchmarking e-Government: A comparison of frameworks for computing e-Government index and ranking, *Government Information Quarterly* (2011), doi:10.1016/j.giq.2010.09.006

In handling the hypothetical data, West's framework 1 reveals some weaknesses. To address this, the remainder of this section presents modified versions of West's framework 1 that incorporate the level of e-Government service development. To differentiate among static sites and portals, and to accentuate the level of e-Government services development, the alterative frameworks use weights proportional to the level of development.

### 4.2. Framework 2

Our first alternative to West's approach – framework 2 – incorporates a weighting of websites proportional to their stage of e-Government service development. As such, these calculations enhance the e-Government ranking of a country that possesses more websites at higher levels of development and diminishes the ranking of a country that possesses fewer websites at a lower level of development.

$$\text{e – Government index for country j, } E_j = \frac{\sum_{i=1}^{n} w_i e_i}{\sum_{i=1}^{n} w_i} \quad (3)$$

where,

$e_i$ = e-Government index for website i (computed using Eq. (1)), $0 \le e_i \le 100$

$w_i$ = Level of e-Government service development of website i, $1 \le w_i \le 4$

n = Total number of websites for country j, $n \ge 1$.

We want to emphasize that the specific method chosen for weighting the level of e-Government service development is not inviolate. Theoretically, $w_i$'s maximum (see Eq. (3)) could be set at any number; doing so would vary the relative weights of stages of development. As we have chosen to use a four-stage classification of e-Government website services (Affisco & Soliman, 2006; Al-adawi et al., 2005), four is a reasonable maximum. Note that a direct mapping of stage to number (i.e., publishing = 1; interacting = 2; transacting = 3; and transforming = 4) assumes that consecutive levels of e-Government development are equidistant. Such assumption may understate the value of the higher stages of development. For example, a website that jumps from stage 3 to stage 4 may have to undergo tremendous changes requiring massive efforts and resources compared to the transition from websites from stage 1 to stage 2. Further research is necessary to confirm this. If so, a greater maximum could be assigned to $w_i$, creating a proportionately greater impact for higher stages of development to have a greater weight in the formula (i.e., publishing = 1; interacting = 2; transacting = 5; and transforming = 8). The exact magnitude of any proportionate weighting would have to be considered carefully.

Applying framework 2 to the hypothetical data (see Table 3), the values of $e_i$ remain the same, as does country B's $E_j$, but country A's $E_j$ rises to 32 (an increase of 6.7%). By adjusting the index based on the website's stages of e-Government service development, framework 2 increases the value for countries with more websites, directly acknowledging those countries that have invested beyond a single presence.

**Table 3**
Summary of data from hypothetical countries and their e-Government indices according to the six frameworks.

| Country | Site | $f_i$ | $x_i$ | $w_i$ | e-Government index by framework | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1 | 2 | 3 | 4 | | 5 | | 6 | |
| | | | | | $e_i$ | $e_i$ | $e_i$ | $e_i$ | $e_{Ri}$ | $e_i$ | $e_{Ri}$ | $e_i$ | $e_{Ri}$ |
| A | | | | | 30* | 32* | 11.3* | | 0.573* | | 0.516* | | 0.524* |
| | 1 | 7 | 7 | 2 | 35 | 35 | 14 | 14 | 0.82 | 49 | 0.766 | 63 | 0.773 |
| | 2 | 6 | 1 | 2 | 25 | 25 | 7 | 7 | 0.18 | 6 | 0.094 | 13 | 0.107 |
| | 3 | 7 | 2 | 2 | 30 | 30 | 9 | 9 | 0.36 | 14 | 0.219 | 23 | 0.24 |
| | 4 | 8 | 8 | 3 | 40 | 40 | 16 | 16 | 1.0 | 64 | 1.0 | 80 | 1 |
| | 5 | 5 | 0 | 1 | 20 | 20 | 5 | 5 | 0.0 | 0 | 0.0 | 5 | 0 |
| B | | | | | 30* | 30* | 9* | | 0.364* | | 0.219* | | 0.24* |
| | 1 | 7 | 2 | 1 | 30 | 30 | 9 | 9 | 0.364 | 14 | 0.219 | 23 | 0.24 |

Site = arbitrary # for website, $f_i$ = # of features, $x_i$ = # of online executable services, $w_i$ = the stage/level of e-Government service development of the website, $e_i$ = e-Government index for website i, $e_{Ri}$ = relative e-Government index for website i, * e-Government index value for country (designated $E_j$ or $E_{Rj}$ in equations).

### 4.3. Framework 3

This approach builds on framework 2 by removing the over-weighting of website features over executable services. This results in far lower values for $e_i$. Indeed, if West's limits are retained (maximum number of features = 18; and maximum number of services = 28), $e_i$ would range from 0 to 46, instead of 0 to 100. These lower numbers allow for an adjustment or elimination of West's maximums, but that issue is irrelevant to the analysis here.

$$\text{e – Government index for site i, } e_i = f_i + x_i \quad (4)$$

$$\text{e – Government index for country j, } E_j = \frac{\sum_{i=1}^{n} w_i e_i}{\sum_{i=1}^{n} w_i} \quad (5)$$

where,

$e_i$ = e-Government index for website i (computed using Eq. (4)), $e_i \ge 0$

$w_i$ = Level of e-Government service development of website i, $1 \le w_i \le 4$

n = Total number of websites for country j, $n \ge 1$.

When applied to the hypothetical data (see Table 3), framework 3's equations resulted in country A's index (11.3) being 25.56% higher than country B's index (9). By using formulas that discount online executable services by a much smaller degree compared to website features, the greater functionality of Country A's more numerous websites is represented better. Even so, framework 3 continues to ignore the greater web presence of country A compared to country B.

### 4.4. Framework 4

Framework 4 computes a relative e-Government index value for each e-Government website ($eR_i$), factoring in a comparison between the website being measured and the most robust website in the study. As a result, when the individual website e-Government index values are combined to create a country e-Government index, a country that offers a greater degree of e-Government presence and functionality, compared to other countries being considered for ranking purpose, will be rated higher.

Because the individual website e-Government index value is calculated relative to the most robust website in the dataset, the value of $eR_i$ ranges from 0 to 1. This framework avoids the need to choose an arbitrary weighting factor and apply it to the number of features in order to rescale the values to fall between 0 and 100. By default, the computed relative e-Government index value for each country ($E_{Rj}$) also falls between 0 and 1, and could easily be rescaled to a value between 0 and 100, multiplying it by 100.

$$\text{Relative e–Government index for site i, } e_{Ri} = \frac{e_i - \min(e_i)}{\max(e_i) - \min(e_i)} \quad (6)$$

where,

$e_i$ = e-Government index for website i (computed using Eq. (4)), $e_i \ge 0$

$\min(e_i)$ = Minimum value of all $e_i$s for websites of all countries in the sample, $\min(e_i) \geq 0$

$\max(e_i)$ = Maximum value of all $e_i$s for websites of all countries in the sample, $\max(e_i) > 0$

$eR_i = 1$, if $\max(e_i) = \min(e_i)$[2]

$$\text{Relativee} - \text{Government index for country j, } E_{Rj} = \frac{\sum_{i=1}^{n} w_i e_{Ri}}{\sum_{i=1}^{n} w_i} \quad (7)$$

where,

$eR_i$ = Relative e-Government index for site i (calculated using Eq. (6)), $0 \leq eR_i \leq 1$

$w_i$ = Level of e-Government service development of website i, $1 \leq w_i \leq 4$

n = Total number of websites for country j, $n \geq 1$.

Once again, when applied to the hypothetical data (see Table 3), framework 4 resulted in an increase in country A's e-Government index value. Under framework 4, the relative e-Government index value for country A (0.573) is greater by 57.5% than the relative e-Government index value of country B (0.364). That is entirely appropriate given country A's more numerous websites with higher levels of e-Government service development and more online executable services.

### 4.5. Framework 5

Framework 5, like framework 4, uses a relative index. In an effort to place greater weight on websites that offer executable services, however, the formula for calculating a website's individual e-Government index ($e_i$) multiplies (instead of adding) the number of features by the number of executable services (Eq. (8)).

$$e - \text{Government index for site i, } e_i = f_i * x_i \text{ (i.e., the product of the two), } e_i \geq 0. \quad (8)$$

Other than this adjustment in $e_i$, the remaining computations (Eqs. (6) and (7)) of framework 4 are repeated.

Although this adjustment favors websites with a greater number of executable services and with greater equivalence between services and features, it raises a novel limitation. A country with a far greater web presence composed of websites with a high number of features may have an e-Government index of zero if none of its websites offer online executable services.

Applying the hypothetical data to framework 5 (see Table 3), country A's relative e-Government index (0.516) is greater by 0.297 than the relative e-Government index value of country B (0.219). This is a superiority of 135.71%, the most significant difference yet calculated.

### 4.6. Framework 6

To remove the anomaly of completely discounting websites that have no executable services, framework 6 slightly adjusts the computation of e-Government indices ($e_i$) for individual e-Government websites. The new formula (Eq. 9) combines the $e_i$ calculations from frameworks 4 and 5.

$$e - \text{Government index for site i, } e_i = (f_i * x_i) + (f_i + x_i), e_i \geq 0. \quad (9)$$

As in framework 5, other than this adjustment in $e_i$, the remaining computations (Eqs. (6) and (7)) of framework 4 are repeated.

Turning to the hypothetical data (see Table 3), the relative e-Government index for country A under framework 6 (0.524) is greater by 0.284 than that of country B (0.24), a difference of 118.33%. The relative difference is not as high as the difference in framework 5, but it is still significantly higher compared to frameworks 1 through 4.

## 5. Applying the frameworks

In the previous section, we used hypothetical data to highlight the characteristics of the six frameworks for computing e-Government indices. Here, we compare the frameworks using real data collected as part of a larger project to study the contents of African e-Government websites. Table 4 presents a summary of the data drawn from 582 African e-Government websites.

Given this data, Table 5 ranks the top five countries based on the e-Government index values generated by the six frameworks discussed in this article.

A closer look at the rankings and the data that supports them illuminates the prominent aspects of the various frameworks. Four of the top five countries (Egypt is the exception) according to frameworks 1 and 2 are among the top five countries based on their mean number of features (see Table 4). This tracks the bias toward features inherent in the West formula quadrupling effect (see Eq. (1)).

Although not as extreme (Eq. (4) removes the quadrupling effect), frameworks 3 and 4 continue to prominently feature countries with high numbers of features, even if they lack online executable services. Togo, with the highest average number of features per website (Eq. (8)), remains in the top five for frameworks 3 and 4 even though none of its two e-Government websites have executable services.

By multiplying the number of features by the number of online executable services, framework 5 sets both as crucially important; if either value is zero, the resulting index is also zero. Under this approach Togo drops to last in the ranking (with an e-Government index value of zero), together with 15 other countries with no online executable services. Framework 6 pulls back from this absolute penalty by adding as well as multiplying features and services (Eq. (9)). Using the last framework's formulas, the e-Government index for a website (and hence a country) cannot be zero unless it lacks both features and executable services (in which case, a zero score seems entirely appropriate).

Frameworks 5 and 6 were designed to champion both executable services and higher stages of e-Government development. After application to the real dataset, the rankings support this conception. The top four countries according to frameworks 5 and 6 have both the highest mean number of online executable services on their e-Government websites, and the highest number of e-Government websites (relative to the total number of their e-Government websites) at levels 3 and 4.

The match between frameworks and features/executable services is confirmed by correlation values. The correlation between e-Government index values in frameworks 1 through 4 and the mean number of features is high ($r \geq 0.70$). Under frameworks 5 and 6, that correlation is low ($r \leq 0.39$). Conversely, the correlation between e-Government index values in frameworks 5 and 6 and the mean number of online executable services per country is high ($r \geq 0.91$), while the same correlation using frameworks 1 and 2 is low ($r \leq 0.39$). According to frameworks 3 and 4,

[2] By creating a relative index for individual websites, framework 4 creates a rare but significant anomaly. If the maximum and minimum values of all website e-Government index values for all countries in the sample are equal, the denominator in Eq. (6) would be zero. This concern can be ignored in almost all cases because these maximum and minimum values can be equal only when all websites studied have identical e-Government index values ($e_i$s). In the very rare event that this occurs, an arbitrary relative e-Government index (eRi) value (for example, 1) could be assigned to all the websites. That work-around creates relative e-Government index values ($ER_j$) of 1 for all the countries, which accurately reflects the equivalence of all the websites under study.



Please cite this article as: Rorissa, A., et al., Benchmarking e-Government: A comparison of frameworks for computing e-Government index and ranking, *Government Information Quarterly* (2011), doi:10.1016/j.giq.2010.09.006

**Table 4**
Features, online executable services, and stage of e-Government service development in sample of African e-Government websites.

| Country | | Features | | Exec. Serv. | | Stage/level | | | |
|---|---|---|---|---|---|---|---|---|---|
| | n | $f_i$ | M($f_i$) | $x_i$ | M($x_i$) | 1 | 2 | 3 | 4 |
| Algeria | 29 | 189 | 6.52 | 3 | 0.10 | 22 | 6 | 1 | 0 |
| Angola | 9 | 58 | 6.44 | 1 | 0.11 | 6 | 3 | 0 | 0 |
| Benin | 9 | 52 | 5.78 | 4 | 0.44 | 5 | 4 | 0 | 0 |
| Botswana | 10 | 50 | 5.00 | 3 | 0.30 | 5 | 5 | 0 | 0 |
| Burkina Faso | 12 | 67 | 5.58 | 3 | 0.25 | 9 | 3 | 0 | 0 |
| Burundi | 3 | 3 | 1.00 | 1 | 0.33 | 3 | 0 | 0 | 0 |
| Cameroon | 16 | 91 | 5.69 | 6 | 0.38 | 14 | 1 | 1 | 0 |
| Cape Verde | 9 | 52 | 5.78 | 1 | 0.11 | 5 | 3 | 1 | 0 |
| Central African Republic | 3 | 18 | 6.00 | 0 | 0.00 | 3 | 0 | 0 | 0 |
| Chad | 3 | 15 | 5.00 | 0 | 0.00 | 3 | 0 | 0 | 0 |
| Comoros | 5 | 32 | 6.40 | 0 | 0.00 | 4 | 1 | 0 | 0 |
| Congo | 7 | 36 | 5.14 | 1 | 0.14 | 5 | 1 | 1 | 0 |
| Congo (DR) | 3 | 12 | 4.00 | 1 | 0.33 | 2 | 1 | 0 | 0 |
| Djibouti | 7 | 36 | 5.14 | 4 | 0.57 | 5 | 2 | 0 | 0 |
| Egypt | 25 | 161 | 6.44 | 57 | 2.28 | 11 | 9 | 3 | 2 |
| Equatorial Guinea | 1 | 5 | 5.00 | 0 | 0.00 | 0 | 1 | 0 | 0 |
| Eritrea | 2 | 14 | 7.00 | 0 | 0.00 | 1 | 1 | 0 | 0 |
| Ethiopia | 21 | 104 | 4.95 | 2 | 0.10 | 8 | 13 | 0 | 0 |
| Gabon | 5 | 24 | 4.80 | 1 | 0.20 | 2 | 3 | 0 | 0 |
| Gambia | 9 | 49 | 5.44 | 3 | 0.33 | 5 | 4 | 0 | 0 |
| Ghana | 20 | 96 | 4.80 | 1 | 0.05 | 14 | 5 | 1 | 0 |
| Guinea | 6 | 33 | 5.50 | 0 | 0.00 | 6 | 0 | 0 | 0 |
| Guinea-Bissau | 3 | 15 | 5.00 | 0 | 0.00 | 3 | 0 | 0 | 0 |
| Ivory Coast | 4 | 20 | 5.00 | 0 | 0.00 | 4 | 0 | 0 | 0 |
| Kenya | 28 | 140 | 5.00 | 4 | 0.14 | 6 | 21 | 1 | 0 |
| Lesotho | 10 | 47 | 4.70 | 5 | 0.50 | 3 | 7 | 0 | 0 |
| Liberia | 2 | 10 | 5.00 | 0 | 0.00 | 1 | 1 | 0 | 0 |
| Libya | 3 | 20 | 6.67 | 0 | 0.00 | 1 | 2 | 0 | 0 |
| Madagascar | 10 | 51 | 5.10 | 3 | 0.30 | 7 | 3 | 0 | 0 |
| Malawi | 9 | 48 | 5.33 | 1 | 0.11 | 5 | 4 | 0 | 0 |
| Mali | 5 | 24 | 4.80 | 2 | 0.40 | 2 | 3 | 0 | 0 |
| Mauritania | 3 | 16 | 5.33 | 2 | 0.67 | 1 | 2 | 0 | 0 |
| Mauritius | 17 | 111 | 6.53 | 15 | 0.88 | 9 | 7 | 1 | 0 |
| Morocco | 21 | 131 | 6.24 | 22 | 1.05 | 11 | 7 | 3 | 0 |
| Mozambique | 10 | 57 | 5.70 | 5 | 0.50 | 6 | 4 | 0 | 0 |
| Namibia | 16 | 87 | 5.44 | 5 | 0.31 | 6 | 10 | 0 | 0 |
| Niger | 2 | 10 | 5.00 | 0 | 0.00 | 2 | 0 | 0 | 0 |
| Nigeria | 17 | 99 | 5.82 | 8 | 0.47 | 4 | 13 | 0 | 0 |
| Rwanda | 11 | 58 | 5.27 | 1 | 0.09 | 7 | 4 | 0 | 0 |
| São Tomé and Príncipe | 2 | 9 | 4.50 | 0 | 0.00 | 2 | 0 | 0 | 0 |
| Senegal | 14 | 83 | 5.93 | 0 | 0.00 | 12 | 2 | 0 | 0 |
| Seychelles | 13 | 66 | 5.08 | 7 | 0.54 | 10 | 3 | 0 | 0 |
| Sierra Leone | 9 | 41 | 4.56 | 1 | 0.11 | 8 | 1 | 0 | 0 |
| Somalia | 2 | 7 | 3.50 | 0 | 0.00 | 2 | 0 | 0 | 0 |
| South Africa | 75 | 460 | 6.13 | 144 | 1.92 | 7 | 60 | 8 | 0 |
| Sudan | 10 | 47 | 4.70 | 0 | 0.00 | 10 | 0 | 0 | 0 |
| Swaziland | 8 | 43 | 5.38 | 2 | 0.25 | 6 | 2 | 0 | 0 |
| Tanzania | 11 | 63 | 5.73 | 5 | 0.45 | 6 | 5 | 0 | 0 |
| Togo | 2 | 16 | 8.00 | 0 | 0.00 | 1 | 1 | 0 | 0 |
| Tunisia | 15 | 104 | 6.93 | 19 | 1.27 | 9 | 3 | 2 | 1 |
| Uganda | 19 | 96 | 5.05 | 12 | 0.63 | 6 | 13 | 0 | 0 |
| Zambia | 10 | 52 | 5.20 | 2 | 0.20 | 9 | 1 | 0 | 0 |
| Zimbabwe | 7 | 36 | 5.14 | 3 | 0.43 | 4 | 3 | 0 | 0 |
| Total | 582 | 3264 | 5.61 | 360 | 0.62 | 308 | 248 | 23 | 3 |

n = # of websites, $f_i$ = # of features, M($f_i$) = mean # of features per website, $x_i$ = # of online executable services, M($x_i$) = mean # of online executable services per website, stage/level = # of websites at the four stages/levels of e-Government service development

**Table 5**
Top five African countries according to the six frameworks for computing e-Government index.

| Rank | Framework | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | Togo | Togo | Egypt | Egypt | Egypt | Egypt |
| 2 | Tunisia | Tunisia | Tunisia | Tunisia | Tunisia | Tunisia |
| 3 | Egypt | Egypt | Togo | Togo | South Africa | South Africa |
| 4 | Eritrea | Libya | Morocco | Morocco | Morocco | Morocco |
| 5 | Mauritius | Mauritius | South Africa | South Africa | Mauritius | Mauritius |

e-Government index values have a moderate (r = 0.69) correlation with the mean number of online executable services.

## 6. Discussion and future work

Benchmarking and rankings are commonly used to determine relative standing and to monitor the progress of entities with respect to a characteristic or achievement goal. For policymakers, benchmarking tools, such as West's e-Government index, serve as information sources and the relative rankings of countries they produce are given a fair amount of attention and importance. To inform sound policy and decision making and to encourage optimal resource allocation, grounded and broadly applicable ranking frameworks are crucial.

Please cite this article as: Rorissa, A., et al., Benchmarking e-Government: A comparison of frameworks for computing e-Government index and ranking, *Government Information Quarterly* (2011), doi:10.1016/j.giq.2010.09.006

**Table 6**
Strengths and limitations of the six frameworks for computing e-Government index.

| Strength/limitation | Framework | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Less complex, less subjective, and replicable | X | X | X | X | X | X |
| Assigns weight proportional to level of development of e-Government services | | X | X | X | X | X |
| Assigns more weight to the number of features than the number of online executable services | X | X | | | | |
| Punishes websites with more (than 18) features and/or more (than 28) online executable services | X | | | | | |
| Static e-Government service websites and portals are afforded equal weight | X | | | | | |
| Punishes countries with websites that have no online executable services | | | | | X | |

Some current e-Government ranking and index computation procedures, in particular West's (2007b) e-Government index, do not recognize that e-Government websites evolve over time from static catalogs of information to fully integrated portals. In this article, we contrast six frameworks, designed to account for the websites' e-Government service development. Our results indicate that frameworks assigning weights to websites proportional to their level of e-Government service development (frameworks 2 through 6) present a more accurate picture of e-Government services than frameworks that do otherwise. Under frameworks 2 though 6, countries with websites at a lower level of development, even when more numerous, are not assessed as highly as countries with fewer sites overall but higher levels of e-Government development.

Among the preferred frameworks (2 through 6), we believe that framework 6 is superior because it incorporates the strengths of the other frameworks while overcoming their limitations (see Table 6). This last framework produces relative e-Government index values that more fully reflect the features and functionality of e-Government websites. It allows for an easier rescaling to values between 0 and 100 (which is a common practice for most indices). Finally, the highest correlation between e-Government indices computed from our sample data for African countries and the e-readiness index of the countries for 2008 (United Nations, 2008) was achieved using framework 6.

The success of any benchmarking study is partly dependent on the availability of relevant data. As long as a country has some governmental presence on the World Wide Web, West's (2007a) mechanisms (framework 1) and others based on this framework (e.g., frameworks 2 through 6 and other Web-based indices) can be applied. These frameworks compute indices based on objective measures compiled and computed with ease and in a relatively short time, even by countries or groups with limited resources. We believe a firm objective basis is one of the strongest components of our frameworks.

As for weaknesses, we concede that our analysis does not include every possible framework for benchmarking e-Government service websites and countries; such a task would far exceed the scope of this article. Nor can we claim that the frameworks presented are without weaknesses. First, a number of classifications of stages of e-Government service development exist; the one chosen for our frameworks might prove to be less effective than others. Second, our specific method of assigning weights to e-Government websites proportional to their levels of e-Government service development is but one of many methods that could be used. It may inappropriately assume that consecutive levels of e-Government service development are equidistant (e.g., a jump from level 1 to level 2 is the same as one from level 3 to level 4). Finally, our methods of weighting website features compared to online executable services, while efficacious (at least in the context of framework 6), could be adjusted if a more appropriate approach is discerned.

A further limitation of our work stems from the use of point-in-time snap-shot data of e-Government service websites. A longitudinal benchmarking, rather than a one-time look, should provide a better sense of the progress being made by countries in terms of e-Government services (Kaylor et al., 2001). Such a study would also provide a robust dataset that could be used to test the reliability of future benchmarking tools and techniques. Further application and testing of the frameworks is also required in countries other than those in Africa (e.g., EU countries, U. S., OECD members, etc.).

Finally, we are mindful that our frameworks may not adequately measure the success of an e-Government service website or platform. Benchmarking evaluations should be extended to include other means of access and/or delivery of e-Government services, such as digital television, mobile technologies, and telecenters. Other approaches, advocated by researchers such as Kunstelj and Vintar (2004), attempt to assess the impact of e-Government on the economy, on social and democratic processes, and on organizations and their work methods. We fully support these more comprehensive approaches, but remain steadfast in our belief that frameworks based on simple, grounded, and broadly applicable measures (such as those presented in this article) serve well as the basis for building more complex frameworks that account for additional factors such as technology adoption and use.

Given the widespread use of benchmarking results by policymakers, practitioners, and funding agencies, future work should continue our focus on mitigating the various limitations of frameworks used to compute e-Government indices and to produce rankings. A continuous assessment and reconsideration of e-Government benchmarking frameworks is crucial for sustained improvement. The assessment approach and the alternative frameworks presented here fuel such efforts, helping to ensure that benchmarking systems, and the limitations of those efforts, are well-understood.

## 7. Uncited reference

Q5

Accenture, 2003

## References

Accenture (2003). e-Government leadership: Engaging the customer. Retrieved October 29, 2009, from http://www.accenture.com/xdoc/en/newsroom/epresskit/egovernment/egov_epress.pdf

Accenture (2004). E-Government leadership: High performance, maximum value. Retrieved October 29, 2009, from http://www.accenture.com/NR/rdonlyres/D7206199-C3D4-4CB4-A7D8-846C94287890/0/gove_egov_value.pdf

Affisco, J., & Soliman, K. (2006). E-Government: A strategic operations management framework for service delivery. *Business Process Management Journal*, *12*(1), 13–21.

Al-adawi, Z., Yousafzai, S., & Pallister, J. (2005). Conceptual model of citizen adoption of e-Government. The Second International Conference on Innovations in Information Technology. Retrieved February 20, 2008, from http://www.it-innovations.ae/iit005/proceedings/articles/G_6_IIT05-Al-Adawi.pdf

Bakry, S. H. (2003). Toward the development of a standard e-readiness assessment policy. *International Journal of Network Management*, *13*(2), 129–137.

Bannister, F. (2007). The curse of the benchmark: An assessment of the validity and value of e-Government comparisons. *International Review of Administrative Sciences*, *73*(2), 171–188.

Bui, T. X., Sankaran, S. R., & Sebastian, I. M. (2003). A framework for measuring national e-readiness. *International Journal of Electronic Business*, *1*(1), 3–22.

Camp, R. C. (1989). *Benchmarking: The search for industry best practices that lead to superior performance.* Milwaukee, WI: ASQC Quality Press.

Codagnone, C., & Undheim, T. A. (2008). Benchmarking e-Government: Tools, theory, and practice. *European Journal of ePractice*, *4* (August). Retrieved August 18, 2009, from http://www.epractice.eu/files/4.2_0.pdf

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement*, *20*, 37–46.

Curtin, G. (2007). *Encyclopedia of political communications.* Thousand Oaks, CA: Sage Publications.

Curtin, G. (2006). Issues and challenges global e-Government/e-participation models, measurement and methodology: A framework for moving forward. *Prepared for the United Nations Department of Administration and Development Management e-Participation and e-Government: Understanding the Present and Creating the Future Workshop, Budapest, Hungary* Retrieved June 25, 2009, from http://www.usc.edu/schools/sppd/private/bedrosian/Global_EGovernmentJul06.pdf

Dill, D. D., & Soo, M. (2005). Academic quality, league tables, and public policy: A cross-national analysis of university ranking systems. *Higher Education*, *49*, 495–533.

FIFA (2010). FIFA/Coca-Cola world ranking. Retrieved June 1, 2010 from http://www.fifa.com/worldfootball/ranking/lastranking/gender=m/fullranking.html

Gauld, R., Gray, A., & McComb, S. (2009). How responsive is E-Government? Evidence from Australia and New Zealand. *Government Information Quarterly*, *26*(1), 69–74.



Please cite this article as: Rorissa, A., et al., Benchmarking e-Government: A comparison of frameworks for computing e-Government index and ranking, *Government Information Quarterly* (2011), doi:10.1016/j.giq.2010.09.006

Gupta, M. P., & Jana, D. (2003). E-Government evaluation: A framework and case study. *Government Information Quarterly*, *20*(4), 365–387.
Hanafizadeh, P., Hanafizadeh, M. R., & Khodabakhshi, M. (2009). Taxonomy of e-readiness assessment measures. *International Journal of Information Management*, *29*, 189–195.
Haq, M. (1995). *Reflections on human development*. New York: Oxford University Press.
Heeks, R. (2006, July). *Understanding and measuring e-Government: International benchmarking studies*. Paper prepared for UNDESA E-Participation and E-Government: Understanding the Present and Creating the Future Workshop, Budapest, Hungary. Retrieved August 18, 2009, from http://unpan1.un.org/intradoc/groups/public/documents/UN/UNPAN023686.pdf
Institute for Economics and Peace, Economist Intelligence Unit (2010). Global peace index: 2010 methodology, results & findings. Retrieved July 21, 2010, from http://www.visionofhumanity.org/wp-content/uploads/PDF/2010/2010%20GPI%20Results%20Report.pdf
ITU (2009). Measuring the information society: The ICT development index. Retrieved September 18, 2009, from http://www.itu.int/ITU-D/ict/publications/idi/2009/material/IDI2009_w5.pdf
Janssen, D., Rotthier, S., & Snijkers, K. (2004). If you measure it they will score: An assessment of international e-Government benchmarking. *Information Polity*, *9*, 121–130.
Kaylor, C., Deshazo, R., & Van Eck, D. (2001). Gauging e-Government: A report on implementing services among American cities. *Government Information Quarterly*, *18*(4), 293–307.
Kunstelj, M., & Vintar, M. (2004). Evaluating the progress of e-Government development: A critical analysis. *Information Polity*, *9*, 131–148.
Layne, K., & Lee, J. (2001). Developing fully functional e-government: A four stage model. *Government Information Quarterly*, *18*(2), 122–136.
Neuendorf, K. A. (2002). *The content analysis guidebook*. Thousand Oaks, CA: Sage Publications.
New Economics Foundation (2009). The happy planet index 2.0. Retrieved June 1, 2010 from http://www.happyplanetindex.org/public-data/files/happy-planet-index-2-0.pdf
Ojo, A., Janowski, T., & Estevez, E. (2007). Determining progress towards e-Government - What are the core indicators? Retrieved June 19, 2008, from http://www.iist.unu.edu/newrh/III/1/docs/techreports/report360.pdf
Osimo, D., & Gareis, K. (2005, May). *The role of inter-regional benchmarking in the policy-making process: Experiences in the field of information society*. Paper presented at the Regional Studies Association Regional Growth Agenda Conference, Aalborg, Denmark. Retrieved June 29, 2008, from http://www.regional-studies-assoc.ac.uk/events/aalborg05/osimo.pdf
Panopoulou, E., Tambouris, E., & Tarabanis, K. (2008). A framework for evaluating Web sites of public authorities. *Aslib Proceedings: New Information Perspectives*, *60*(5), 517–546.
Reporters Without Borders (2009). World press freedom index 2009—The rankings. Retrieved June 1, 2010 from http://arabia.reporters-sans-frontieres.org/IMG/pdf/classement_en.pdf
UNCTAD (2009). *Manual for the production of statistics on the information economy, 2009*. Revised Edition. Geneva: UNCTAD Retrieved August 20, 2009, from http://www.unctad.org/en/docs/sdteecb20072rev1_en.pdf.
UNDP (2009). Human development report 2009. Retrieved July 21, 2010, from http://hdr.undp.org/en/media/HDR_2009_EN_Complete.pdf
UNDPEPA (2002). Benchmarking e-Government: A global perspective. Retrieved June 19, 2008, from http://aps.vlaanderen.be/straplan/vindplaatsen/benchmarking-e-government.pdf
United Nations (2010). United Nations e-Government survey 2010: Leveraging e-Government at a time of financial and economic crisis. Retrieved July 19, 2010, from http://unpan1.un.org/intradoc/groups/public/documents/UN-DPADM/UNPAN038853.pdf
United Nations (2008). UN e-Government survey 2008: From e-Government to connected governance. Retrieved June 19, 2008, from http://www.ansa-africa.net/uploads/documents/publications/UN_e-government_survey_2008.pdf
United Nations (2005). United Nations global e-Government readiness report. Retrieved February 20, 2008, from http://unpan1.un.org/intradoc/groups/public/documents/un/unpan021888.pdf
United Nations (2004). United Nations global e-government readiness report. Retrieved February 20, 2008, from http://unpan1.un.org/intradoc/groups/public/documents/UN/UNPAN019207.pdf
United Nations (2003). UN global e-government survey. Retrieved February 20, 2008, from http://unpan1.un.org/intradoc/groups/public/documents/un/unpan016066.pdf
Watson, G. H. (1993). *Strategic benchmarking*. New York, NY: Wiley.
West, D. M. (2007b). Global e-Government. Retrieved February 20, 2008, from http://www.insidepolitics.org/egovt07int.pdf
West, D. (2007a). *Digital government: Technology and public sector performance*. Princeton, NJ: Princeton University Press.
West, D. M. (2004). E-Government and the transformation of service delivery and citizen attitudes. *Public Administration Review*, *64*(1), 15–27.
World Bank (2009). Governance matters 2009. Retrieved June 1, 2010 from http://info.worldbank.org/governance/wgi/mc_countries.asp
World Health Organization (2000). *The WHO report 2000, health systems: Improving performance*. Geneva: WHO.

**Abebe Rorissa** is an Assistant Professor at the Department of Information Studies, University at Albany, SUNY. He has over 21 years of experience working in four countries and consulted for academic institutions, national governments, and international organizations on information and communication technologies as well as information organization. Dr. Rorissa is widely published and his works appear in the Journal of the American Society for Information Science & Technology, Government Information Quarterly, and Information Processing and Management. His research interests include adoption, use, and impact of information and communication technologies (ICTs); multimedia information organization and retrieval; and human information behavior. Dr. Rorissa served on program committees of international conferences and edited some proceedings.

**Dawit Demissie** is a Ph.D candidate in the Informatics (INF) PhD program at the College of Computing and Information, University at Albany, SUNY. He received a BA in Computer/Information Science from State University of New York at Oswego, and an MS in Telecommunications & Network Management from Syracuse University. Before joining the INF PhD program, he had been a Software Engineer in Test and prior to that, he had served as a System Consultant and Information Technology Specialist at various organizations in New York. He also had been an Instructor at the University at Albany, Hudson Valley Community College, Bryant & Stratton College, Syracuse University, and SUNY Oswego. He has published in Government Information Quarterly and presented at major conferences. His research interests include empirical testing of models and theories of information technology, Human computer Interaction, e-Government, and knowledge management.

**Theresa A. Pardo** is Director of the Center for Technology in Government located at the University at Albany. She is also a faculty member in Public Administration and Policy and Informatics at the University. Theresa has written extensively on a range of topics related to IT innovation in government including cross-boundary information sharing, trust and knowledge-sharing, and preservation of government digital records. She has received research funding from the U.S. National Science Foundation, the U.S. Department of Justice, and the Library of Congress, among others. She was recently appointed as a senior adviser to the Informatization Research Institution, State Information Center, PR China.



Please cite this article as: Rorissa, A., et al., Benchmarking e-Government: A comparison of frameworks for computing e-Government index and ranking, *Government Information Quarterly* (2011), doi:10.1016/j.giq.2010.09.006