QUANTIFYING CUSTOMER SATISFACTION WITH E-COMMERCE WEBSITES

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Abstract

E-commerce is an increasingly significant part of the global economy. Users of E-commerce Web sites often have high expectations for the quality of service, and if those expectations are not met, the next site is only a click away. A number of performance problems have been observed for E-commerce Web sites, and much work has gone into characterising the performance of Web servers and Internet applications. However, the customers of E-commerce Web sites are less well studied. In this work, we discuss a way of assessing satisfaction for different customer types with a Web site according to various different parameters. Individual measures may be scaled for simple comparison, and combined to give an overall satisfaction rating. This methodology is applied to three Irish E-Commerce Web sites.

1) Introduction

The World Wide Web is one of the most important Internet services, and has been largely responsible for the phenomenal growth of the Internet in recent years. An increasingly popular and important Web-based activity is E-Commerce, in which various types of financial transactions are carried out or facilitated using the Web. It is widely expected that E-Commerce activity will continue to grow and that it will be a significant component of the global economy in the near future.

A number of performance problems in E-Commerce systems have been observed, mainly due to heavier-than-anticipated loads and the consequent inability to satisfy customer requirements. This has resulted in a lot of work attempting to characterise the performance of Web servers and Internet applications e.g. [1]–[4]. However the customers of these E-Commerce systems are less well studied. Some surveys show considerable dissatisfaction with current E-Commerce and Web servers; for example, it has been reported that as many as 60% of users typically cannot find the information they are looking for in a Web site, even though the information is present [5]. In an area such as E-Commerce, customers demand a high quality of the service they receive, since it is easy to move away to another site if they perceive the current one to be unsatisfactory.

An important issue in designing E-Commerce systems is to characterise the customer's requirements for satisfactory service. Parameters which affect a customer's satisfaction with an E-Commerce system include the response time, number of clicks needed to find what they want, amount of information they are required to give, and predictability of the service received. This leads to the idea of customer classification, where customers in the same class would value parameters in a similar fashion. Customer classification may be performed either based on how they judge their satisfaction with an E-Commerce system, or on some other way (e.g. large/medium/small budget; type/speed of Internet connection the customer has to the server; frequent/previous/new customer).

Here we briefly present a methodology for measuring the satisfaction of customer classes. This methodology is applied to a test case consisting of three Irish E-Commerce Web sites in the telecommunications sector. We are able to demonstrate different levels of customer satisfaction among the Web sites, and also different levels of satisfaction with various parameters for each individual Web site.

2) Methodology

In our methodology, we identify customer classes reflecting groups of customers with different behavioural characteristics, and Web site parameters relating to features of the Web site which will potentially affect customer satisfaction. We then seek to measure customer satisfaction with the various parameters in a consistent and quantifiable way. This methodology is summarised below; a more detailed discussion of the methodology may be found in [6].

2.1) Customer Classification

Customers may be classified in various ways, such as their behaviour or according to how they measure satisfaction with a Web site. However this classification is made, a representation of the customer class must then be made. This representation has two components: first, customer behaviour; and second, customer satisfaction measures

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for various Web site parameters. We define customer behaviour in terms of the interaction with the Web site. A *trace behaviour* is defined as the series of clicks and other information that the customer exchanges with the site. Typically, behaviour for a customer class is defined as one or more traces. For a customer class, a weighting may be associated with the traces indicating how likely it is for the customer to perform that particular trace behaviour. That is, some behaviour may be exhibited more frequently by a user in a class, and this behaviour should be given higher weighting.

2.2) Customer Satisfaction Measures

The factors which might affect customer satisfaction with a Web site are contained in a *parameter list*. It is important that for each parameter in the list satisfaction should be quantifiable. Some quantification measures are easily defined. For instance, if the parameter is the number of clicks, the quantification may be defined as an integer value. Other parameters may have more subjective quantifications. For instance, how does one quantify the "quality" of information available at a Web site?

In order to compare the satisfaction measured for different parameters, the quantifications must be mapped to a fixed scale. For instance, all measures could be mapped to a scale of 0 to 10. This mapping is what allows us to represent customer valuation of the same parameters. For instance, some customers will tolerate delay better than others. This may lead to one customer mapping a download time of 5 seconds to 10 and another mapping a download time of 5 seconds to 0. Studies such as [7] indicate that this mapping can be complex and context dependent.

2.3) Analysis of Customer Satisfaction for a Web Site

Using the above, for each trace it is possible to associate a satisfaction value with every parameter. The trace weightings may then be used to arrive at a weighted average of the satisfaction values associated with the parameters. This gives a measure of how satisfied a given class of customers is with a given parameter. Finally a weighting of parameters can be defined, allowing for an overall satisfaction measure of a class for the Web site. By varying this weighting, we can study how different parameters affect customer satisfaction.

3) Test Results

The most difficult part of this exercise is in relating customer trace behaviour to the satisfaction vector. How parameter satisfaction is measured and how it is mapped onto a fixed scale must be addressed on a case-by-case basis, although experience using the methodology may lead to the definition of some standard cases. Also, since multiple executions of the same trace may lead to different values, some statistical analysis may be required. We have applied our methodology to three Irish E-Commerce Web sites in the telecommunications sector (designated here as Web sites A, B, and C).

3.1) Customer Classification

Customers for the three Web sites we examined have been divided into two distinct classes: Private and Business. Traces are associated with searching for specific information that the customers might be interested in. Six customer tasks are identified in Table 1 and for each Web site a trace is devised to perform the task. For the sake of convenience, we call all traces associated with a given task by the same name, even though the trace is obviously specific to the Web site. Data services is split into T4a and T4b because Web site B provided different pages depending on whether the customer was private or business.

Trace	Task
T1	Where to buy a phone
T2	Coverage
T3	Tariffs
T4a	WAP Data Services
T4b	Data Services for Business
T5	Roaming List
T6	Business Tariffs

Table 1: Tasks

The Private and Business customer classes are defined as a collection of the above tasks, and an associated weighting is given which is indicative of the relative likelihood of customers of a given class seeking to perform that task. Trace weightings for the Private and Business classes are given in Table 2. The interpretation is that for a group of Private users roughly half might want to know where to buy a phone, 30% might want to know about tariffs, 10%

might want to know about coverage and 10% might want to know about WAP services. The Business users exhibit different behaviour with 30% wanting to know about coverage, 30% being interested in the roaming list, 20% being interested in data services and 20% being interested in business tariffs.

Customer Class	Trace	Trace Weighting
Private	T1	0.5
	T2	0.1
	T3	0.3
	T4a	0.1
Business	T2	0.3
	T4a, T4b	0.2
	T5	0.3
	T6	0.2

Table 2: Trace weightings for different customer classes
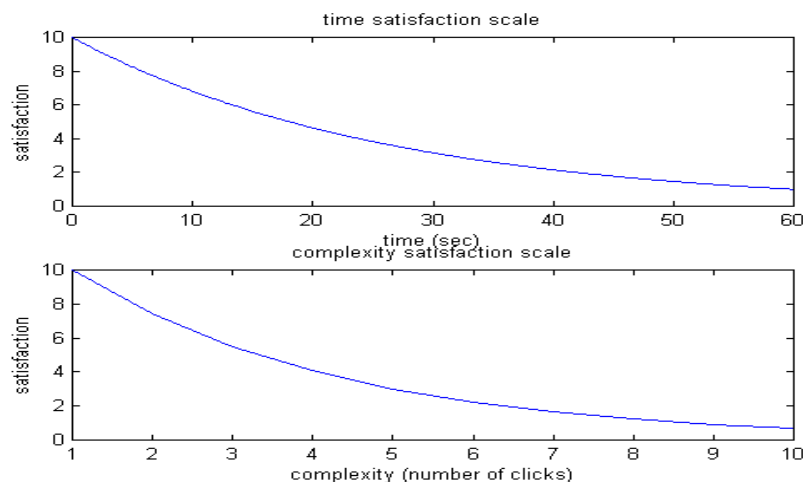
3.2) Satisfaction Measures

Three parameters were identified: Complexity, Time, and Quality. Complexity was measured as the number of clicks to reach the destination. Time was measures as total download time in seconds. Quality was a subjective measure of the quality of the information contained in the site (could the information be found, and how easy was it to find?). Quality was measured using a small-scale user survey where the users were asked to examine the end page for each task and rate their satisfaction with the information they found there on a scale of 0-100%.

A scale of 0-10 (with 0 being worst and 10 best) was chosen for a uniform comparison of satisfaction values. The measured satisfaction values were mapped onto the 0-10 scale as follows:

Complexity: $10(20^{-(n-1)/10})$, where n is the number of clicks
Time: $10(10^{-t/60})$, where t is the trace download time in seconds
Quality: x/10, where x is the average value of user satisfaction with the quality of the page

For Quality a straightforward linear mapping was applied. More complex mappings were employed for Complexity and Time, and are shown in Figure 1. Examining the Time mapping we see that 60 seconds is regarded as an unacceptable download time, and even 30 seconds leads to a fairly poor rating. Similarly, for Complexity, 10 clicks is regarded as unacceptable, and even 5 clicks is fairly poor.

Note that we have chosen one among many possible mappings. It is up to the tester to decide how to choose a mapping that best reflects customer preferences. Also note that, in this case, all customers use the same mappings, and thus are seen to perceive the parameters in a similar fashion. It is an easy extension to attach different scale mappings to different customer classes or to different traces.

Figure 1: mapping time and complexity measures to a 0-10 scale

3.3) Satisfaction Measurement for Web Sites

Once the satisfaction measures are determined, it remains to test the Web sites and compare results. Data was gathered using the Web Performance Trainer 2.1 tool [8] to execute each of the traces on the Web site in question. This was necessary solely to take time data, and was carried out on a weekday. The other two satisfaction values can be determined by an examination of the Web sites. Tables 3, 4, and 5 summarise the satisfaction measures for the three Web sites respectively.

Web Site A		Satisfaction Measures					
Customer Class	Trace	Complexity		Time		Quality	
		raw	scaled	raw	scaled	raw	scaled
Private	T1	4	4.1	37.6	2.4	80	8.0
	T3	5	3.0	34.0	2.7	72	7.2
	T2	4	4.1	34.7	2.6	67	6.7
	T4a	4	4.1	28.6	3.3	68	6.8
	weighted avg.		**3.8**		**2.6**		**7.5**
Business	T2	4	4.1	34.7	2.6	61	6.1
	T5	5	3.0	46.9	1.7	69	6.9
	T4a	4	4.1	28.6	3.3	66	6.6
	T6	4	4.1	38.7	2.3	64	6.4
	weighted avg.		**3.8**		**2.4**		**6.5**

Table 3: Customer Satisfaction for Web Site A

Web Site B		Satisfaction Measures					
Customer Class	Trace	Complexity		Time		Quality	
		raw	scaled	raw	scaled	raw	scaled
Private	T1	4	4.1	16.7	5.3	86	8.6
	T3	2	7.4	11.2	6.5	76	7.6
	T2	3	5.5	17.1	5.2	76	7.6
	T4a	3	5.5	13.9	5.9	74	7.4
	weighted avg.		**5.4**		**5.7**		**8.1**
Business	T2	3	5.5	17.1	5.2	73	7.3
	T5	4	4.1	14.7	5.7	75	7.5
	T4b	4	4.1	39.7	2.2	64	6.4
	T6	2	7.4	12.3	6.2	76	7.6
	weighted avg.		**5.2**		**4.9**		**7.2**

Table 4: Customer Satisfaction for Web Site B

Web Site C		Satisfaction Measures					
Customer Class	Trace	Complexity		Time		Quality	
		raw	scaled	raw	scaled	raw	scaled
Private	T1	4	4.1	14.0	5.8	81	8.1
	T3	3	5.5	13.0	6.1	68	6.8
	T2	2	7.4	11.1	6.5	68	6.8
	T4a	3	5.5	12.4	6.2	58	5.8
	weighted avg.		**5.0**		**6.0**		**7.4**
Business	T2	2	7.4	11.1	6.5	61	6.1
	T5	2	7.4	10.2	6.8	53	5.3
	T4a	3	5.5	12.4	6.2	60	6.0
	T6	2	7.4	10.9	6.6	53	5.3
	weighted avg.		**7.0**		**6.5**		**5.7**

Table 5: Customer Satisfaction for Web Site C

The overall satisfaction measures are summarised in Table 6. Some interesting conclusions can be drawn from these measures. Firstly, for all Web sites and all parameters, there was a variation in satisfaction levels between the customer classes. Thus, not all users find the Web sites equally good. This is most noticeable for the Quality parameter: Private users rated Quality higher than Business users in all cases. If Business customers are considered valuable, this gap is not desirable. There is also a large difference in satisfaction ratings for the Time parameter of Web site B, again favouring Private customers over Business customers. Secondly, for all users and all measures, there are a range of values across the Web sites. For instance, the Time satisfaction for Business users varies from 6.5 for Web site C down to 2.4 for Web site A. This indicates that Web site C might have an edge in attracting Business customers. Finally, for a given user class and Web site, different satisfaction levels are observed. For example, Private users of Web site A have a Time satisfaction value of 2.6 and a Quality satisfaction value of 7.5. The exact interpretation of this is difficult, since the different parameter satisfaction values are dependent on the mapping of the raw data, which of necessity, differs for each parameter. However, it does perhaps indicate a favouring of form over efficiency.

Customer Class Satisfaction		Satisfaction Measures		
Customer Class	Web Site	Complexity	Time	Quality
Private	Web site A	3.8	2.6	7.5
	Web site B	5.4	5.7	8.1
	Web site C	5.0	6.0	7.4
Business	Web site A	3.8	2.4	6.5
	Web site B	5.2	4.9	7.2
	Web site C	7.0	6.5	5.7

Table 6: Customer Class Satisfaction for Web sites A, B, and C

Finally, an overall assessment of customer satisfaction may be found by weighting the various parameters. Table 7 displays the overall satisfaction results under several different weighting schemes:
- Weighting 1 gives all parameters equal weighting;
- Weighting 2 gives Time and Complexity equal weighting and Quality zero weighting;
- Weighting 3 considers Time only (zero weighting for Quality and Complexity).

These weightings reflect possible values the tester places on the various parameters. We can see that for all the weightings, Business users have a clear order of preference, ranking Web site C highest, then Web site B, and finally Web site A. The order of preference for Private users varies according to the weighting used, although Web site A is worst under all three weightings.

Customer Class Satisfaction		Satisfaction Measures		
Customer Class	Web Site	Weighting 1	Weighting 2	Weighting 3
Private	Web site A	4.6	3.2	2.6
	Web site B	6.4	5.6	5.7
	Web site C	6.1	5.5	6.0
Business	Web site A	4.2	3.1	2.4
	Web site B	5.8	5.1	4.9
	Web site C	6.4	6.8	6.5

Table 7: Customer satisfaction with a Web site

4) Conclusions

Modelling customer satisfaction with Web and E-commerce sites is not as well studied as Web server modelling, but determining whether and how the customers of these sites are satisfied with their interactions is becoming increasingly important as the Web matures. We have proposed a methodology for estimating how satisfied defined classes of customers are with a Web site. Our approach recognises that customer satisfaction is a complex issue and includes factors which are not easily measured.

We have applied our methodology to the study of three Irish E-Commerce Web sites. These sites were chosen for representative purposes only and the results do not necessarily generalise to other Web sites. Choices for the tester include not only what customer categories and what Web site parameters to examine, but also how to interpret the measured data such as download time. The flexibility of the methodology means that it will be necessary for the tester to carefully consider all of their options.

The next step is to investigate whether 'generic' categories of users can be defined, and/or whether they care about 'generic' Web site parameters (e.g. it seems download time will always be a factor in user satisfaction). Given a specific Web site, we will explore methods for mapping these generic user types and satisfaction parameters into the site's content. If an analysis of the resulting satisfaction measures shows that there is a disparity in the satisfaction of different user types, we will study how the Web site designer or administrator should take this into account, and whether their reaction can be determined dynamically while the user is interacting with the site.

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