Exploratory Study of the Download Speed of Leading University Hospitality and Tourism Department Websites Worldwide

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Increased broadband penetration (BP) rates around the world have encouraged web designers to include more web content and additional functions on their web sites, thereby enhancing the richness and playfulness of the information. However, it is often very difficult for web surfers who are still using narrowband connections to access such web sites. Many university web sites target international audiences; therefore their download performance should be considered, as it may directly influence the user experience. This exploratory study examined 331 university hospitality and tourism department web sites in 37 countries. The empirical results showed that entry web pages of universities in Asia, with a medium BP rate (mid-BP), have the slowest download speeds, and those in Australia and New Zealand perform the best. The adoption rate of the Cascade Style Sheet (CSS) in Asia is relatively lower than that of other regions.

INTRODUCTION

The Internet has become an essential part of people's daily lives. Web users generally expect rich content and great functionality from the Internet (Pons, 2006), but the richer the content, the longer the download time that is required. As the majority of web design companies around the world have installed broadband connections, web designers tend to concentrate on enriching web site content and often pay little attention to download speed. According to Web siteOptimization.com (2008), Monaco boasts the world's highest broadband penetration (BP) rate (40%); the average BP rate internationally is only 4.6% (Internet World Stats, 2008). This indicates that the majority of Internet users are unable to enjoy high-speed Internet access. Previous studies have found that web surfers will leave a site and search for alternatives if downloads take longer than expected (Ranganathan & Ganaphy, 2002; Rose, Lees, & Meuter, 2001) and may even abandon the use of a web site completely (Shneiderman, 1998). Therefore, a reduction in web page download time can keep most, if not all, web visitors, thus leading to greater web site service quality (King, 2003). Moreover, if a web page has no unnecessary content and a short download time, then visitors' satisfaction level may increase.

In the education context, students access various university web sites to locate information that will help them choose which university to attend. For overseas students, in particular, the first point of contact with a university is very likely to be through its web site. Students' impression

of this web site thus directly affects their feelings about the university, which, in turn, influence their university choice (Corry, Frick, & Hansen, 1997). This is in line with Yamamoto's (2006) findings that a web page has the greatest impact on university selection. If students are not satisfied with a university's web site performance, then their likelihood of selecting that university is lessened. Therefore, university web site designers must enhance web page performance by improving download time.

The literature contains a very limited number of studies that examine web page download time in general and university web page download time in particular. Most of the prior studies on web site response time focused on web site design and subjective web site performance evaluations. Weinberg (2000) indicated that the most important page within a web site is the home page, as it provides visitors with their first, and possibly only, impression of the site. To bridge the aforementioned research gap, the study reported herein focused on the download speed of the home pages of the world's leading university hospitality and tourism department web sites. Its findings will be of use to the users and owners of the selected web sites.

LITERATURE REVIEW

Web sites are consumers' key interface when they use the Internet, and web site performance directly influences web surfers' satisfaction. Researchers have presented various approaches to improving both web site usability and functionality (Au Yeung & Law, 2006; Law & Wong, 2003; Nielsen, 2000; Yeung & Lu, 2004). Palmer (2002) has pointed out that the speed with which web site content is accessed and displayed has a major impact on web site success. Many web designers add a lot of information to a single web page to enrich the content, but this leads to a longer download time (Nah, 2003), which may result in a lower degree of service satisfaction; impatient users may simply abandon the site (Hoxmeier & DiCeare, 2000; Galletta, Henry, McCoy, & Polak, 2004; Rose et al.).

Studies have shown that response time is one of the critical determinants of web site quality (McKinney, Yoon, & Zahedi, 2002; Torkzadeh & Dhillon, 2002; Turban & Gehrke, 2000). More specifically, web users have indicated that long web page download times have been a consistent problem (Lightner, Bose, & Salvendy, 1996; Pitkow & Kehoe 1996; Selvidge 1999, 2003). Users constantly request faster page downloads (Nielsen, 2000). Several studies have found that rich web page content (images, multimedia, and text) is the main factor that affects

download speed (Jacko, Sears, & Borella, 2000; Pons). Galletta et al. suggested that, to maintain a positive attitude among web users, site delays should be no longer than eight seconds; to encourage users to "stick with" a task (e.g., an online purchase), this delay should be no more than four seconds. A few studies have also demonstrated a positive relationship between web site response time and online transaction completion (Hoxmeier & DiCesare; Ramsay, Barbesi, & Preece, 1998; Weinberg). To conclude, web designers should always remember that "web pages have to be designed with speed in mind" (Nielsen, 1997).

The Internet currently plays an important role in most, if not all, universities around the world (Hiller & Jones, 2000). The content of the top web pages may influence the decision of potential students or other users (Yamamoto). Universities frequently recognize innovation in research (Hiller & Jones). They should also, therefore, identify and rectify any problems associated with their web sites. This timely study of the download speeds of their web sites will aid universities in this endeavor by providing useful insight into the factors that have a direct impact on the performance of these sites.

METHODOLOGY

The web sites of 331 university tourism and hospitality departments worldwide were analyzed for this study. Web site selection was based on recently published articles on the world's leading tourism and hospitality institutions and scholars (Jogaratname, Chon, McCleary, Mena, & Yoo, 2005; Schmidgall, Woods, & Hardigree, 2007; Ryan, 2005; Zhao & Ritchie, 2007). The universities were grouped into five different geographical regions, namely North America, Asia, Australia and New Zealand, Europe, and Other. Regional web site performance was examined by BP ranking, where a greater than 25% BP rate was considered to be high and a less than 10% rate was considered to be low. These percentages represented the largest gaps in the BP rate, which, in this study, referred to the percentage of broadband subscribers among the general population. Obviously, BP has a strong correlation (0.821) with per capita GDP (Table 1).

Table 1
Number of Universities with Hospitality and Tourism Departments by Geographical Region with BP rankings and GDP

Country/ Independent area	Frequency (%)	BP (%/ Ranking)[1]	BP (High/ Mid/Low)	Population/ GDP[2] (US$)
N. America (n = 2)	**118 (35.65%)**			
Canada	14 (4.23%)	25.1%/14	H	33.0 M/38,600
USA	104 (31.42%)	21.9%/20	M	303.8 M/45,800
Asia (n = 13)	**112 (33.84%)**			
China	39 (11.78%)	3.7%/71	L	1330.0 M/5,400
Hong Kong	2 (0.60%)	25.1%/13	H	7.0 M/42,000
India	3 (0.91%)	0.2%/120	L	1148.0 M/2,600
Indonesia	2 (0.60%)	0.0%/167	L	237.5 M/3,600
Japan	8 (2.42%)	21.1%/23	M	127.3 M/33,500
Korea	12 (3.63%)	28.3%/10	H	48.4 M/25,000
Macau	2 (0.60%)	18.4%/30	M	0.5 M/28,400
Malaysia	1 (0.30%)	3.9%/67	L	25.3 M/14,500
Nepal	1 (0.30%)	0.0%/207	L	29.5 M/1,000
The Philippines	1 (0.30%)	0.1%/122	L	96.1 M/3,200
Singapore	2 (0.60%)	21.8%/21	M	4.6 M/49,900
Taiwan	34 (10.27%)	19.6%/25	M	22.9 M/30,100
Thailand	5 (1.51%)	0.0%/159	L	65.5 M/8,000
Europe (n = 14)	**70 (21.15%)**			
Austria	5 (1.51%)	18.8%/28	M	8.2 M/39,300
Belgium	1 (0.30%)	23.9%/15	M	10.4 M/36,200
Croatia	1 (0.30%)	5.6%/55	L	4.5 M/15,500
Cyprus	2 (0.60%)	7.5%/48	L	0.8 M/27,100
Finland	3 (0.91%)	28.8%/8	H	5.2 M/36,000
Germany	2 (0.60%)	21.2%/22	M	82.0 M/34,100
Greece	5 (1.51%)	6.9%/49	L	10.7 M/30,600
Ireland	2 (0.60%)	15.9%/34	M	4.1 M/46,600
Spain	6 (1.81%)	16.7%/32	M	40.5 M/33,600
Sweden	3 (0.91%)	28.5%/9	H	9.0 M/37,500
Switzerland	7 (2.11%)	30.9%/5	H	7.6 M/40,100
The Netherlands	3 (0.91%)	33.3%/3	H	16.6 M/39,000
Turkey	6 (1.81%)	5.0%/59	L	71.9 M/12,000
The UK	24 (7.25%)	23.8%/16	M	60.9 M/35,000
Australia and New Zealand (n = 2)	**25 (7.55%)**			
Australia	19 (5.74%)	22.4%/19	M	21.0 M/37,300
New Zealand	6 (1.81%)	16.0%/33	M	4.2 M/27,200
Other (n = 6)	**6 (1.81%)**			
The Bahamas	1 (0.30%)	4.0%/66	L	0.3 M/28,000
Fiji	1 (0.30%)	0.8%/97	L	0.9 M/3,900
Israel	1 (0.30%)	19.6%/26	M	7.1 M/26,600
Jamaica	1 (0.30%)	1.7%/82	L	2.8 M/7,400
South Africa	1 (0.30%)	0.3%/111	L	48.7 M/9,700
The United Arab Emirates	1 (0.30%)	6.0%/53	L	4.6 M/37,000
Total (n = 37)	311 **(100.00%)**			

[1] *Source: Internet World Stats (2007)*
[2] *Source: CIA - The World Factbook (2008)*

Many factors affect measurements of web page download time consistency, including clients' broadband performance, computer performance, and server location. To obtain fair measurements in such an environment, web page file size, rather that download time as recorded with a timer, was used in this study. On the basis of a commercially available web site optimization analyzer, the researchers developed a web analyzing tool to collect the file size of each of five web components for an examination of download performance (Table 2): *HTML, image, external script files, external Cascade Style Sheet (CSS) files and multimedia files.* Data for all of the university web sites were collected in July 2008. The test results show the number of files and the file size of each component, which together indicate the download performance of the web sites.

Table 2
Five Basic Web page Design Components

Basic Component	Definition	Benefit for web page
HTML	A computer language used to mark up web pages and display web content.	It is basically the universal language of web design, and HTML size is a key factor in fast page display (King, 2003).
Image & Multimedia files	These files display visual and aural product images such as video, audio and graphics (Chan & Law, 2006).	Multimedia and images have been shown to motivate and attract visitors to use a web site (Hong, Thong, & Tam, 2004). Too many or too large images can lead to download delays (Perdue, 2001).
External Cascading Style Sheet (CSS) files	A new style sheet language that can be applied to any web page and used by both web site designers and users to create elements such as colors, layout and headers (Webopedia, 2007; Wikipedia, 2007a).	CSS-style web elements can save 25% to 50% in file size compared to old-style web elements (King, 2003).
External Script	Script in computer programming languages is commonly called a script language. These languages are typed directly from a keyboard and can be written as an internal or external part of a web page program (Wikipedia, 2007b).	External scripts mean the program is written out of the whole web program, thus making it easier to change the web page.

Source: Adopted from Qi et al. (2008), p. 270.

FINDINGS AND DISCUSSION

HTML

The layouts of the selected web sites in Asian countries with a medium BP rate (mid-BP) showed empirically significant differences from those in other sectors. On average, each web site in this sector contained 1.66 HTML frames, whereas the other sectors contained one to 1.27 frames (Table 3). Moreover, eight of the web sites in Taiwan contained three to four HTML frames, which implied that many universities in that country were still unaware of the disadvantages of adopting multiple frames. The use of so many frames may, unfortunately, result in incomplete information retrieval when web surfers perform searches via search engines. As the majority of web surfers search for information in this manner, the use of multiple HTML frames is not recommended. Universities in Australia and New Zealand, and most of those in North America, use only one HTML frame to generate the best search engine indexing results. Although the results of the ANOVA test demonstrated no significant differences in HTML size with different BP sectors, regionally speaking, Asia was significantly different from North America and Australia and New Zealand. Therefore, Asian universities should focus on enhancing the HTML size of their home pages to align with international practice. One way to decrease HTML size is to make use of CSS in HTML formatting.

Table 3
HTML File Count and Size Analysis

Sector		No. of HTML frames	HTML Size
North America-High	Mean	1.00[1]	17,653.86
(n = 14)	Std.	0.00	
North America-Mid	Mean	1.04[2,10]	21,696.00
(n = 100)	Std.	0.32	
Asia-High	Mean	1.10[3]	22,683.70
(n = 10)	Std.	0.32	
Asia-Mid	Mean	1.66[1,2,3,4,5,6,7,8,9]	34,574.80
(n = 44)	Std.	1.03	
Asia-Low	Mean	1.27[4,10]	34,426.20
(n = 41)	Std.	0.81	
Australia and New Zealand-High	Mean	1.00[5]	17,573.86
(n = 22)	Std.	0.00	
Europe-High	Mean	1.20[6]	18,245.53
(n = 15)	Std.	1.13	
Europe-Mid	Mean	1.13[7]	19,102.03
(n = 40)	Std.	0.52	
Europe-Low	Mean	1.23[8]	14,790.85
(n = 13)	Std.	0.60	
Other-Mid	Mean	2.00	22,708.00
(n = 1)	Std.	0.00	
Other-Low	Mean	1.00[9]	12,328.50
(n = 4)	Std.	0.00	
Total	Mean	1.20	23,898.18
(n = 304)	Std.	0.66	

[1-10]The mean difference for these two sectors is significant at the 0.05 level: 0.000, 0.000, 0.007, 0.002, 0.000, 0.010, 0.000, 0.022, 0.033, 0.039.

Images

The textual information on a web site cannot bring a university's external and internal environment alive for web surfers as well as images can. Therefore, the use of image files can be a good way to equip viewers with a better understanding of the university. The research results shown in Table 4 indicate that the number of image files used on the sites in the different sectors were more or less the same. However, when total image file size was considered, Canada, the North American region with a high BP penetration rate (high-BP), was significantly different from the others, with an average of 418 KB per web page. The web pages in the other regions had image file sizes that ranged from 51 KB to 200 KB. The average image size for the Canadian universities was more than 35 KB

per image, whereas the sizes in the other sectors were only 16% to 27% of that size. This indicates that the Canadian web sites have not optimized image compression. Although Canada's BP rate is ranked 14th in the world, Canadian universities should consider matching their download speeds to those of countries with lower BP rates to cater to the needs of students from those regions. In addition, global awareness of image file compression needs to be increased to enhance web site performance.

Table 4
Image File Comparison between All Sectors and North America's High-BP Sector

Sector		No. of Images	Total Image Size	Sig.[1]	Avg. Image Size	Sig.[1]
North America-High (n = 14)	Mean Std.	20.79 14.35	418,249.07		36,119.98	
North America-Mid (n = 100)	Mean Std.	19.67 20.65	170,028.27	0.032	9,876.33	0.002
Asia-High (n = 10)	Mean Std.	21.40 15.46	75,651.30	0.041	5,845.89	0.013
Asia-Mid (n = 42)	Mean Std.	23.26 17.92	198,745.08	0.045	8,033.00	0.002
Asia-Low (n = 39)	Mean Std.	18.23 11.59	164,865.28		15,242.28	0.023
Australia and New Zealand-High (n = 23)	Mean Std.	20.83 17.59	68,989.48	0.011	6,983.26	0.004
Europe-High (n = 14)	Mean Std.	21.79 28.15	84,664.79	0.003	6,738.66	0.009
Europe-Mid (n = 39)	Mean Std.	25.33 22.94	171,161.69		5,498.74	0.001
Europe-Low (n = 12)	Mean Std.	13.50 10.93	51,746.82	0.025	8,315.56	0.020
Other-Mid (n = 1)	Mean Std.	6.00 0.00	117,315.00		19,552.50	
Other-Low (n = 4)	Mean Std.	9.75 7.50	83,637.50		16,777.95	
Total (n = 298)	Mean Std.	20.60 18.95	164,163.54		10,568.20	

[1]*The mean difference for this sector is significant at the 0.05 level with* ***North America-High.***

CSS

The use of CSS not only speeds up the design process and standardizes the HTML formatting within a web site, but it can also reduce HTML file size. Compared with the other web components, CSS use varied across sectors. Generally speaking, the number and size of CSS files on university web sites in high-BP regions were significantly different

from those in low-BP regions. In North America and Australia and New Zealand, there were averages of 3.55 and 4.08 CSS files, whereas the corresponding numbers for universities in low-BP sectors in Europe and Asia were 1.40 and 1.60. Moreover, the file size for Asian web sites was no more than 8.5 KB, whereas those in other regions ranged from 9.5 KB to 28 KB. The CSS adoption rate in Asia was also relatively lower than that in other regions: 60% to 70% of universities in Asia used CSS to format their web sites, whereas more than 80% of those in the other regions did so (Table 5). This low CSS adoption rate also means that the average HTML file sizes on Asian university web sites are significantly larger than those in the other regions.

Table 5
External CSS Adoption Rate, File Count and Size Analysis

Sector		No. of CSS	Total CSS Size	CSS Adoption Rate
North America-High (n = 13)	Mean Std.	4.08[1,5,9] 3.04	21,023.08[a]	92.80%
North America-Mid (n = 85)	Mean Std.	2.64 2.47	17,997.29[b,h]	85.00%
Asia-High (n = 7)	Mean Std.	1.29[9,10,11] 0.49	3,866.71[f,i]	70.00%
Asia-Mid (n = 28)	Mean Std.	2.36 2.95	8,473.77[g,i]	63.64%
Asia-Low (n = 25)	Mean Std.	1.60[1,2,3,4] 1.26	5,205.48[a,b,c,d,e]	60.98%
Australia and New Zealand-High (n = 20)	Mean Std.	3.55[2,6] 3.14	24,004.00[e,f,g]	90.91%
Europe-High (n = 12)	Mean Std.	4.17[3,7,10] 4.63	23,828.83[d]	80.00%
Europe-Mid (n=34)	Mean Std.	3.76[4,8,11] 3.72	28,093.48[e,h,i,j,k]	85.00%
Europe-Low (n = 10)	Mean Std.	1.40[5,6,7,8] 0.52	9,697.38[k]	92.31%
Other-Mid (n = 1)	Mean Std.	3.00 0.00	17,400.00	100.00%
Other-Low (n = 2)	Mean Std.	1.00 0.00	11,265.00	50.00%
Total (n = 237)	Mean Std.	2.78 2.88	17,281.67	77.96%

The mean difference for these two sectors is significant at the 0.05 level:
[1 to 11]p = 0.011, 0.022, 0.010, 0.004, 0.025, 0.050, 0.023, 0.020, 0.035, 0.032, 0.035;
[a to k]p = 0.045, 0.017, 0.007, 0.022, 0.000, 0.044, 0.022, 0.031, 0.011, 0.001, 0.040.

External Script Files

Unlike hotels and airlines, which rely on their web sites to increase business volume, universities use their web sites primarily for information dissemination. Many commercial web sites use external script files to handle membership logins, secure payments and validate data, whereas university web sites usually use them for search functions, menu bar handling and content management. This study found no significant differences among the sectors in external script file count or size. On average, each selected web page contained only 2.55 external script files with a file size of 26 KB, whereas the average hotel web site's main page contains 4.69 such files with a file size of 66 KB (Qi, Leung, Law, & Buhalis, 2008). As external script files are all text-based, with a relatively small file size, they are not a critical factor in download time.

Multimedia

The multimedia adoption rate among the selected web sites was relatively low compared to that of commercial web sites. Only 19.08% (58) of them incorporated multimedia files in their home pages, compared to 31.37% of hotel web sites (Qi et al.). Interestingly, the highest multimedia adoption rate was not found in the high-BP sectors. Of the 58 universities that incorporated such files in their sites, 38 and 14 were in mid- and low-BP sectors, respectively, and only six were in high-BP sectors. Only one university each in Europe, and Australia and New Zealand, respectively, adopted multimedia on its web site, which made it impossible to carry out an ANOVA test. The results showed that the universities in Asia's mid-BP sector had an average of 1.87 multimedia files on their web sites, significantly more than the 1.07 files on those in North America's mid-BP sector, and the average file size in the former was almost eight times larger than that in the low-BP sectors (Table 6). Of the 58 universities that make use of these files, only two (one in Taiwan and one in Singapore) incorporate videos in their web pages to demonstrate the characteristics of their programs. The remaining sites use Flash to display photo slide shows and promotion banners. However, some of these Flash files, at around 2.4 MB in size, were found to be even larger than video files. Many web designers are aware of the large size of video files, and thus the majority does not incorporate them into their web sites; however, they may be unaware that Flash files can be equally large and require a long time to download.

Table 6
Multimedia File Count and Size Analysis

Sector		No. of Multimedia Files	Total File Size	Average Size
North America- (n = 1)	Mean	3.00	311,792.00	103,930.67
	Std.	0.00		
North America-Mid (n = 14)	Mean	1.07 [1]	439,300.43	426,253.96
	Std.	0.27		
Asia-High (n = 3)	Mean	2.00	202,716.33	95,370.33
	Std.	1.73		
Asia-Mid (n = 20)	Mean	1.85 [1]	496,287.15 [2]	300,714.56
	Std.	1.50		
Asia-Low (n = 14)	Mean	1.36	62,618.33 [2]	59,708.05
	Std.	0.63		
Australia and New Zealand-High (n = 1)	Mean	3.00	311,792.00	103,930.67
	Std.	0.00		
Europe-High (n = 1)	Mean	1.00	612,923.00	612,923.00
	Std.	0.00		
Europe-Mid (n = 4)	Mean	1.00	24,860.60	26,378.00
	Std.	0.00		
Total (n = 58)	Mean	1.49	312,564.73	247,616.57
	Std.	1.07		

[1]The mean difference for these two sectors is significant at the 0.05 level (p = 0.038).
[2]The mean difference for these two sectors is significant at the 0.05 level (p = 0.036).

Overall Performance

The overall performance of the web sites in each sector was compared by adding up all of the file counts and the sizes of each component. The number of objects in all of the low-BP sectors (16.38 and 21.46) was significantly less than that in Europe's mid-BP sector (31.1 objects). Europe's low-BP sector had the smallest average file size, 70 KB, whereas North America's high-BP sector had the largest, at 485 KB. The second largest file size – only 50 KB less than that in North America's mid-BP sector – was found in Asia's mid-BP sector. To provide the richest information with the smallest file size, a smaller average object size should be adopted. However, in this study, the web sites in the low-BP sectors tended to have larger object sizes. In contrast, those in Australia and New Zealand, a high-BP sector, had the lowest average object size of only 5 KB. The corresponding number for the North American high-BP sector was five times greater (Table 7).

Table 7
Analysis of Number and Overall Size of Objects in Web sites

Sector		No. of Objects	Total Size	Average Object Size
North America-High (n = 14)	Mean Std.	27.64 15.09	496,154.00[3]	29,594.55
North America-Mid (n = 100)	Mean Std.	24.91 21.88	296,172.03	13,302.89
Asia-High (n = 10)	Mean Std.	26.50 15.92	186,456.80	10,313.64
Asia-Mid (n = 44)	Mean Std.	27.50 19.03	449,840.34[4,5,6]	21,914.49
Asia-Low (n = 41)	Mean Std.	21.46[1] 13.57	217,988.51[4]	12,852.22
Australia and New Zealand-High (n = 23)	Mean Std.	26.78 20.16	118,545.48[5]	5,594.38
Europe-High (n = 15)	Mean Std.	27.07 30.94	172,487.40	12,860.19
Europe-Mid (n = 40)	Mean Std.	31.10[1,2] 24.79	233,181.73	6,923.44
Europe-Low (n = 13)	Mean Std.	16.38[2] 12.37	71,880.23[3,6]	6,032.60
Others-Mid (n = 1)	Mean Std.	11.00 0.00	157,423.00	14,311.18
Others-Low (n = 4)	Mean Std.	12.00 7.96	93,704.50	11,609.76
Total (n = 305)	Mean Std.	25.48 20.54	273,004.07	13,365.94

[1-6]The mean difference for these two sectors is significant at the 0.05 level: p = 0.036, 0.026, 0.032, 0.040, 0.013, 0.021.

CONCLUSIONS

The more objects that a web site contains, the more information and functions that a user can view; however, to provide rich content and facilitate speedy downloads, the size of these objects needs to be reduced. It seems that many universities in Asia use multiple HTML frames in their web sites, which can affect their search engine indexing results. Moreover, their HTML file sizes were the largest, and CSS adoption rate the lowest, among all of the regions considered in this study. The adoption of CSS could help these sites to minimize HTML format coding by reducing repetitive text. North America universities, which are located in a relatively high-BP region, are characterized by a larger overall web site file size. Prospective students from low-BP regions may thus experience very slow download times when they access North American university web sites, which factor may reduce their level of satisfaction.

Many web sites use multimedia to enhance their playfulness, even though average multimedia file sizes are larger than those for text and images. Although increased BP means faster downloads, file size should still be carefully monitored to prevent long download times for those without broadband. Given that HTML, CSS and external script files are text-only files, image and multimedia files represent the major bottlenecks with regard to download time. Before such files are uploaded to a server, they need to be fully compressed using image compression software to enhance download performance. Universities also need to be aware of the BP rate in their target regions to maximize the satisfaction of prospective students and other users.

This study has several limitations that provide avenues for future research. For instance, we were unable to analyze web sites that were created by .NET applications because of limitations in the tools that are currently available. Given that such applications represent the latest technology, the findings of this study may not reflect the most up-to-date information on the web performance of hospitality and tourism department web sites. In addition, the study considered only a select list of web sites, rather than all university web sites. It can therefore be considered exploratory in nature, and its findings may not represent the general situation. Future research should include more universities to make the findings more representative. Moreover, although home pages are the entry points to web sites, the majority of web browsers use search engines to locate their desired information. Therefore, a university's information page and application page may be as important as its home page. As image and multimedia files affect download performance to the greatest extent, future research could be extended to the use and compression performance of such files on these critical pages.

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