Multi-criteria Assessment of the Quality of Local Government Websites: An Example from Małopolskie Voivodeship, Poland

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Abstract

Purpose: E-services provided by public administration are most often available through a web browser or mobile application. The development technique can directly affect use comfort and conformity with service and operating quality policy of the entire office. The quality of the application matters and should be monitored. It is valid for all tiers of public administration, also local governments. The purpose of the work is to perform a multi-criteria assessment of websites of local government units in Małopolskie Voivodeship. **Design/methodology/approach:** The study covered 182 websites of local government units. The results were normalised with zero unitarisation. This way, each website could be assigned a synthetic aggregate quality indicator, SQI. **Findings**: The attribute with the lowest score for the tested websites was the performance on mobile devices. It suggests that local governments should optimise their websites for mobile devices. **Research limitations/implications:** The study involved a limited number of website quality attributes and a limited number of test applications. **Originality/value:** The study pinpoints critical attributes of local government websites in need of optimisation.

Keywords: E-Administration, Quality, Usability, User Experience, Optimisations, Design Standards.

Introduction

E-administration develops thanks to IT systems. They are handled by administration personnel who need restricted-access privileges, usually through authorised access, identity check, or encrypted VPN to work with the system. The results of the use of such systems might, however, be available to the general public. Their primary user should be a citizen. Therefore e-services are most often provided through web browsers or mobile applications for two-way communication. The user is not required to install additional software.

End-user applications are built in various ways. Their development technique can directly affect use comfort and conformity with service and operating quality policy of the entire office [Qutaishat 2013, Sá et al. 2016, Ismailova and Inal 2017]. Therefore, the quality of the application matters and should be monitored. It is valid for all tiers of public administration, also local governments [Król and Zdonek 2020a]. Local governments often implement central-government regulations. They also solve problems of local communities and can use websites and mobile applications to this end. So these should be of high quality. The purpose of the work is to perform a multi-criteria assessment of websites of local government units in Małopolskie Voivodeship.

This paper is organised as follows. The second section presents issues relevant to the quality of websites, particularly multi-criteria quality assessment. Section three describes the methodological framework for the research. Key results and conclusions are presented next. Discussion analyses results of selected public administration website quality tests. The findings are provided in the summary, and research limitations are discussed in the final part.

Website Quality

In principle, a website can be built according to precise and easily available standards, such as the World Wide Web Consortium W3C standards regarding code correctness (HTML and CSS) and website accessibility. They contain guidelines for each part of a website. One can also choose from among myriads of content management systems (CMS) that conform to the standards. Note, however, that W3C standards are not normative. They are, nevertheless, respected and followed by creators of websites and web applications all over the world.

Design standards can be 'official' (recorded in the documentation) or come in the form of 'good practice'. Many universal attributes of IT system quality have been recorded in standards by the International Organization for Standardization (ISO). ISO/IEC 25010:2011* , for example, describes six main software quality characteristics: (1) functionality, (2) reliability, (3) usability, (4) efficiency, (5) maintainability, and (6) portability. According to ISO 9241-100** , usability is derived from (1) effectiveness; (2) efficiency, and (3) use satisfaction. Such standards as ISO 13406*** , ISO 14915**** , or ISO TR 16982***** apply to the usability of interactive systems and user interface ergonomics. They set required quality attributes to ensure sufficient use and human-machine interaction quality. It is not always the case that a list of guidelines and quality criteria is available. It is particularly true for website attributes that affect its place on the search engine ranking list. In such a case, it is the intuition, knowledge, and experience of the administrator/editor of a website that matter the most. High search result rankings are often achieved with trial and error. Moreover, the usability quality of websites is often measured with metrics formulated as good practices, such as Nielsen's heuristics [Huang and Benyoucef 2014].

Website Quality Assessment

Website quality is a complex issue [Lee-Geiller and Lee 2019]; hence it can be evaluated in different ways: with or without users, automatically (an algorithmic indicator score) or manually after a cognitive walkthrough. The approaches listed above can be successfully combined as well. What is more, website quality assessment is often subjective, based on original checklists, and hinging on the author's skills and knowledge to a large extent.

An indicator-based assessment usually comes in two forms. (1) A global aggregate multi-criteria assessment takes into consideration as large a number of numeric indicators describing website quality as possible. (2) A detailed assessment focused on a specific domain cross-validates a selected quality attribute, such as performance.

Website quality attributes include mobile readiness, content quality (content is king), etc. Mobile readiness can be verified in various ways, using test applications, CSS (Cascading Style Sheet) code exploration, or with specific mobile devices [Galvez and Youngblood 2016]. It is relatively easy to check whether a website changes its appearance to fit a mobile device, but to verify the usability (the comfort of use) of a website is more complicated and requires extensive testing [Garcia-Lopez et al. 2017]. The same applies to content quality assessment. It can be quantitative or qualitative. A qualitative assessment measures the ratio of code (HTML, CSS, JS) to the text content (the text to HTML ratio, THR). A qualitative assessment can measure the so-called semantic value or its ease of perception [Ojha et al. 2018]. Performance [Dickinger and Stangl 2013] and SEO [Giannakoulopoulos et al. 2019] are just as important. Website performance can be expressed with various scores, such as Yslow, PageSpeed Score, or measures of load time (in seconds): First Byte, First Contentful Paint, or Fully Loaded. Assessment of search engine optimisation can aggregate measurements of all of the attributes mentioned above.

Another design attribute determining the quality of a website is its accessibility. Relevant guidelines (Web Content Accessibility Guidelines, WCAG) are provided by the World Wide Web Consortium W3C [Ismail et al. 2018, Król and Zdonek 2020a]. Other factors of website quality are the number of backlinks and the quality of internal links [Król and Zdonek 2019] as well as global quality indicators such as Alexa Rank, Serpstat Visibility, or Open PageRank [Ziakis et al. 2019].

Materials and Methods

The study covered websites of all 182 local government units in Małopolskie Voivodeship, Poland (Fig. 1). The quality of the websites was measured with eight web applications run in a web browser (Table 1). The quality indicators and test tools were selected based on a literature analysis [Galvez and Youngblood 2016, King and Youngblood 2016, Garcia-Lopez et al. 2017, Giannakoulopoulos et al. 2019, Król and Zdonek 2020b].
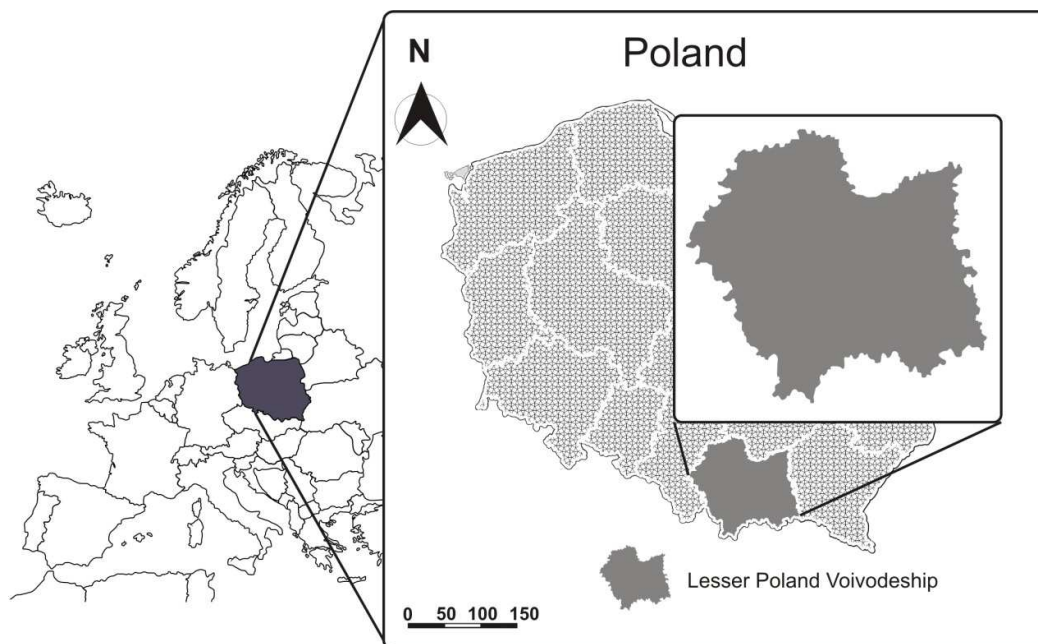
Fig. 2: Małopolskie Voivodeship, Poland. Source: own work

The research was informal, quantitative, and carried out under normal use conditions. Each test gave a final score. The final scores were positioned in various ranges and resulted from the aggregation of various tests (Table 1).

Table 1: Test applications and scope of tests

Test scope	Test tool (URL)	Indicator (score scale)
Search Engine Optimisation (SEO)	ZadroWeb (zadroweb.com/seo-auditor)	SEO Score (0–100)
Mobile optimisation test	Mobile-Friendly Test: Bulk Testing Tool (technicalseo.com/tools/mobile-friendly/)	Mobile readiness (0–1)
Performance (desktop) PSI desktop	PageSpeed Insights (developers.google.com/speed/pagespeed/insights/)	Google PageSpeed Score (0–100)
Performance (mobile) PSI mobile	PageSpeed Insights (developers.google.com/speed/pagespeed/insights/)	Google PageSpeed Score (0–100)
Text to HTML ratio THR	Text to HTML ratio checker (prepostseo.com/code-to-text-ratio)	Text ratio (0–100%)
No. of backlinks	Backlink Checker (iwebtool.com/backlink_checker)	Backlinks (>0)
General website quality	Blink Audit Tool (audyt.blink.pl)	Quality indicator (0–100%)
Text semantics, marketing value evaluation	Blink Audit Tool (audyt.blink.pl)	Score (0–100%)
Accessibility (WCAG guidelines)	WebAIM WAVE Web Accessibility Evaluation Tool (wave.webaim.org)	Errors (>0)
Open PageRank	Open PageRank Online Tool (domcop.com/openpagerank)	Page Rank Value (0–10)

Research Process

The author first assessed the search engine optimisation of the websites using automatic algorithms. ZadroWeb generated the final summary score for SEO tests. The application evaluates such parameters as conformity with

W3C standards, complete metadata, performance, and values of Page Authority and Domain Authority. Mobile readiness was tested with the Bulk Testing Tool.

Website performance was tested in the desktop and mobile modes with PageSpeed Insights (Google Developers). The value of the Text to HTML ratio (THR) and the number of backlinks were verified. The semantic value of the text was assessed with Blink Audit Tool. Conformity with WCAG was verified using WAVE Web Accessibility, and global 'website ranking position' was evaluated with Open PageRank. The measurements were then standardised with Equation (1) for LTB characteristics and Equation (2) for STB values. An LTB diagnostic variable, larger-the better, should be as high as possible (SEO score, for example). An STB variable, smaller-the-better, should have the lowest possible value (such as syntax errors in HTML code). Standardised variables lie in the [0,1] interval.

$$z_{ij} = [x_{ij} - \min_i\{x_{ij}\}] / r_j \qquad (1)$$
$$z_{ij} = [\max_i\{x_{ij}\} - x_{ij}] / r_j \qquad (2)$$

where $z_{ij} \in [0,1]$.
and:
z_{ij} – a standardised variable;
$z_{ij} = 0 \Leftrightarrow x_{ij} = \min_i\{x_{ij}\}$;
$z_{ij} = 1 \Leftrightarrow x_{ij} = \max_i\{x_{ij}\}$;
x_{ij} – the value of the variable before standardisation;
$\min_i\{x_{ij}\}$ – the minimum value of the variable before standardisation;
$\max_i\{x_{ij}\}$ – the maximum value of the variable before standardisation;
r_j – the range for the j-th variable.

The standardisation found the common denominator for the diagnostic variables so they could be added up. This way, each website could be described with a synthetic aggregate quality indicator (SQI). The SQI value was used to group the websites into categories.

Results and Conclusions

Each of the websites could score 0 to 10 multi-criteria quality assessment points [0,10]. The website with the lowest score had 2.86 points (SQI value), while the website with the highest result had 6.68 points. All the investigated websites scored 865.9 points in total out of 1820, which is 47.6% of the available points (Fig. 1). It is a mediocre result at best, suggesting that most of the websites needed to be optimised. Characteristics most in need of optimisation included mobile performance (PSI mobile) and the number of backlinks. Still, desktop performance (PSI desktop) had plenty of room for improvement as well.
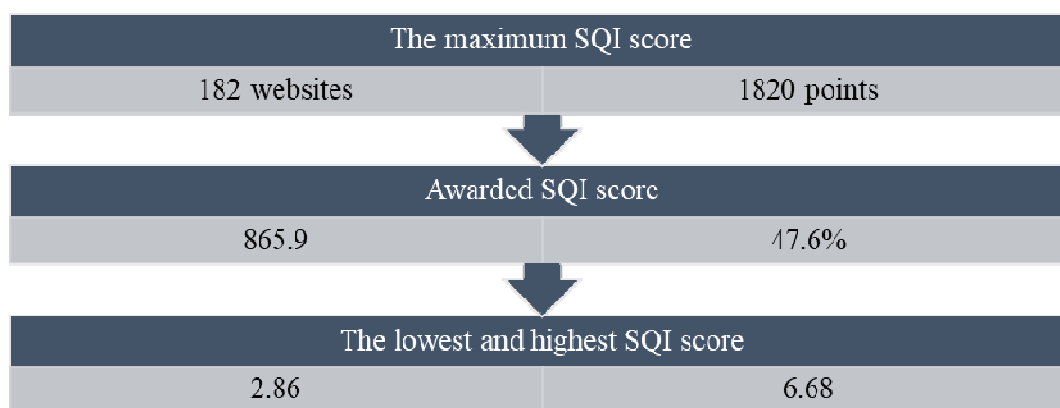

The maximum SQI score	
182 websites	1820 points
Awarded SQI score	
865.9	47.6%
The lowest and highest SQI score	
2.86	6.68

**Figure 2: The general quality results for local government
websites in Małopolskie Voivodeship. Source: own work**

As many as 88 websites (a little over 48%) reached mobile performance up to 38 points (out of 100 maximum PSI mobile points). The poorest performing website scored only 2 PSI mobile points out of 100 (Table 2). Mobile performance of 33 websites was critical, with scores below 20. Such a low performance can significantly hinder browsing comfort or even prevent mobile use completely. Moreover, at least 41 websites (22.5%) required urgent desktop performance optimisation (PSI desktop).

Table 2: Descriptive statistics – SEO, performance, and THR tests

Attribute	SEO	PSI desktop	PSI mobile	THR
Mean	71.66	63.26	39.21	14.99
Median	72.9	63	38	16
Min.	52.34	10	2	2
Max.	85.05	99	93	33

Source: own research

The largest range was noted for the number of backlinks (Table 3). Note, however, that the quality of the pages the links came from was not verified, and this quality is important for search engine results page ranking. Values of a general quality indicator (according to the Blink Audit Tool) ranged from 36 to 82 percentage points (Table 3). Note further that there were relatively many websites with average or low Open PageRank values (below 2 points). In addition, many of the investigated websites required accessibility optimisation, in particular as regards the visibility of some content on the screen/display (Table 3).

Low values of Open PageRank are characteristic of unpopular websites, which are those with low visitor counts and few quality backlinks. It is somewhat puzzling as public administration websites are open to the public and need not attract visitors. Their audience comes 'ex officio'. Such websites are, therefore, predisposed to large visitor volumes and many backlinks.

Table 3: Descriptive statistics – link, content, accessibility, and other quality indicators

Attribute	Backlink	General quality score	Semantics	Accessibility	Open PageRank
Mean	215,184.16	61.38	63.54	20.47	2.97
Median	8,530.5	61	65	15	3.18
Min.	223	36	35	0	0.22
Max.	18,066,954	82	95	185	4.85

Source: own research

Most objects in the set of websites scored 'average' SQI values. This group constituted almost 77% of all the websites (type II and II websites combined). The mean quality score under the research design was from 4 to 6 SQI points (Table 4). Websites that demonstrated 'average quality' required optimisation, but no gross design errors were identified. Nevertheless, the multitude of minor flaws in many areas, including development technique and the way content was published, cumulated, which reduced their general score. Websites not optimised for mobile devices, with poor performance, few backlinks, and low values of other quality indicators had the poorest results.

Table 4: Typology of websites divided by the SQI value

Score range	0–2.99	3.0–3.99	4.0–4.99	5.0–5.99	6.00–7.00
Number of websites	1	30	81	59	11
Percentage (%)	0.55	16.48	44.51	32.42	6.04
Website type	V	IV	III	II	I

Source: own research

The investigated websites scored almost 72% of the maximum number of points for SEO, about 63% of points for PSI desktop performance, and a little over 39% of PSI mobile performance points (Table 5). Moreover, almost 80% of them 'reacted to display size'. They adapted their appearance (layout, content position, menu, etc.) to mobile devices (in various ways and to various extents).

Table 5: Quantitative statistics – SEO, performance, THR, and mobile readiness tests

Attribute	SEO	PSI desktop	PSI mobile	THR	Mobile readiness
The maximum score	18,200	18,200	18,200	18,200	182
Total scores	13,042.14	11,513	7,137	2,729	144
Percentage (%)	71.66	63.26	39.21	14.99	79.12

Source: own research

The websites scored high as regards search engine optimisation. It is a good result, but the measurement involved only one tool and does not provide a sound footing for an unambiguous SEO assessment. Algorithmic SEO measurements should employ complementary tests with several test tools.

Discussion

The quality of public administration websites is assessed comprehensively or in one dimension. One of the most frequently investigated attributes of such websites is accessibility [Kamoun and Basel Almourad 2014, Galvez and Youngblood 2016, King and Youngblood 2016, Paul and Das 2019, Król and Zdonek 2020a]. It is mostly because the accessibility of websites of institutions financed by the public budget is regulated in many countries, also in Poland [KRI 2012].

Kopackova et al. [2010] focused on the accessibility of local e-government websites in the Czech Republic (n=39). They looked into website accessibility from a wider perspective, taking into consideration the search engine results page visibility. The researchers employed selected computerised tools and techniques. The criteria defined for accessibility and findability testing were as follows: findability through Czech search engines, page rank, URL comprehensibility, observance of WCAG rules, comprehensibility of screen reader output, (X)HTML validation, display in a low-resolution browser, separation of content from the graphic part, and metadata usage. Kopackova et al. [2010] demonstrated that the websites they tested most often had to be corrected to conform to W3C recommendations, mostly as regards (X)HTML syntax and WCAG compliance. Furthermore, they noted a need to improve the content as regards SEO, including keywords and headers.

Galvez and Youngblood [2016] comprehensively assessed local e-government websites in Rhode Island. They evaluated development technique quality in terms of accessibility, usability, and mobile readiness. They used WebAIM's WAVE to investigate accessibility. Galvez and Youngblood [2016] demonstrated that local government websites in Rhode Island should be optimised, in particular, in terms of accessibility and mobile readiness.

Al-Soud and Nakata [2010] tested accessibility, usability, transparency, and responsiveness of thirty Jordanian government websites and their readiness to deliver government services online. They employed tools for automatic evaluation of selected website attributes, including SortSite (PowerMapper Software) in their research. They assessed such attributes as usability, conformity to W3C standards, link rot, and SEO. Their website evaluation revealed that the websites suffered from a lack of consistency in standards and features. Furthermore, they identified a lack of consideration of citizens' expectations and needs through the absence of various features which facilitate the user interaction process.

Most studies on public administration websites conclude that the websites require optimisation, especially regarding accessibility and mobile readiness. Generally, every website can be optimised, amended, or improved to a certain extent both as regards technical issues and content.

Summary

From the technical perspective, public administration websites, including those of local government units, should conform to the same design (quality) standards as other websites. Websites can differ in terms of content, for example, its arrangement and text or layout, but also function and functionalities.

The attribute with the lowest score for the tested websites was the performance on mobile devices (PSI mobile). The results indicate a real need to optimise websites of local government units for mobile devices. The importance of the matter rises with the rising number of users who browse websites on mobile devices. Moreover, desktop and mobile performance affect website rank in search engine results pages.

Research limitations

There is a risk that studies on large sets of websites can turn out to be superficial or relatively generalising because of a large number of tested objects and the complexity of the issue of 'website quality'. On the other hand, only a study on a representative (sufficiently large) sample can justify conclusions for the entire population. Such an approach inherently limits the number of assessed quality criteria and tools. It provides no room for in-depth quality assessment, which is the foundation of dedicated quality audits.

Quality assessment of a specific set of websites provides certain general insight mostly into global problems. Nevertheless, when upgrading their websites, local government units should focus primarily on the results of a detailed audit, which can pinpoint problem areas in need of intervention. One must not forget that the online ecosystem is a complex one, and each website is an individual specimen.

Acknowledgment

Footnotes

* ISO/IEC 25010:2011: Systems and Software Engineering – Systems and Software Quality Requirements and Evaluation (SQuaRE) – System and Software Quality Models.
** ISO 9241-100: Ergonomics of Human-System Interaction. Part 110: Dialogue Principles.
***ISO 13406: Ergonomic Requirements for Work with Visual Displays Based on Flat Panels.
****ISO 14915: Software Ergonomics for Multimedia User Interfaces.
*****ISO TR 16982: Usability Methods Supporting Human-centred Design.

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