IDENTIFYING AND MEASURING ELECTRONIC SERVICE QUALITY GAPS

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ABSTRACT

It has been proposed that the existence of electronic service quality gaps inhibits a customer's website experience which reduces their perceived e-SQ, value, and ultimately purchases and repeat purchases. For a website to be an effective business tool e-SQ gaps should be minimal. In this paper a method of identifying and measuring e-SQ gaps is described. E-SQ gaps are first defined mathematically so that hypotheses regarding their existence can be tested using statistical measures. Secondly, the extent of the identified e-SQ gaps are measured using a formula devised based on the statistical measures from the hypotheses testing. The process is demonstrated using data collected from a study of Australian wineries. It was found that while winery managers had a good idea of customer website requirements, often this was not implemented on the website itself leading to a large fulfilment gap, hence a less than ideal website experience. While it is unreasonable to expect the total elimination of e-SQ gaps, such analysis can give the practitioner vital knowledge in determining where improvements can be made

Index Terms— Electronic service quality gaps, e-SQ, effective websites, Australian wineries

1. INTRODUCTION

The objective of this research is to devise a way to identify and measure electronic service quality (e-SQ) gaps. It is proposed that in practice this information will assist Web site designers to build a more effective Web presence that will be part of the overall strategy of deploying Internet technology to gain a competitive advantage. One of the driving forces behind a business-to-consumer (B2C) Web presence is providing for customer requirements; similarly, meeting customer requirements has been the premise behind traditional service quality for many years.

Zeithaml, Parasuraman and Malhotra's (2002) conceptual model for understanding and improving e-service quality (e-SQ) is used as the underlying framework for this research. They (Zeithaml et al., 2002) purport that e-SQ gaps, which represent the discrepancy between customer website requirements, managements beliefs of customer requirements, the design and implementation of the website itself, and marketing of the website leads to customer dissatisfaction. In this research a way of identifying and measuring e-SQ gaps is developed.

The e-SQ gaps are defined mathematically, which allows hypotheses regarding the existence of such gaps to be tested using regression and correlation analysis. To measure the size of the e-SQ gaps a formula is devised using the variables from the regression analysis. This results in a gap score between the value of zero and one hundred. Zero represents no gap (all customer requirements are known and implemented on the website) and 100, which represents a complete gap (complete lack of knowledge and provision of customer requirements).

This method of measuring and identifying e-SQ gaps is tested on Australian wineries. A summary of the results of this study is presented in this paper to demonstrate its practical use.

2. BACKGROUND

2.1 Electronic Service Quality

Electronic service quality (e-SQ) is defined as "the extent to which a Web site facilitates efficient and effective shopping, purchases and delivery of products and services" (Zeithaml et al., 2002, p363). This includes both pre- and post-website service aspects. They (Zeithaml et al., 2002) believe that e-SQ is the key determinate of success or failure of a Web presence. Extending on their comprehensive work in the field of traditional service quality (Parasuraman, Berry, & Zeithaml, 1985, 1991), Zeithaml et al. (2000) propose a conceptual model for understanding and improving e-SQ, which focuses on shortfalls in companies interacting with their customers. In 2002 Zeithaml et al. published a refined version of this model as shown in Figure 1 on the next page.

In this model a series of e-SQ gaps are identified, which when present, give rise to customer dissatisfaction. The top section of the model is the customer side. Zeithaml et al., (2002) propose that the elimination of e-SQ gaps will result in a better website experience for customers; that the customer expectation of the experience is based on the customers' website requirements; and that the creation of satisfied customers will lead to greater perceived e-SQ, value and ultimately purchases and repeat purchases. In the lower section of the model, the company side, there are three e-SQ gaps: the information, design, and communication gaps.

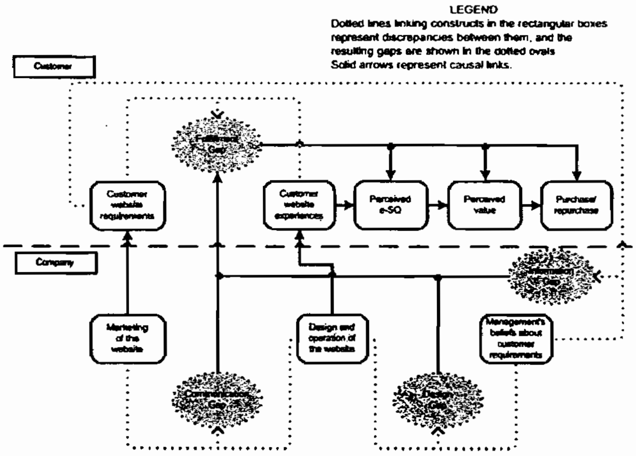

Figure 1: Conceptual Model for Understanding and Improving e-Service Quality, source: Zeithaml et al. (2002)

The information gap represents the difference between customer website requirements and management's beliefs about those requirements. The design gap represents the company's failure to fully incorporate knowledge about customer requirements into the structure and functioning of the website. The communication gap represents the inaccurate or inflated promises made about a website through traditional media and on the website itself. The fulfillment gap represents the discrepancy between customer requirements and experiences (what they actually receive). Each of the information, design, and communication gaps contribute to the fulfillment gap on the customer side of the model.

All facets of Zeithaml et al.'s (2002) model are not examined in this research. The scope is limited to three of the four e-SQ gaps, (i.e. the information, design and fulfilment gaps). The customer website requirements and management's beliefs about customer requirements are measured, in addition to an evaluation of websites. A simplified model that covers the context of this research is illustrated in Figure 2.

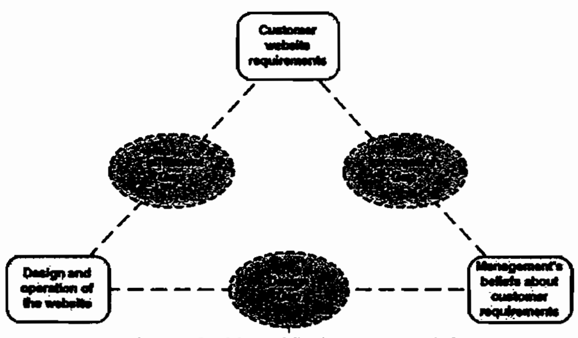

Figure 2: Simplified e-SQ Model

In this simplified model the information gap represents the discrepancy between customer website requirements and management's beliefs about the customer requirements, and the design gap represents the discrepancy between management's beliefs of customer requirements and the design and operation of the website. This is consistent with Zeithaml et al.'s (2002) model. Unlike Zeithaml et al.'s (2002) model, in this simplified model the fulfilment gap represents the discrepancy between customer website requirements and the design and operation of the website. In Zeithaml et al.'s (2002) model the fulfilment gap is placed between the customer website requirements and customer website experiences. In this research, no attempt is made to measure customer experiences as the fulfilment gap indirectly captures this. That is, the assumption is made that if customer requirements are being met, then customers have a good experience. A limitation of this is that some positive experiences, such as a pleasant surprise from something the customer may not have even thought about, may not be captured in the study.

The result of closing the gaps, and having a better website experience, which should lead to greater perceived e-SQ, perceived value and purchases and repeat purchases is also not within the scope of this research and is not represented in the simplified model.

The communication gap is also excluded from this study as are the attributes relating to marketing of the website. The reason for excluding the communication gap is that it required a different research methodology and data collection from the other gaps. It is expected that testing for the existence of the communication gap will be the subject of future research.

Excluding these aspects of Zeithaml et al.'s (2002) model allows the research to focus on the customers, managers, and websites themselves.

2.2 Australian Wine Industry

In order to demonstrate the devised method of identifying and measuring e-SQ gaps a study was conducted of Australian wineries. Australian wineries were chosen because they are in important industry in Australia. The Australian wine industry has grown rapidly in recent years. In 2001 there were 1,318 wineries in Australia compared to 2,299 in 2008 which has been an increase of between 6 to 11% each year. After accounting for closures, the wine industry has gained a new wine producer every 62.5 hours over the past seven years (AWBC, 2008). In addition, the wine industry contributes to the employment of an estimated 31,000 people in Australia (AWBC, 2007).

Australia is the 6th largest wine producer in the world and contributes a 5.1% share of world wine production. In 2007/08, Australian exports of wine were worth 2.68 billion dollars (ABS, 2008).

As further evidence of the continual growth in this industry, domestic sales have increased by nearly 13% between 2001 and 2007 and exports have increased by 110% over the same period (ABS 2006 & 2008).

The majority of Australia's wine is produced by a few large wine businesses which produce 98.2% of the national total. The many smaller winemakers account for the remaining 1.8% of the total crush. As the large wineries have such a huge market share, they also have a big advantage in terms of distribution and more influence with the major retail chains so the smaller players need to look at other, less traditional, routes to markets such as the Internet (ACIL Consulting, 2002). Furthermore, wine production currently exceeds domestic consumption and exports resulting in an oversupply (Grant, 2009); further evidence that wineries need to look at other ways of promoting their product with the intent of increasing overall sales (ACIL Consulting, 2002).

The Internet is seen as the new economy, and having a World Wide Web presence has been identified as an important step towards sustainability and gaining a competitive advantage for Australian wineries (ACIL Consulting, 2002; Goodman, 2002; NOIE, 2000). As such, wineries have been quick to take up the challenge with 80% of Australian wineries having a website at the beginning of 2009 compared with 37% in 2002 (Winetitles, 2002 & 2009). With this rapid uptake, and given that the majority of Australian wineries are small family run businesses it is not surprising that more and more resources are being put into having an effective Web presence

3. RESEARCH METHOD

This research closely follows Siegel and Castellan's (1988) steps for confirming an hypothesis. First e-SQ gaps are formally defined and the hypotheses stated, then the statistical tests used to test the hypotheses are outlined, followed by how the e-SQ gaps will be measured. To show how this can be applied in a practical sense the results of the Australian winery study are given in Section 4 of this paper. However, the scope of this paper does not cover specific details of the winery study. Further information on the data collection method can be found in Davidson and Lambert (2005).

3.1 Defining e-SQ gaps

The aim of the research was to develop a way to identify and measure electronic service quality gaps and to test the developed method on Australian wineries. The research question was therefore:

What is the extent, if any, of the information, design, and fulfilment electronic-service quality gaps in Australian wineries?

The hypotheses tests partly answer this question, by statistically establishing the existence, or non-existence, of e-SQ gaps. Applying the devised formula for measuring the discrepancies reveals the extent of the gaps.

The hypotheses are the predictions derived from the underlying theory (Siegel & Castellan, 1988), in this case Zeithaml et al.'s (2002) conceptual model. In order to state the formal hypotheses, e-SQ gaps had to be formally defined. Up until now there has not been a definition of what constitutes an e-SQ gap other than the literal descriptions given by Zeithaml et al. (2002).

Referring to Zeithaml et al.'s (2002) model it can be said that there is no information gap present, when managers know exactly what customers require and there is a perfect positive relationship between customer requirements and managements' beliefs about customer requirements. Therefore, in a situation where there is no information gap, if customers are presented with a list of possible requirements and asked to rate the importance of each, and managers are given the same list of requirements and asked to rate their beliefs about customer requirements, the ratings would match. Similarly, there will be no design, communication and fulfilment gaps when there is a perfect positive relationship between:

- managements' beliefs about customer requirements and the design and operation of the websites (design gap);
- the design and operation of the website and the marketing of the website (communication gap); and
- the customer requirements and website experiences (what they find on the website) (fulfilment gap).

These relationships can be shown graphically. The scatter plot in Figure 3 represents a 'no e-SQ gap exists' situation and the scatter plots in Figure 4 represent an 'e-SQ gap exists' situation. Note that even though the communication gap was not identified and measured in this study, it is included in this explanation of e-SQ gaps for completeness.

The x and y-axis in these graphs represent the customer requirements, managements' beliefs about customer requirements, design and operation of the website, and marketing of the website depending on which e-SQ gap is under consideration. Table 1 provides the axis labels for each of the four e-SQ gaps. The three graphs in Figure 4, (a), (b) and (c), represent each of the three possible scenarios that can cause an e-SQ gap to be present. The scale of the x and y-axis is the median rating or standardised frequency obtained for each variable (further explained below).

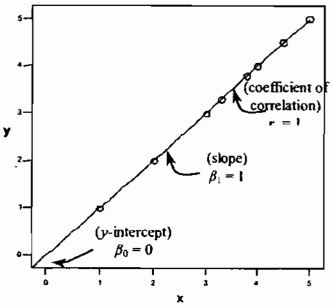

Figure 3: Scatter Plot Representing 'No e-SQ Gap Exists'

e-SQ Gap	X	Y
Information Gap	Customers requirements	Managements beliefs about customer requirements
Design Gap	Managements beliefs about customer requirements	Design and operation of website
Communication Gap	Design and operation of website	Marketing of the Website
Fulfilment Gap	Design and operation of website	Customers requirements

Table 1: x and y-axis labels

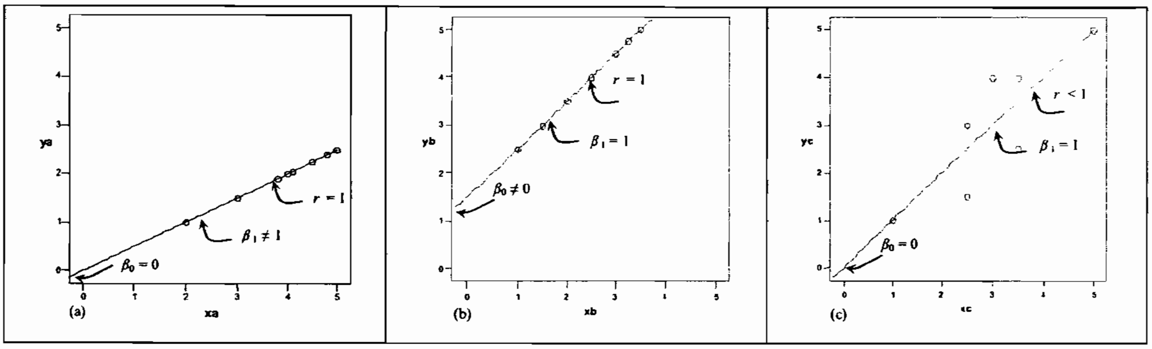

Figure 4: Scatter Plots Representing 'e-SQ Gaps Exist'

The position of the y-intercept (β_0), the slope of the regression line (β_1), and the coefficient of correlation (r) influence the existence and size of a gap. In a perfect positive relationship no gap exists and the line of regression intercepts the y-axis at zero ($\beta_0 = 0$), has a slope of one ($\beta_1 = 1$), and a coefficient of correlation of one ($r = 1$). Conversely, any deviation from these three conditions will result in the presence of a gap. Note that not all three conditions need to be deviated from, just one or more. For example:

- In Figure 4(a) $\beta_0 = 0$ and $r = 1$, but the slope is not equal to one ($\beta_1 \neq 1$), therefore the x and y-coordinates do not have the same value even though they do form a straight line passing through y at zero.
- In Figure 4(b), $\beta_1 = 1$ and $r = 1$, however the y-intercept is not at zero ($\beta_0 \neq 0$), therefore the difference between the value of the x and y coordinates equals the value of β_0.
- In Figure 4(c) $\beta_0 = 0$ and $\beta_1 = 1$, but $r < 1$, indicating that even though the intercept and slope rules are satisfied there is not a strong relationship between the two variables.

Any combination of the above three conditions in Figure 4 results in the existence of a gap. Technically, r should equal 1, (as well as $\beta_0 = 0$ and $\beta_1 = 1$) for a perfect relationship. However, it is unusual for all data to occur in a straight line (Zar, 1999) which would result in the condition $r = 1$ never being satisfied when in fact it could be very close. Therefore, a threshold for r is set at 0.75 as recommended by Zar (1999). Hence the $r = 1$ condition becomes $r \geq 0.75$ and any r value that is significantly less than 0.75 results in a rejection of the condition. Mathematically 'no e-SQ gap' and 'e-SQ gap' situations can be expressed as:

- There is no e-SQ gap when **all** of $r \geq 0.75$, $\beta_0 = 0$, and $\beta_1 = 1$ hold true.
- There is an e-SQ gap when **at least one** of $r < 0.75$, $\beta_0 \neq 0$, or $\beta_1 \neq 1$ hold true

3.2 The hypotheses

Having mathematically defined what constitutes an e-SQ gap, the hypotheses can be stated so that the existence of e-SQ gaps can be statistically tested as:

1. H_0: ***There is no information gap*** (All of: $r \geq 0.75$, $\beta_0 = 0$, and $\beta_1 = 1$ hold true)

   H_1: ***There is an information gap*** (At least one of: $r < 0.75$, $\beta_0 \neq 0$, or $\beta_1 \neq 1$ hold true)

2. H_0: ***There is no design gap*** (All of: $r \geq 0.75$, $\beta_0 = 0$, and $\beta_1 = 1$ hold true)

   H_1: ***There is a design gap*** (At least one of: $r < 0.75$, $\beta_0 \neq 0$, or $\beta_1 \neq 1$ hold true)

3. H_0: ***There is no fulfilment gap*** (All of: $r \geq 0.75$, $\beta_0 = 0$, and $\beta_1 = 1$ hold true)

   H_1: ***There is a fulfilment gap*** (At least one of: $r < 0.75$, $\beta_0 \neq 0$, or $\beta_1 \neq 1$ hold true)

The position of the hypotheses on the simplified model is illustrated in Figure 5.

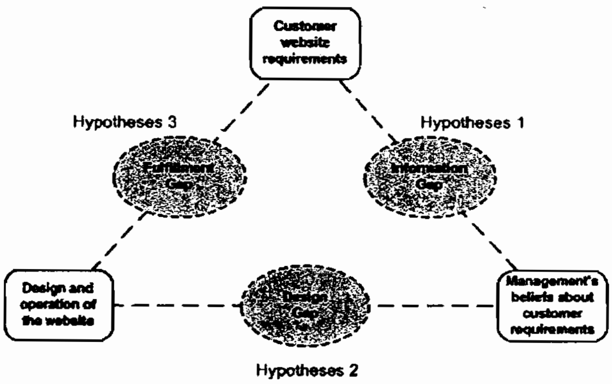

Figure 5: Simplified e-SQ model showing the hypotheses

3.3 Statistical testing of the hypothesis

The data is collected by conducting a customer and manager survey which both uses ordinal data in the form of a 5-point Likert scale to rank importance, in addition website evaluations are carried out which used nominal dichotomous data of 1-present and 0-not present. Each data collection uses the same variables that question a range of content and design issues. The median value for each question in the customer and manager surveys are used along with the standardised percentage that an item recorded 'present' for in the website evaluations. The percentage present is standardised to a value between 1 and 5 so that it is on a comparable scale to that of the customer and manager medians. The underlying assumption, that if an item is valued as very important it will be present on the majority of websites or if it is not important it will not be present, still holds true. Table 2 shows the conversion scale and the formula used. Hence, if an item was present on 80% of websites it was given a score of 4.2 (80/100 x 4+1 = 4.2).

Website evaluations		Customer & Manager Surveys
Percentage Present	**Standardized Website Frequency used†**	**Medium value used**
100	5	5 Very Important
75	4	4
50	3	3
25	2	2
0	1	1 Not Important
† = (Percentage Present/100) x 4+1		

Table 2: Measurement Scales

The hypotheses are tested using correlation and regression analysis. Simple linear correlation and regression is used to determine the linear relationship between the three pairs of the three variables. The three variables in the study are customer requirements, winery managers' beliefs about customer requirements, and percentage of the number of websites for which the item is present. For ease of reading these variables are called Customers' Median, Managers' Median, and Standardised (S.) Website Frequency respectively. The pairing of variables (Table 3) for the testing follows that required for the hypotheses and follows the logical dependence outlined by Zeithaml et al.'s (2002) e-SQ model.

E-SQ Gap	*X* (predictor)	*Y* (dependent)
Information Gap	Customers' Median	Managers' Median
Design Gap	Managers' Median	S.Website Frequency
Fulfilment Gap	S.Website Frequency	Customers' Median

Table 3: Pairing of Variables

Linear regression is used to model the value of the dependent scale variable based on its linear relationship to the predictor. The linear regression model assumes that there is a linear relationship between the dependent variable and each predictor. The simplest functional relationship of one variable to another is $y = \beta_0 + \beta_1 x$ where β_0 is the y-intercept and β_1 the slope (Zar, 1999).

The statistical software package SPSS was used to conduct the regression analysis. SPSS readily calculates the slope of the regression line, β_1, however, the significance value produced by SPSS for β_1 is not applicable for testing the hypotheses. This is because the significance value provided by SPSS-is testing for a slope of zero, whereas the hypotheses require testing for a slope of one (H_0: $\beta_1 = 1$ and H_1: $\beta_1 \neq 1$). Therefore, the 95% confidence interval for β_1 is used which is readily calculated. For the hypotheses H_0: $\beta_1 = 1$ and H_1: $\beta_1 \neq 1$, if 1 falls within the upper and lower bounds of the 95% confidence interval for β_1, then H_0 is accepted.

As for β_1, SPSS readily computes the β_0 value. Also like β_1, SPSS computes a significance value that tests for significance against zero, which in this case is acceptable because the hypotheses tests for zero (H_0: $\beta_0 = 0$ and H_0: $\beta_0 \neq 0$). However, to ease understanding and to be consistent with the test for β_1, the 95% confidence interval for β_0 is used. Therefore, for the hypotheses H_0: $\beta_0 = 0$ and H_0: $\beta_0 \neq 0$, if 0 falls within the upper and lower bounds of the 95% confidence interval for β_0, then H_0 is accepted.

Unfortunately, SPSS cannot be used to test for $r \geq 0.75$ as SPSS calculates a value that is a measure of the significance of r being different from zero. Therefore, Fisher's (1915) r to z transformation is used with a one-tailed test and a critical value of $Z_{\alpha(1)\infty} = t_{\alpha(1)\infty}$. For ease of understanding and consistency with the tests for β_0 and β_1 the 95% confidence interval for z is calculated using $z \pm 1.6449 \times \sigma(z)$ then transformed back to an upper and lower limit for r. Therefore, for H_0: $r \geq 0.75$ and H_1: $r < 0.75$, if the upper or lower bounds of the 95% confidence interval for r are greater or equal to 0.75, accept H_0.

In summary, the hypotheses are tested using the upper (U) and lower (L) bounds of the 95% confidence intervals for r, β_0, and β_1 using the following rules:

For H_0: $r \geq 0.75$ and H_1: $r < 0.75$ if L or $U \geq 0.75$ accept H_0

For H_0: $\beta_0 = 0$ and H_1: $\beta_0 \neq 0$ if $L \leq 0 \leq U$ accept H_0

For H_0: $\beta_1 = 1$ and H_1: $\beta_1 \neq 1$ if $L \leq 1 \leq U$ accept H_0

All of the above must hold true for H_0 to be accepted. If any one of the above are rejected then H_0 is rejected.

3.4 Measurement of E-SQ gaps

A formula was devised to measure the deviation away from the perfect positive position, which represents the extent of the e-SQ gap (Figure 6). This formula uses the values from the correlation and regression analysis of r, β_0, and β_1.

$$D = \left(\left((1 - r^2) \times 0.5 \right) + \left(\frac{|\beta_0|}{5} \times 0.25 \right) + \left(\frac{|(\beta_1 - 1)|}{4} \times 0.25 \right) \right) \times 100$$

Figure 6: Measurement of e-SQ Gaps

In this formula r is squared to give the coefficient of determination, which represents the intensity or precision of the agreement between the two variables. Each of the values, r^2, β_0, and β_1 are converted to an absolute value between zero and one based on the minimum and maximum values possible. It is an absolute value because the deviation away from the perfect positive position is important and not the direction in which it has deviated.

Each of the values is weighted. The y-intercept and slope (β_0 and β_1) which represent the agreement between the variables is given 50% in total – 25% each, and the coefficient of determination (r^2) which represents the precision of the agreement between the two variables, is given 50%.

The weighted values are added and multiplied by 100 to give the final discrepancy (or gap) score, denoted by D. Zero and 100 are used as the extreme points simply to aid understanding by the user, where zero indicates no gap and 100 indicates a complete gap. To determine the appropriate weightings a sensitivity analysis was conducted using various combinations of weightings and applied to the data collected for the Australian winery study. After taking into consideration the cumulative effect that the information, design, and communication gaps have on the fulfilment gap, and the size of the resultant gaps using various combinations of weightings, it was felt that the above weighting gave the most logical results. The difference between the sum of the information and design gaps and the fulfilment gap were minimised.

As this study is limited in scope and does not take into consideration the communication gap there is an unknown factor contributing to the fulfilment gap. Precision and agreement are considered to be equally important, if each of r^2, β_0, and β_1 were given an equal weighting it would result in agreement having a weighting of 66.6% and precision 33.3%. This is a point for further research to confirm the appropriateness of the weightings.

In Table 4 descriptions of the extremes for each of the four e-SQ gaps are given. Again, even though the communication gap was excluded from the winery study it is included in this table for completeness.

0 – None	e-SQ Gap	Complete – 100
Managers know everything that customers require	**Information Gap**	Managers do not know what customers require
Everything that managers know about customer requirements is implemented on the website	**Design Gap**	What managers know about customer requirements is not implemented on the website
Everything that is promised about the website by marketing is implemented on the website	**Communication Gap**	What marketing promises about the website is not delivered on the website
Everything the customer requires is on the website	**Fulfillment Gap**	None of the customer requirements are on the website

Table 4: Description of e-SQ Extreme Gaps

Theoretically, a perfect D of zero means that customers are totally satisfied. While this may be impractical or almost impossible to achieve, the closer a firm comes to a Đ of zero the more effective its website will be, conversely, the closer Đ moves towards 100 the less effective the website will be.

The relationship between r, β_0, and β_1, and Đ is further illustrated in Table 5. It can be seen that when there is a perfect positive relationship and $r = 1, \beta_0 = 0$, and $\beta_1 = 1$, there is no gap and Đ = 0. Conversely when conditions change and r moves towards zero, β_0 moves towards ±5, and β_1 moves towards −3 or +5 (−3 and +5 do not appear symmetrical but are 4 steps away in each direction from the perfect positive relationship position of $\beta_1 = 1$), Đ moves towards 100, indicating a complete gap. The values of $r = 0$, $\beta_0 = \pm5$, and $\beta_1 = -3$ or +5 are the upper and lower bounds that can be obtained.

	Precision (*coefficient of determination*)		Agreement					E- SQ Gap Score
			(intercept)	*(slope)*	*(a)*	*(b)*	*(c)*	*Đ*
	r	r^2	β_0	β_1	$1 - r^2$	$\|\beta_0\| / 5$	$\|(\beta_1-1)\|/4$	$((a \times 0.5)+(b \times 0.25)+(c \times 0.25)) \times 100$
Complete gap	0.00	0.00	-5.00	-3.00	1.00	1.00	1.00	100.0
3/4 gap	0.50	0.25	-3.75	-2.00	0.75	0.75	0.75	75.0
1/2 gap	0.71	0.50	-2.50	-1.00	0.50	0.50	0.50	50.0
1/4 gap	0.87	0.75	-1.25	0.00	0.25	0.25	0.25	25.0
No Gap	1.00	1.00	0.00	1.00	0.00	0.00	0.00	00.0
1/4 gap	0.87	0.75	1.25	2.00	0.25	0.25	0.25	25.0
1/2 gap	0.71	0.50	2.50	3.00	0.50	0.50	0.50	50.0
3/4 gap	0.50	0.25	3.75	4.00	0.75	0.75	0.75	75.0
Complete gap	0.00	0.00	5.00	5.00	1.00	1.00	1.00	100.0

Table 5: Relationship Between r, β_0, β_1, and Đ

The formula given in Figure 6 and used in Table 5 is in un-simplified form to aid understanding by showing the maximum values and weightings. It can be further simplified by multiplying out each term so that $0.25 \times \beta_0 / 5$ simplifies to $\beta_0 / 20$, and $0.25 \times (\beta_1-1) / 4$ simplifies to $(\beta_1 - 1)/16$. As the first term is equivalent to $(1 - r^2)/2$ a common factor is 0.5, therefore a simpler equation can be shown as in Figure 7.

$$Đ = \left(\left(1 - r^2\right) + \left(\frac{|\beta_0|}{10} \right) + \left(\frac{|(\beta_1 - 1)|}{8} \right) \right) \times 50$$

Figure 7: Simplified Measurement of e-SQ Gaps

Having shown how e-SQ gaps can be mathematically identified and measured, the next section applies this to a study of Australian wineries to demonstrate how it can be used in a practical setting.

4 APPLYING THE E-SQ GAP IDENTIFICATION AND MEASUREMENT TO AUSTRALIAN WINERIES.

This section shows how the above e-SQ gap identification and measurement method is applied to a study of Australian wineries. Further details regarding the sample selection, data collection instruments, validity tests, and more can be found in other publication including Davidson (2005) and Davidson and Lambert (2005).

In summary there were three data collections:

- A sample of 260 Australian winery websites from a population of 796 were evaluated against 88 variables.
- The entire population of 1050 winery managers (with email) were invited to participate in the manager survey of which 227 responded (21.6%).
- Winery managers invited their customers to participate and those customers that did were invited to refer their friends. This resulted in 358 usable responses.

Scatter plots of the results are shown in Figures 8, 9 and 10. The plots include the regression line and the values for the coefficient of correlation (r), y-intercept (β_0), and slope (β_1). The plots themselves are not absolutely necessary to test the hypotheses, however, the visualisation does add to the understanding of the relationships between the customers, managers, and websites.

The values that are derived for r, β_0, and β_1 for each of the three pairs of variables are placed into Table 6 and checked against the lower and upper bounds of the 95% confidence interval to test the hypotheses. Table 6 provides the relevant statistical test results and hypotheses testing. Each of the three null hypotheses has been rejected and the alternative accepted. Therefore, it can be said that:

In Australian wineries, information, design, and fulfilment e-SQ gaps do exist.

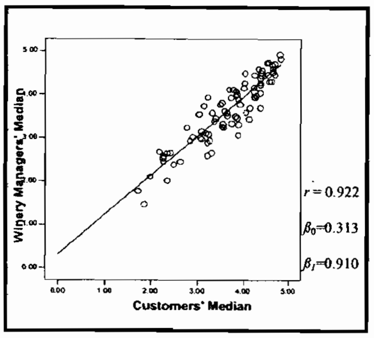

Figure 8: Information Gap

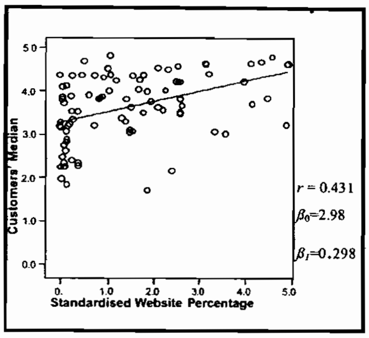

Figure 9: Design Gap

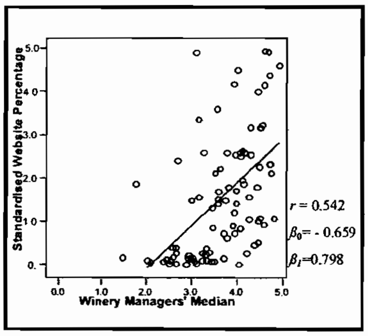

Figure 10: Fulfilment Gap

Hypotheses - Descriptive test	Test	t	r	r 95% CI	Test	t	β_0	β_0 95% CI	Test	t	β_1	β_1 95% CI	Test Result
1 H_0: There is no Information Gap	$r \geq 0.75$	✓	0.922	L 0.8917	$\beta_0=0$		0.313	L 0.010	$\beta_1=1$		0.910	L 0.829	Reject H_0
H_1: There is an Information Gap	$r<0.75$			U 0.9447	$\beta_0 \neq 0$	✓		U 0.616	$\beta_1 \neq 1$	✓		U 0.992	Accept H_1
2 H_0: There is no Design Gap	$r \geq 0.75$		0.542	L 0.4062	$\beta_0=0$	✓	-0.659	L -1.626	$\beta_1=1$	✓	0.794	L 0.533	Reject H_0
H_1: There is a Design Gap	$r<0.75$	✓		U 0.6544	$\beta_0 \neq 0$			U 0.308	$\beta_1 \neq 1$			U 1.054	Accept H_1
3 H_0: There is no Fulfilment Gap	$r \geq 0.75$		0.431	L 0.2775	$\beta_0=0$		2.98	L 2.652	$\beta_1=1$		0.298	L 0.166	Reject H_0
H_1: There is an Fulfilment Gap	$r<0.75$	✓		U 0.5629	$\beta_0 \neq 0$	✓		U 3.312	$\beta_1 \neq 1$	✓		U 0.430	Accept H_1

H_0: All of $r \geq 0.75$, $\beta_0=0$, and $\beta_1=0$ holds true

H_1: At least one of $r < 0.75$, $\beta_0 \neq 0$, or $\beta_1 \neq 1$ holds true

t - ✓ if test is true

r 95% Confidence Interval for r – H_0: $r \geq 0.75$ true if L or $U \geq 0.75$

β_0 95% Confidence Interval for β_0 – H_0: $\beta_0=0$ true if $L \leq 0 \leq U$

β_1 95% Confidence Interval for β_1 – H_0: $\beta_1=1$ true if $L \leq 1 \leq U$

Table 6: Results of Hypotheses Tests

Having established that information, design, and fulfilment e-service quality gaps exist, it remained to provide a measurement, and to graphically show the gaps.

Based on the formula for calculating the e-SQ gap (D), the relevant statical measures and associated Ds are given in Table 7. Figure 11 illustrates the gaps identified graphically in order to increase the visual impact of the location and extent of the gaps.

From the e-SQ gap measurements it can be said that:

Australian winery managers have a good understanding of customer website requirements as evidenced by the information gap of 9.6/100. However, these requirements are not well represented on winery websites resulting in a design gap of 39.9/100, which contributes to an overall level of dissatisfaction by customers, hence the fulfilment gap of 60/100.

	Precision *(coefficient of determination)*		Agreement *(intercept)*	*(slope)*	*(a)*	*(b)*	*(c)*	E-SQ Gap Score D
	r	r^2	β_0	β_1	$1-r^2$	$\lvert\beta_0\rvert / 5$	$\lvert\beta_1-1\rvert/4$	$((a \times 0.5)+(b \times 0.25)+(c \times 0.25)) \times 100$
Information Gap	0.922	0.850	0.313	0.910	0.150	0.063	0.023	9.6
Design Gap	0.542	0.294	-0.659	0.794	0.706	0.132	0.052	39.9
Fulfilment Gap	0.431	0.186	2.982	0.298	0.814	0.596	0.176	60.0

Table 7: Australian Winery E-SQ Gap Scores

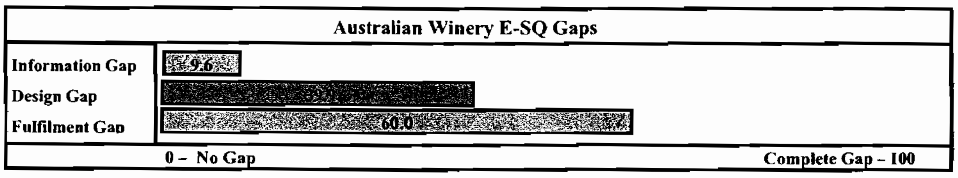

Figure 11: Australian Winery E-SQ Gaps

Theoretically, eliminating these e-SQ gaps should result in satisfied customers, which ultimately leads to purchases. In order for the practitioner to get a clearer view of where the problems lie, the amount of deviation from the perfect position was calculated for each characteristic. This list was sorted from highest to lowest deviation to show which characteristics contributed the most to the identified e-SQ gaps. In addition, the framework upon which the surveys were based provides a comprehensive list of content and design issues that would prove useful to a winery manager and website designer (see Davidson & Lambert, 2005). Winery managers could further evaluate their own websites against the criteria and assess how well their sites meet general customer needs. Ongoing research by the author has enabled a comparison of the maturity of winery websites over several years (Davidson 2009).

It is envisioned that similar studies could be undertaken in the wine industry in other counties and other industries that would enable cross-country and cross-industry comparisons.

5 CONCLUDING REMARKS

This research has made a contribution to knowledge. Zeithaml et al.'s (2002) work on the conceptual model for understanding and improving e-service quality has been extended to consider how to identify and measure the existence of e-SQ gaps.

Electronic service quality gaps are mathematically defined as being non-existent when correlation and regression analysis of the data associated with customers' requirements, managers' beliefs about customer requirements, and the design and operation of the website, reveals a perfect positive relationship. That is, that managers know what customers require (information gap), what managers know is being implemented on the website (design gap), and customers requirements are being met (fulfilment gap). Having defined e-SQ gaps mathematically, a series of rules are constructed which allow the statistical testing of hypotheses regarding the existence of such gaps.

To further add to the usefulness of this research, the values from the correlation and regression analysis for the coefficient of correlation (r), y-intercept (β_0), and slope (β_1) are standardised and combined with appropriate weightings and used to determine the extent of the e-SQ gaps. A number between zero and one hundred indicates the extent of the gap where zero is no gap, i.e. complete agreement or a perfect positive relationship, while 100 indicates a complete gaps, i.e. no relationship between variables at all.

This method of identifying and measuring e-SQ gaps is demonstrated on Australian wineries where it was found that winery managers had a fair idea of customer website requirements (information gap of 9.6), but the requirements are not well represented on their websites (design gap of 39.9), resulting in an overall level of dissatisfaction from customers (fulfilment gap of 60). While not covered in this paper, further analysis of the data allows the practitioner to determine the contributing sources of dissatisfaction (which customer requirements are not being met) further adding to the practical usefulness of this work.

While the scope of this research was limited to three of the four e-SQ gaps that Ziethaml et al. (2002) proposes, Zeithaml's model has proven useful and relevant, and this research provides a solid basis for further research in this area.

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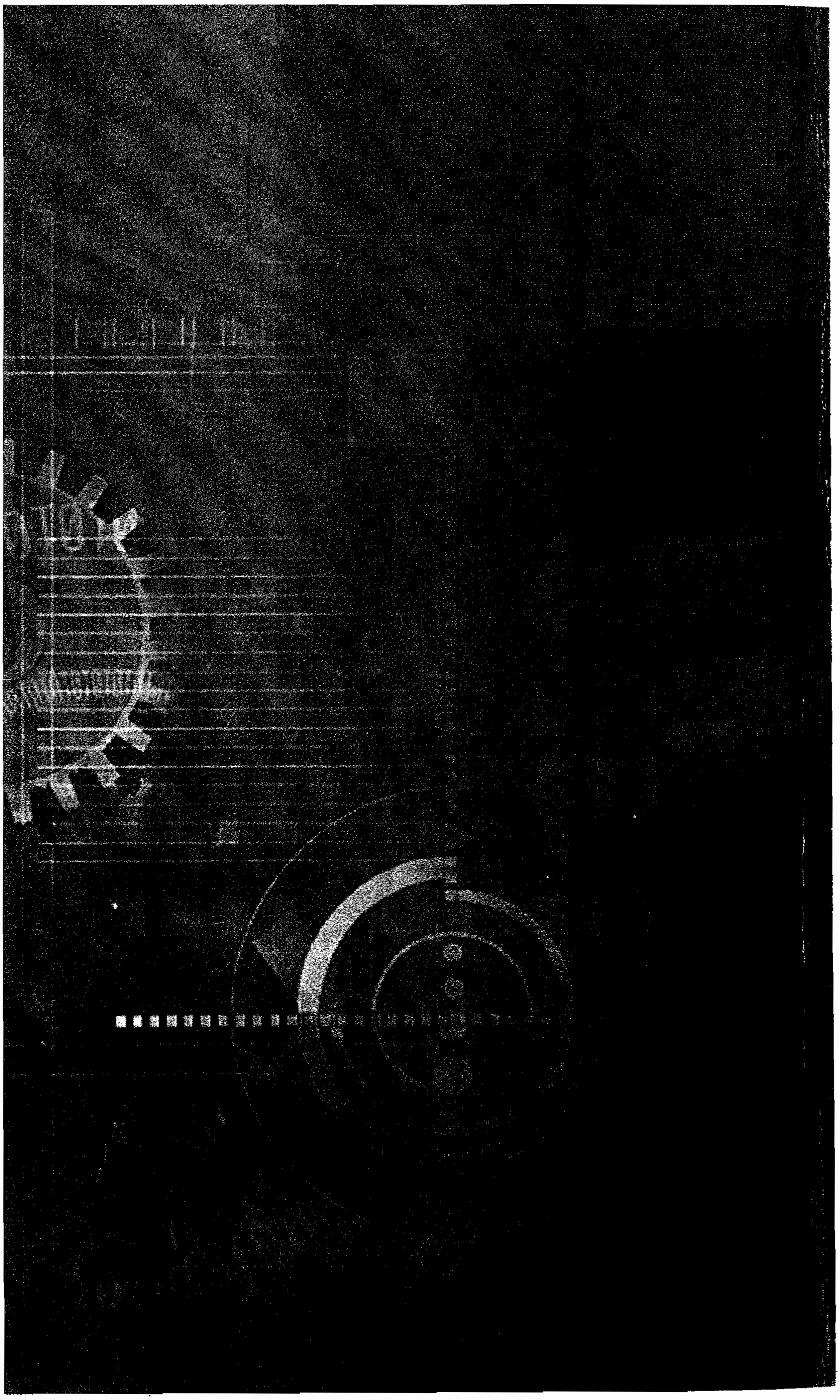

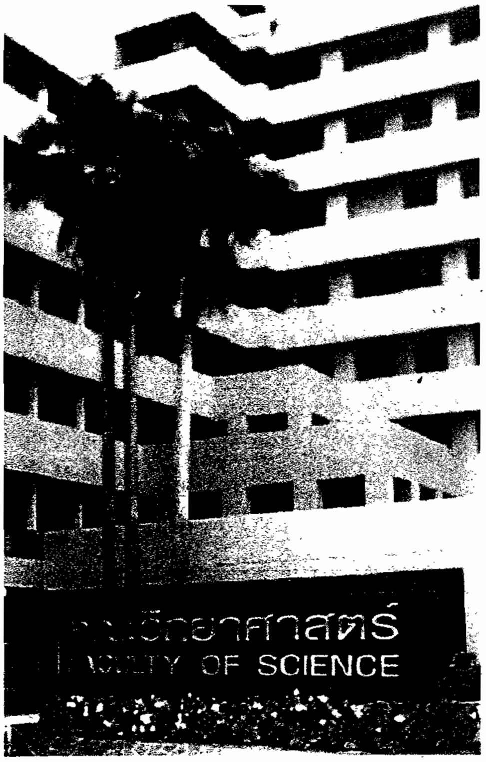

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