PERFORMANCE EVALUATION ON QUALITY OF ASIAN AIRLINES WEBSITES – AN AHP APPROACH

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ABSTRACT

In recent years, many people have devoted their efforts to the issue of quality of Web site. The concept of quality is consisting of many criteria: quality of service perspective, a user perspective, a content perspective or indeed a usability perspective. Because of its possible instant worldwide audience a Website's quality and reliability are crucial. The very special nature of the web applications and websites pose unique software testing challenges. Webmasters, Web applications developers, and Website quality assurance managers need tools and methods that can match up to the new needs. This research conducts some tests to measure the quality web site of Asian flag carrier airlines via web diagnostic tools online. We propose a methodology for determining and evaluate the best airlines websites based on many criteria of website quality. The approach has been implemented using Analytical Hierarchy Process (AHP) to generate the weights for the criteria which are much better and guarantee more fairly preference of criteria. The proposed model uses the AHP pairwise comparisons and the measure scale to generate the weights for the criteria which are much better and guarantee more fairly preference of criteria. The result of this study confirmed that the airlines websites of Asian are neglecting performance and quality criteria.

KEYWORDS

performance, quality, websites, Analytical hierarchy process

1. INTRODUCTION

Website quality is a new topic in the software quality. Web based application can be used and reached more users than non web based application. The importance of website creates a demand from the users for the quality and fast delivery, unfortunately the complexities of the websites and technology which support this application make testing and quality control more difficult to handle. Automation of the testing for website quality is a new chance and a new method. Each definition of quality leads to lists of criteria about what constitutes a quality site. All of these criteria from multiple studies on Web quality to form a comprehensive tool for evaluating the quality of a Website that would serve to assess its trustworthiness explained in one research (McInerney, 2000). The principle was that 'if information can pass a test of quality, it is most likely to prove trustworthy' and because of this belief, should have higher credibility. The Website Quality Evaluation Tool (WQET) is an interdisciplinary assessment instrument and this is an important instrument that produced from the analysis and synthesis of multiple Web quality studies. The tool needs a lot of time and cautious consideration. It takes more than one hour to examine a Website thoroughly and apply criteria of the quality. This time dedication may be available to information professionals, but for the public user may not be willing to spend the same amount of time. Thus, the challenge is to create a method that will guide the Internet user to the same finding as the WQET without needed a lot of time.
There are many scope of quality, and each measure will pertain to a particular website in varying degrees. Here are some of them: first factor is time, a credible site should be updated frequently. The information about latest update also should be included on the homepage. However, if the information

has not been updated currently, the visitor could easily know that perhaps the site manager does really bother to update the site. Second factor is structural, all of the parts of the website hold together and all links inside and outside the website should work well. Broken links on the webpage also are another factor that always downgrades the quality of website. Each page usually has references or links or connections to other pages. These may be internal or external web site. Users expect each link to be valid, meaning that it leads successfully to the intended page or other resource. In the year of 2003, discovered that about one link out of every 200 disappeared each week from the Internet (McCowen et al., 2005).
The third factor is content; number of the links, or link popularity is one of the off page factors that search engines are looking to determine the value of the webpage. Most of search engine will need a website to have at least two links pointing to their site before they will place it to their index, and the idea of this link popularity is that to increase the link popularity of a website, this website must have large amount of high quality content. Number of links to website improves access growth and helps to generate traffic (Page et al., 1998). Search engine such as Google make a citation analysis to rank hits, then a website which has a many links to it will have a higher ranking compared a website with few links. This indicator can be used to measure the quality of web site. Fourth factor is response time and latency; a website server should respond to a browser request within certain parameters, it is found that extraneous content exists on the majority of popular pages, and that blocking this content buys a 25-30% reduction in objects downloaded and bytes, with a 33% decrease in page latency, from 2003 to 2008 the average web page grew from 93.7K to over 312K (Josep et al., 2007). Popular sites averaged 52 objects per page, 8.1 of which were ads, served from 5.7 servers (Krishnamurthy et al., 2006), and object overhead now dominates the latency of most web pages (Yuan et al., 2005). Following the recommendation of the HTTP 1.1 specification, browsers typically default to two simultaneous threads per hostname. As the number of HTTP requests required by a web page increase from 3 to 23, the actual download time of objects as a percentage of total page download time drops from 50% to only 14%.

The last criterion is performance. Technology continues to make a important impact in service industries and fundamentally shapes how services are delivered (Durkin, 2007). One of the research finding mention that website which has slow download time less attractive compare than website with faster download time (Ramsay et al., 1998). In the recent time the average time of the connection speed is 5Kbps (kilobytes per second). This facts give an implication that one web page with 40Kb page size will be downloaded during 8 seconds. This matter in accordance with the 'eight second rule', this 8 second is a normal time for loading webpage and will not be tolerable from the user. This result are supported by many research result mentioned that mean of tolerable download time in the user side is 8.57 with standard deviation 5.9 seconds (Bouch et al., 2000). Providing information related with waiting time is very important for user. For the long download time, it is better to provide information about how many percentage of the webpage already downloaded and how many hours needed to complete this task. Another important aspect is information fit-to-task, information presented on a website is accurate and appropriate for the task at hand (Loiacono et al., 2007)
Website page optimization continues to provide significant improvements for performance and can have a large impact on its quality. Despite the increasing broadband adoption, slow downloads continue to be a cause of slow web browsing which can be one of the most frustrating experiences. The optimizations are organized into three basic categories including image, website design, and HTML code optimization. This optimization can be improved by improving the quality of your website's images, reducing the complexity of the HTML coding, and increasing the overall usability. As the web continues to mature as a competitive tool for business applications, there is a growing need to understand the relationship between web usability and business performance. Much of the prior research has viewed the website development from a set of usability factors (Green et al., 2006; Seffah et al., 2006).

2. LITERATURE REVIEW

The web site evaluation can be approached from users, web site designer/administrator or both together (Olsina et al., 2001). Web-site Quality Evaluation Method (QEM) for six university sites from different countries tested using this factor (Huizingh, 2000). Web site architecture is classified into content and design (Apostolou et al., 2008), and each category is specified into evaluation criteria according to the characteristics and perception of a web site. Web site evaluation framework is developed to test 30 major airlines website all around the world (Palmer, 2002). This new framework called Airline Site Evaluation Framework (ASEF) consists of five categories: Finding, Interface, Navigation, Content, Reliability, and Technical aspects. Web site usability, design, and performance is developed using metrics and conducted a user test with them (Palmer, 2002). A quantitative inspector-based methodology for Web site evaluation, with a hierarchical structure called EQT4Web and the assessment method is general-purpose is developed for cultural sites (Rafikul et al., 2007). This new approach, hazed on fuzzy operators, permits a sophisticated aggregation of measured atomic quality values, using linguistic criteria to express human experts' evaluations. Every webpage design has their own characteristics and this characteristic has drawbacks and benefits. There is a mechanism for measuring the effects of the webpage component toward the performance and quality of website. This mechanism will measure size, component, and time needed by the client for downloading a website. The main factor that will influences this download time are page size (bytes), number and types of component, number of server from the accessed web. Table 1 displayed a research conducted by IBM that can be used as a standard for performance measurement of quality (Sakthivel et al., 2007).

Table1. Standard of the website performance

Tested Factor	Quality Standard
Average server response time	< 0.5 second
Number of component per page	< 20 objects
Webpage loading time	< 30 second
Webpage size in byte	< 64 Kbytes

3. METHODOLOGY

The web site evaluation can be approached from users, web site designer/administrator or both together (Olsina et al., 2001). Web-site Quality Evaluation Method (QEM) for six university sites from different countries tested using this factor (Huizingh, 2000). Web site architecture is classified into content and design (Apostolou et al., 2008), and each category is specified into evaluation criteria according to the characteristics and perception of a web site. Web site evaluation framework is developed to test 30 major airlines website all around the world (Palmer, 2002). This new framework called Airline Site Evaluation Framework (ASEF) consists of five categories: Finding, Interface, Navigation, Content, Reliability, and Technical aspects. Web site usability, design, and performance is developed using metrics and conducted a user test with them (Palmer, 2002). A quantitative inspector-based methodology for Web site evaluation, with a hierarchical structure called EQT4Web and the assessment method is general-purpose is developed for cultural sites (Rafikul et al., 2007). This new approach, hazed on fuzzy operators, permits a sophisticated aggregation of measured atomic quality values, using linguistic criteria to express human experts' evaluations. Every webpage design has their own characteristics and this characteristic has drawbacks and benefits. There is a mechanism for measuring the effects of the webpage component toward the performance and quality of website. This mechanism will measure size, component, and time needed by the client for downloading a website. The main factor that will influences this download time are page size (bytes), number and types of component, number of server from the accessed web. Table 1 displayed a research conducted by IBM that can be used as a standard for performance measurement of quality (Sakthivel et al., 2007).

3.1 Web diagnostic tools

We used a number of widely available web diagnostic tools online, thus we used widely available website performance tool and webpage speed analyzer online service (http://www.websiteoptimization.com). List of performance measured and reported by this service include total size, number of objects (HTML, images, CSS, scripts), and download times on a 56.6 kbps connection, another available webpage online tools that we used are for testing quality is: http://validator.w3.org/checklink which was utilised in order to monitor broken links in the HTML code of the portals, while the W3C's HTML validator website (http://validator.w3.org) was used to validate the HTML code of the portals, this standard was set up by World Wide Web Consortium (W3C), the main international standards organization for the World Wide Web. A website tool for measuring Link popularity website (www.linkpopularity.com) is used to determine the amount and quality of links that are made to a single website from many websites, this based on the page-rank analysis.

This research also conduct using accessibility software for testing whether the webpage tested already fulfill the criteria to be accessed by people with dissabilities. This software has an ability to conduct an online test for webpage refer to the criteria setup by W3C-WCAG. Web Content Accessibility Guidelines (WCAG) is part of a series of Web accessibility guidelines published by the W3C's Web Accessibility Initiative. Accessibility software can be downloaded from www.tawdis.net. Testing using accessibility software consist of test for HTML code for knowing whether the webpage can be read by screen reader, and testing for knowing is there any alternative text for every single picture, animation, video, and audio in the webpage.

3.2 Sample Data

In order to get the data for this research, we examined airlines websites from five Asian countries and were not randomly selected, but a careful process was undertaken. Rather than selecting any generic websites this research attempted to evaluate the website that are considered to be leaders in the area information technology implementation based on result of a survey conducted by pingdom and skytrax company for airlines websites. By doing such an approach it was felt that measures of 'best practices' could emerge.

3.3 Analytical Hierarchy Process

Analytic Hierarchy Process (AHP) was originally designed to solve complicated multi-criteria decision problem (Saaty, 1980), beside that AHP is appropriate whenever a target is obviously declared and a set of relevant criteria and alternatives are offered (Ozden et al., 2005). AHP has been proposed for determining the best website to support researcher through the decision making activity, which aims to determine the best website among pool of airlines website. AHP is a popular model to aggregate multiple criteria for decision making (Yuen et al., 2008). In AHP the problems are usually presented in a hierarchical structure and the decision maker is guided throughout a subsequent series of pair wise comparisons to express the relative strength of the elements in the hierarchy. In general the hierarchy structure encompasses of three levels, where the top level represents the goal, and the lowest level has the website under consideration. The intermediate level contains the criteria under which each website is evaluated. The final score obtain for each website across each criterion is calculated by multiplying the weight of each criterion with the weight of each website. Website which has got the highest score is suggested as the best website and decision maker may consider that one as the best decision choice.

Generally, AHP has the following steps:

1. Employ a pair-wise comparison approach. Fundamental scale for pair-wise comparisons developed to solve this problem (Saaty, 1980). The pair-wise comparison matrix A, in which the

element a_{ij} of the matrix is the relative importance of the i^{th} factor with respect to the j^{th} factor, could be calculated

$$\text{as } A=[a_{ij}]=\begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \qquad (4)$$

2. There are $n(n-1)$ /judgments required for developing the set of matrices in step 1. Reciprocals are automatically assigned to each pair-wise comparison, where n is the matrix size.
3. There are $n(n-1)$ /judgments required for developing the set of matrices in step 3. Reciprocals are automatically assigned to each pair-wise comparison, where n is the matrix size.
4. Hierarchical synthesis is now utilized to weight the eigenvectors according to weights of criteria. The sum is for all weighted eigenvectors corresponding to those in the next lower hierarchy level.
5. Having made all pair-wise comparisons, consistency is identified by using the eigen value $\lambda \max$, to calculate the consistency index. The largest eigen value, $\lambda \max$, will be

$$\lambda \max = \sum_{j=1}^{n} a_{ij} \frac{W_j}{W_i} \qquad (2)$$

where:
$\lambda \max$ is the principal or largest eigen value of positive real values in a judgment matrix;
W_j is the weight of j^{th} factor
W_i is the weight of i^{th} factor.

6. Consistency test. Each pair-wise comparison contains numerous decision elements for the consistency index (CI), which measures the entire consistency judgment for each comparison matrix and the hierarchy structure. CI and consistency ration (CR) is utilized to assess the consistency of the comparison matrix (Saaty, 1980). The CI and CR are defined as

$$\text{CI}=\frac{\lambda \max - n}{n-1} \qquad (3)$$

7. where n is the matrix size.

CR=**Error!** (4)

8. where the judgment consistency can be checked by taking the CR of CI with the appropriate value. The CR is acceptable if it does not exceed 0.10. The CR is > 0.10, the judgment matrix is inconsistent. To acquire a consistent matrix, judgments should be reviewed and improved.

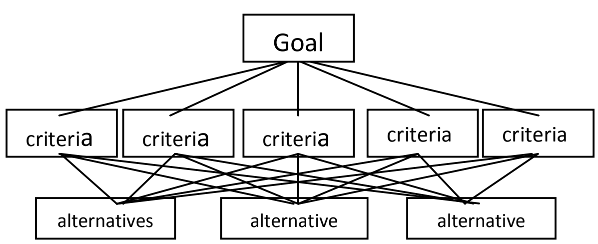

Figure3. FAHP/AHP Model of Best Websites

The Fundamental Scale for judgments is shown in **Error! Reference source not found.**.

Table 2. The Fundamental Scale for Making Judgments

1	Equal
2	Between Equal and Moderate
3	Moderate
4	Between Moderate and Strong
5	Strong
6	Between Strong and Very Strong
7	Very Strong
8	Between Very Strong and Extreme
9	Extreme
	Decimal judgments, such as 3.5, are allowed for fine tuning, and judgments greater than 9 may be entered, though it is suggested that they be avoided.

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4. RESULT AND DISCUSSION

Results of the airlines websites test based on load time, response time, page rank, frequency of update, traffic, design optimization, size, number of items, accessibility error, markup validation, and broken link are showed in table 3. The data in table 3 shows that most of the airlines websites in Asian can not meet the criteria as a high quality website. Most of server response, load times, size, and number of items exceed the value standardized by IBM, except Malaysia airlines websites in load time, size, and number of items criteria. Implementation of the W3C's HTML validator highlighted that only Japan Airlines of the Asian website had HTML 4.01 valid entry page, most of it did not have DOCTYPE declarations. Consequences of this problem will be on the portability and development of the website. In case of accessibility, there are two Airlines: Japan Airlines and Malaysia Airlines have zero error. It is mean that those airlines can be be accessed by people with dissabilities. In term of broken link, Singapore Airlines and Cathay Pacific or 40% of the sample have a broken link.

Table3. Testing Result for Websites Performance Based on Criteria

quality Criteria	Sia	kal	Jal	Cathay	mas
load time	91.91	5.16	35.5	42.23	0.32
response time	1.35	1.92	1.56	1.1	1.52
page rank	1180	919	326	1310	765
frequency of update	60	60	60	60	60
Traffic	971100	533000	410400	868200	861500
design optimization	25	27	61	92	89
Size	408003	21865	123919	145666	582
Number of items	53	4	54	66	1
accessibility error	2	12	0	26	0
markup validation	141	25	0	444	1
broken link	2	0	0	28	0

First column in Table 3 shows the criteria of the quality website. Criteria involves in the website selection process using proposed Linier Weightage Model are load time (A), response time (B), page rank (C), frequency of update (D), traffic (E), design optimization (F), size (G), number of items (H), accessibility error (I), mark up validation (J, and broken link (K). The second column represents the country airlines performance value. After determining the attributes and performance results, the next step is implementing AHP pair wise model and give a weight for those respective criteria. Result of this procedure shown in table 4.

Load time is more important than response time so the cells which represent load time across response time in the second row third column is 2 according the AHP measure scale, and when compare response time to load time it will be 1/2 or 0.5 because of the opposite calculation. The same calculation is followed to calculate for all criteria pair wise comparison. The next step is to get the weight for every criterion by normalized the data in Table 2. The steps applied to the criteria matrix and weights will be calculated.

1. Sum the elements in each column.
2. Divide each value by its column total.
3. Calculate row averages.

Table 4. Preference Criteria Matrix

criteria	A	B	C	D	E	F	G	H	I	J	K
A	1.000	2.000	3.000	4.000	5.000	6.000	6.000	6.000	7.000	8.000	9.000
B	0.500	1.000	2.000	3.000	4.000	5.000	5.000	5.000	6.000	7.000	8.000
C	0.333	0.500	1.000	2.000	3.000	4.000	5.000	5.000	5.000	6.000	7.000
D	0.250	0.333	0.500	1.000	2.000	3.000	4.000	4.000	4.000	5.000	6.000
E	0.200	0.250	0.333	0.500	1.000	2.000	3.000	3.000	3.000	4.000	5.000
F	0.167	0.200	0.250	0.333	0.500	1.000	2.000	2.000	2.000	3.000	4.000
G	0.167	0.200	0.200	0.250	0.333	0.500	1.000	1.000	2.000	3.000	4.000
H	0.167	0.200	0.200	0.250	0.333	0.500	1.000	1.000	2.000	3.000	4.000
I	0.143	0.167	0.200	0.250	0.333	0.500	0.500	0.500	1.000	2.000	3.000
J	0.125	0.143	0.167	0.200	0.250	0.333	0.333	0.333	0.500	1.000	2.000
K	0.111	0.125	0.143	0.167	0.200	0.250	0.250	0.250	0.333	0.500	1.000
sum	3.162	5.118	7.993	11.95	16.95	23.08	28.08	28.08	32.83	42.50	53.00

Calculation yields the normalized matrix of criteria is illustrated in Table 5. The average weights of rows are computed in the last column to indicate the weights of the criteria.

Table 5. weight of criteria and website

Website	Sia	Kal	jal	Cathay	Mas	Weigh
A	0.030	0.286	0.1	0.095	0.43	0.270
B	0.259	0.058	0.1	0.413	0.15	0.197
C	0.253	0.136	0.0	0.506	0.07	0.148
D	0.200	0.200	0.2	0.200	0.20	0.107
E	0.418	0.101	0.0	0.253	0.17	0.076
F	0.040	0.058	0.1	0.410	0.30	0.052
G	0.074	0.285	0.1	0.085	0.43	0.042

H	0.085	0.308	0.0	0.035	0.50	0.042
I	0.211	0.116	0.3	0.048	0.31	0.030
J	0.069	0.172	0.4	0.029	0.31	0.021
K	0.147	0.272	0.2	0.036	0.27	0.016

From the Table 4, the weight of the load time is 0.270, response time is 0.197, page rank is 0.148, frequency of update is 0.107, traffic is 0.076, design optimization is 0.052, size is 0.042, number of items is 0.042, accessibility error is 0.030, mark up validation is 0.021, and the last one is broken link with a value of 0.016. The next step in the step is to compute the weight of criteria by the corresponding weights of attributes. The result of the criteria values matrix displayed in table 5.
The last step in this method is to compute the final score of each website. Then get the sum of each column and the sum represents the score of each single website. Table 6 depicts the final scores of websites. The most important thing is regarding the final results, the website which has the highest score is suggested as the best website for the proposed AHP model.

Table 6. Final Result

Criteri	Sia	Kal	jal	cathay	Mas
A	0.008	0.077	0.042	0.026	0.117
B	0.051	0.011	0.022	0.081	0.031
C	0.037	0.020	0.005	0.075	0.011
D	0.021	0.021	0.021	0.021	0.021
E	0.032	0.008	0.004	0.019	0.013
F	0.002	0.003	0.010	0.021	0.016
G	0.003	0.012	0.005	0.004	0.018
H	0.004	0.013	0.003	0.001	0.021
I	0.006	0.003	0.009	0.001	0.009
J	0.001	0.004	0.009	0.001	0.007
K	0.002	0.004	0.004	0.001	0.004
Sum	0.169	0.177	0.134	0.252	0.269

In accordance with the results generated by the proposed model, Malaysia Airlines website has the highest score of 0.269 in comparison with the rest of airlines websites. As a result, the proposed AHP model rank for airlines websites website are: Malaysia Airlines (score: 0.269), Cathay Pacific (score: 0.252), Korea Airlines (score: 0.177), Singapore Airlines (score: 0.169), and the last rank is Japan Airlines (score: 0.134).

5. CONCLUSION

This paper we evaluate the quality of airlines websites with the sample of five Asian carrier flag airlines. Using a series of online diagnostic tolls, we examined many dimensions of quality, and each dimension will be measured by specific test online. The result of this study confirmed that the website presence of airlines website is neglecting performance and quality criteria. It is clear in our research that more effort is required to meet with these criteria in the context of website design. This suggests that web developer responsible for airlines website should follow and encourage the use of recognised guidelines when designing website. To get results on the quality of a Web site, we measure sample data from airline website in five Asian countries and calculate load time, response time, page rank, frequency of update, traffic, design optimization, size, number of items, accessibility error, markup validation, and broken link. The proposed model uses the AHP pair wise comparisons and the measure scale to generate the weights for the criteria which are much better and guarantee more fairly

preference of criteria. Limitation of this research occurred in the number of sample size and time factor, this research used limited sample size 30 data and taken during short period observation time.
Future directions for this research are added criteria for evaluating websites quality, such as availability and security aspect, also from the cultural perspective, since culture has an impact upon a website. Another approach also can be conducted for other service sectors such as academic website. Moreover because the ultimate determinant of quality website is the users, future directions for this research also involve the objective and subjective views of the e-government website from user's perspective.

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