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Web Site Effectiveness: A Measure of Information and Service Quality

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ABSTRACT

Research into Information Systems (IS) effectiveness is again attracting attention because of the emergence of new technology in the form of the Web. In this study Web site effectiveness was measured in terms of information and service quality. The former is important because of the key purpose of a Web site to provide up-to-date information and was captured by the WEBQUAL instrument. For the latter, the well accepted SERVQUAL instrument was available and applied. The study, which examined the usefulness of the Web site to the university's library staff, confirmed te distinctiveness of information and service quality as measures of Web site effectiveness. Specific findings indicated that the greatest differences between subjects' expectations and perceptions were for service quality rather than information quality items. Furthermore, the gap was significantly higher for those employees who had worked in the library the longest. As Web sites become ubiquitous the desire to establish their effectiveness will increase and hence the demand for suitable measurement approaches and metrics.

INTRODUCTION

The questions of how to measure the effectiveness of an investment in Information Technology (IT) has attracted the attention of researchers over the last decades. DeLone and McLean (1992) in a seminal paper reviewed 100 empirical papers to establish the approaches to measuring Information Systems (IS) success for the period 1981-1987. Their findings enabled them to synthesise six categories of success measures which they presented as a model of IS success. The six measures were system quality, information quality, use, user satisfaction, individual impact, and organisational impact. This model has since been augmented (e.g. Pitt et al, 1995) and re-specified (Seddon, 1997) to fit different system and organisational environments.

More recently, Seddon (1999) reviewed studies in the IS effectiveness domain for the period 1988-1996 and concluded that effectiveness measures varied greatly and where essentially determined by stakeholders views and the type of IT system being evaluated. They suggested that studies into IS effectiveness should take into account six key questions, as was originally proposed by Cameron and Whetten (1983) in the study of organisational performance.

Whilst previous approaches indicated a richness in attempts to evaluate IT systems, they may once again have to be reassessed and modified in terms of their relevance to measure the success of systems that are based on the use of the Internet. This needs to be done systematically to ensure grounding in theory and previous practices. The purpose of our research is to provide a model that is suitable to measuring the effectiveness of a Web site, to test the model empirically, and to offer suggestions for the refinement of the model and future research.

RESEARCH DESIGN

Our study aims to establish an approach to measuring the effectiveness of our university's Web site. We adopted the framework developed by Cameron and Whetten (1983) and outlined by Seddon et al (1999) to design our research. Key questions were addressed as follows:

- the perspective of the stakeholder: the usefulness of the Web site to the university's library staff.
- the domain of the activity: to access information (e.g. to respond to an enquiry) and to place and track orders for books, journals, etc.
- purpose of the evaluation: to establish the difference between what was expected from the Web site and was provided (see instrument design below).
- time frame: the current effectiveness of the Web site.
- type of data used: effectiveness was captured by perceptual data provided by library staff when answering a questionnaire.
- referent against which effectiveness is judged: there was no referent available because of the newness of the research domain.

Web site effectiveness was measured in terms of information and service quality. The former is important because of the key purpose of a Web site to provide up-to-date information. We adopted the WEBQUAL instrument which had been used by Barnes and Vidgen (2000) to evaluate the quality of 4 UK business school's Web sites. For the latter, the well accepted SERVQUAL instrument (Parasuraman et al, 1991) was available and had been applied to measure IS service quality (Pitt et al, 1995).

The two instruments were combined because the library's Web site provides static information and interactivity (e.g. placing orders, making payments and tracking the status of online orders) which required an acceptable level of IT service. Both instruments measure quality by a difference score between perception and expectations. We refer to this difference as the gap. The variables, included in the questionnaire and distributed over thirteen research dimensions, are shown in the following table.

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Table 1: Research Dimensions and Variables

WEBQUAL	SERVQUAL
Navigation	*Tangibles*
Is easy to find your way around	Up-to-date hardware and software
Has fast navigation to pages	Physical facilities are visually appealing
General Ease of Use	*Reliability*
Is easy to use	IT support is dependable
Visual impact	IT support provide their services at the
Has an attractive appearance	times they promise to do so
Has an appropriate style of design for the	*Responsiveness*
site type	IT support give prompt service to users
Individual Impact	IT support have operating hours convenient
Conveys a sense of community	to all their users
Is a site that feels secure	*Assurance*
Finding information	The behaviour of IT support instills
Provides quick and easy access to finding	confidence in users
information	IT support have the knowledge to do their
Has a reasonable loading time	job well
Information Content	*Empathy*
Provides information at an appropriate	When users have a problem, IT support
level of detail	shows a sincere interest in solving it.
Has information that is updated regularly	IT support always are willing to help users
External integration	
Has useful links to other sites	
Communication	
Communicates information in an	
appropriate format	
Provides information content that is easy to	
understand	

While the WEBQUAL instrument reflected the information characteristics of Web sites, the SERVQUAL instrument reflects traditional IS services. The latter's wording had to be modified to reflect Web site service rather than traditional IT systems service. For WEBQUAL, some questions were left out, for e.g. 'creates an experience' and 'makes it easy to contact the organisation' because they were relevant for the study by Barnes and Vidgen (2000) where students rather than staff, as in our study, evaluated the information quality of Web sites.

PILOT TEST

Three members of the library staff tested the draft questionnaire. One person was in a supervisory capacity, another person provided Web support for the library Web site and the third person was a Web site user. They were requested to provide feedback on the ease of completing the questionnaire (e.g. was the estimated time for completion adequate?), highlight changes in the wording required (e.g. was the terminology used correct in the context of the library?), were the instructions contained in the questionnaire satisfactory (e.g. did they need expansion?).

A number of improvements resulted from the pilot test. The main one related to the scope of the study viz. distinguishing between a Web site and Web pages. The instruction page of the questionnaire was modified to indicate that the study was for the library Web site whose home page could be found at a particular URL and Web pages with library related information that could be accessed from the home page.

Another clarification was the nature of IT service provided. Since some IT support was provided by a member of the library section in the form of Web page design and which other support was provided through a central resource for hardware and software problems in general, the term IT support was clarified. The questionnaire instructions indicate that the term IT support would include IT services such as modification of Web pages (e.g. information), improvement in the functionality and operations of the Web site (e.g. navigation) and rectifying of hardware and software problems.

Only one question needed to be modified. It referred to reasonable loading time, which could have meant the time to access/move between Web pages and the downloading of information. The question was changed to clarify that it referred to time for downloading information. Some minor typographical errors were corrected. The time to complete the questionnaire namely 10-15 minutes was regarded as correct and the feedback indicated that staff would be willing to complete the questionnaire.

ANALYSIS OF DATA

The study provided each staff working in the university's library with a questionnaire. This resulted in 80 questionnaires being distributed of which 47 were returned giving a response rate of 59 percent. Below is an analysis of the date that was collected.

Background Information

Tables 2 and 3 below summarise the backgrounds of study participants.

Table 2: Years worked in the University's Library

	Frequency	Percentage
Less than 1 year	3	6.4
1-3 years	4	8.5
4-6 years	8	17.0
Over 6 years	32	68.1
Total	47	100.0

Table 3: Frequency and Necessity of Web site Use and Overall Experience

	Mean	Median	St. Dev.	Range
Frequency of using Library Web site	5.38	6.00	1.81	1 - 7
Necessity of Library Web site to carry out duties	5.47	6.00	1.87	1 - 7
Overall experience with using Web resources	4.96	5.00	1.33	2 - 7

It can be seen from the above tables that most participants had been employed in the university library for more than 6 years. The frequency of using the library Web site and the necessity to use it to carry out their duties was rated high (mean of 5.38 and 5.47 on a 7-point scale). The overall experience with using Web resources was rated towards the middle of the scale (mean of 4.96).

Data Reliability and Validity

Data reliability and validity was established in three respects, namely content validity, reliability and nomological and discriminant validity.

Content Validity

Content validity refers to the extent to which an instrument covers the range of meanings included in the research constructs. Of the two instruments, WEBQUAL was more recent and therefore less well established. The developers of WEBQUAL (Barnes and Vidgen, 2000) found validity in their use of the instrument but recommended that further testing with larger and varied samples was needed. This was not the case with SERVQUAL which had been carefully designed and thoroughly tested to measure IS service quality (Parasuraman et al, 1991; Pitt et al, 1995).

Reliability

The reliability of research dimensions shown in Table 1 was assessed by calculating Cronbach's alpha for each dimension's gap score. Reliability varied from .67 to .95 with only two dimensions below .80. They were 'individual impact' (.67) on WEBQUAL and 'tangibles' (.73) on SERVQUAL.

Nomological and Discriminant Validity

In an ideal case, if a factor analysis would exactly reproduce the thirteen-dimension model shown in Table 1, this would indi-

cate both nomological and discriminant validity (Pitt et al, 1995). The gap data was analysed in various ways using principal components and maximum likelihood methods with varimax rotation. The best fitting model split data into two parts which closely reflected the WEBQUAL and SERVQUAL dimensions of the research model. The factor analysis is shown in Table 4.

Table 4: Factor Analysis of Gap data

		F1	F2
	Information quality		
G1	Is easy to find your way around	.73	
G2	Has fast navigation to pages	.73	
G3	Is easy to use	.86	
G4	Has an attractive appearance	.70	
G5	Has an appropriate style of design for the site type	.77	
G6	Conveys a sense of community	.73	
G7	Is a site that feels secure	.40	
G8	Provides quick and easy access to finding information	.80	
G9	Has a reasonable loading time		.61
G10	Provides information at an appropriate level of detail	.80	
G11	Has information that is updated regularly	.82	
G12	Has useful links to other sites	.79	
G13	Communicates information in an appropriate format	.83	
G14	Provides information content that is easy to understand	.73	
	Service quality		
G15	Up-to-date hardware and software		.60
G16	Physical facilities are visually appealing	.57	
G17	IT support is dependable		.69
G18	IT support provide their services at the times they promise to do so		.87
G19	IT support give prompt service to users		.89
G20	IT support have operating hours convenient to all their users		.90
G21	The behaviour of IT support instills confidence in users		.88
G22	IT support have the knowledge to do their job well		.87
G23	When users have a problem, IT support shows a sincere interest in solving it.		.87
G24	IT support always are willing to help users		.89

Analysis of Gap data

The mean ratings of the responses for expectations and perceptions were computed so that the gap could be determined. Appendix 1 provides the means for each of the variables. According to t-tests, all differences in the means for expectations and perceptions were statistically significant with 95% confidence. A ranking of the mean differences (i.e. the gap) is provided in Table 5. An indication is also provided of whether the item was of an information quality (I) or a service quality (S) nature.

Table 5: Ranking of Gap data

Rank	Item #	Item description	Mean	St. Dev.	Q'lity (I / S)
1	G19	IT support give prompt service to users	3.32	1.96	S
2	G18	IT support provide their services at the times they promise to do so	3.07	1.86	S
3	G17	IT support is dependable	2.96	2.10	S
4	G21	The behaviour of IT support instills confidence in users	2.81	1.97	S
5	G20	IT support have operating hours convenient to all their users	2.58	2.06	S
6	G23	When users have a problem, IT support shows a sincere interest in solving it.	2.50	2.01	S
7	G24	IT support always are willing to help users	2.44	1.96	S
8	G22	IT support have the knowledge to do their job well	2.33	1.91	S
9	G9	Has a reasonable loading time	2.11	1.98	I
10	G2	Has fast navigation to pages	1.82	1.86	I
11	G8	Provides quick and easy access to finding information	1.80	1.69	I
12	G15	Up-to-date hardware and software	1.75	1.78	S
13	G11	Has information that is updated regularly	1.52	1.49	I
14	G3	Is easy to use	1.45	1.45	I
15	G1	Is easy to find your way around	1.36	1.48	I
16	G14	Provides information content that is easy to understand	1.33	1.62	I
17	G10	Provides information at an appropriate level of detail	1.24	1.48	I
18	G4	Has an attractive appearance	1.10	1.61	I
19	G13	Communicates information in an appropriate format	1.02	1.45	I
20	G16	Physical facilities are visually appealing	1.00	1.79	S
21	G6	Conveys a sense of community	.98	1.86	I
22	G5	Has an appropriate style of design for the site type	.84	1.49	I
23	G12	Has useful links to other sites	.70	1.53	I
24	G7	Is a site that feels secure	.58	1.66	I

In order to establish group effects, gap means were subjected to additional statistical procedures. First, the effect of years of employment in the university's library was established. Two groupings were identified, namely those with 6 or less years experience and those with more than 6 years experience. The Kruskal-Wallis test was applied and statistically significant results are shown in Table 6.

Table 6: Kruskal-Wallis test for Effect of Years of Service on Gap data

Item #	Item description	Mean <=6yrs	Mean >6yrs	Chi-square	Sig.
G4	Has an attractive appearance	1.53	.84	2.82	.093
G15	Up-to-date hardware and software	1.06	2.16	4.98	.026
G17	IT support is dependable	2.20	3.33	3.91	.048
G18	IT support provide their services at the times they promise to do so	2.33	3.43	3.52	.060
G19	IT support give prompt service to users	2.60	3.68	3.39	.066
G21	The behaviour of IT support instills confidence in users	2.00	3.25	4.04	.044
G22	IT support have the knowledge to do their job well	1.20	2.90	7.58	.006

Table 6 shows that gaps were higher for staff that had served over 6 years in the library with the exception of item G4. With this exception, all the items were of a service quality nature.

One-way analysis of variance (ANOVA) was used to establish the effects of frequency and necessity to use the Web site and overall experience in using Web resources on gap data. The analysis indicated only one significant effect, reflected in Table 7.

Table 7: ANOVA for Experience in using Web Resources on Gap data

Item #	Item description	F	Sig.
G14	Provides information content that is easy to understand	2.31	.061

Table 7 shows that overall experience in using Web resources impacted on the gap that existed for 'easy to understand informa-

tion content' (G14). A further examination of the data revealed a negative correlation, i.e. the gap tended to increase as experience with the use of Web resources decreased.

DISCUSSION

A satisfactory response rate of 59% resulted in 47 completed questionnaires being collected. Content validity can be regarded high for the SERVQUAL instrument but less so for WEBQUAL as this instrument will most likely undergo further developments. By combining the two instruments the study developed a thirteen-dimension model which had not been used in research before. The model contained 24 variables, used in a questionnaire to capture the quality of the university' library Web site by measuring the difference score, or gap, between perceptions and expectations. Reliability tests of gap data indicated satisfactory alpha values for most of the thirteen research dimensions.

However, when examining nomological and discriminant validity of the gap data, we found two major factors in the data that reflected the information and service quality dimensions rather than factors for the thirteen sub-dimensions. This could have a number of implications. One, it shows that the information and service quality variables form two distinct dimensions with little 'overlap' between them. They can therefore be accepted as two measures of Web site effectiveness as indicated in the title of the paper.

Second, our findings on the design of the measurement instrument may influence the way future effectiveness instruments will evolve. For example, one suitable approach may be to add one or more major dimensions to the two dimensions applied in this study. Alternatively or in addition to further dimensions, the number of variables within dimensions can be increased.

Findings on gap data indicated that the greatest differences between expectations and perceptions were for service quality rather than information quality items. Of the total of ten service quality items used in the study, eight accounted for the largest gap items. Furthermore, gaps were significantly higher for those employees who had worked in the library for more than 6 years. These findings cannot, of course, be generalised and need to be interpreted in the context of the university's environment. It is, however, not within the intentions of this paper to explore the reasons why service perceptions fell short of service expectations.

CONCLUSION

The study indicated that information and service quality are two distinct dimensions to measure Web site effectiveness. Validity of sub-dimensions within the two categories, however, was less apparent. It is suggested that future researchers who may want to develop more comprehensive instruments to establish Web site effectiveness could do so by adding an additional dimension and/or increasing the variables within major dimensions. As Web sites become ubiquitous the desire to establish their effectiveness will increase and hence the demand for suitable measurement approaches and metrics.

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APPENDIX

Means of Responses

Item #	Item description	Expectation (E)	Perception (P)	Gap (G)
1	Is easy to find your way around	6.53	5.18	1.36
2	Has fast navigation to pages	6.49	4.67	1.82
3	Is easy to use	6.61	5.16	1.45
4	Has an attractive appearance	6.10	5.00	1.10
5	Has an appropriate style of design for the site type	5.96	5.11	.84
6	Conveys a sense of community	5.15	4.17	.98
7	Is a site that feels secure	5.33	4.75	.58
8	Provides quick and easy access to finding information	6.58	4.78	1.80
9	Has a reasonable loading time	6.31	4.20	2.11
10	Provides information at an appropriate level of detail	6.26	5.02	1.24
11	Has information that is updated regularly	6.64	5.11	1.52
12	Has useful links to other sites	6.07	5.36	.70
13	Communicates information in an appropriate format	6.35	5.33	1.02
14	Provides information content that is easy to understand	6.43	5.11	1.33
15	Up-to-date hardware and software	6.55	4.80	1.75
16	Physical facilities are visually appealing	5.74	4.74	1.00
17	IT support is dependable	6.64	3.69	2.96
18	IT support provide their services at the times they promise to do so	6.76	3.69	3.07
19	IT support give prompt service to users	6.64	3.32	3.32
20	IT support have operating hours convenient to all their users	6.44	3.87	2.58
21	The behaviour of IT support instills confidence in users	6.60	3.79	2.81
22	IT support have the knowledge to do their job well	6.73	4.40	2.33
23	When users have a problem, IT support shows a sincere interest in solving it.	6.52	4.02	2.50
24	IT support always are willing to help users	6.53	4.09	2.44