NEW MODELS DESCRIBING INFLUENCES ON THE PERCEPTION OF WEBSITE QUALITY

Abstract

If electronic commerce is to succeed, then a key influence will be the Human – computer interface. Interaction between potential buyers and the seller's website or an Electronic Market's website will have an influence on success: An easy to use website would, logically, be used more frequently than one that is difficult to use. What makes a good website a good website? What are the characteristics that make a website easy to use for people? This paper describes research carried out to determine what a sample of users and potential users of electronic markets perceived as influencing the quality of a website. The research uses a proven measurement instrument, in the form of a survey and utilises the techniques of Factor Analysis and Structural Equation Modelling for analysing the results. The results are presented in the form of a number of models to describe the influences on perceptions of website quality.

Keywords: Website quality, Webqual, Structural equation modelling, quantitative research, B2B e-commerce, electronic markets.

ISRL Categories: AI0102, AI0606, EI0206, HA0702,

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INTRODUCTION

Internet commerce has had mixed fortunes over the last few years: From boom to bust with many casualties along the way. However, it is not all bad news: Amazon.com turned a profit for the first time and Web technology is being actively promoted for business via Microsoft.net. One thing is common to all of this: The interface between Human users and the Websites. What makes a website easy to use? Populist views include the ability to find information quickly and privacy (Business 2.0). This paper seeks to answer the question "What influences perceptions of website quality?" The logical argument being that if business understands the factors that influence a user's perception of websites, measures can be taken to improve design to include features that match user expectations and that this may result in more business.

PRIOR RESEARCH

Website Quality

A significant amount of prior research exists on the subject of website content and quality: Barnes and Vidgen (2000) developed A measurement instrument named WEBQUAL 1.0 from the principles of Quality Function Deployment (QFD). QFD is a technique that originates from Japan in the late 1960s. The name of the concept is a translation from the Japanese "hinshitsu kino tenkai". The concept of QFD is to deploy critical quality assurance parameters to ensure design quality in production BEFORE a design goes to be manufactured (Akao, 1997). The aims of QFD can be summarised in three points (QFD Institute, 2002):

- "Prioritise spoken and unspoken customer wows, wants, and needs.

- Translate these needs into technical characteristics and specifications.
- Build and deliver a quality product or service by focusing everybody toward customer satisfaction."

WEBQUAL was developed further by the application of research conducted on SERVQUAL (Parasuraman et al., 1991) to website quality. As a result of this work WEBQUAL 2.0 was developed (Barnes and Vidgen, 2001). The WEBQUAL survey instruments uses questions that can be categorised in the following way (Barnes and Vidgen, 2001):

1. Tangibles.
   - Aesthetics
   - Navigation
2. Reliability.
   - Reliability
   - Competence
3. Responsiveness.
   - Responsiveness
   - Access
4. Assurance.
   - Credibility
   - Security
5. Empathy.
   - Communication
   - Understanding the individual

Barnes and Vidgen (2001) conducted research applying the WEBQUAL 2.0 instrument to measuring perceived quality of specific online bookshops. They concluded that the instrument was useful for measuring perceptions of quality and that

it was valid. Although WEBQUAL does not cover all of the possible influences on a user's perception of a website, it does seem quite comprehensive.

Many other studies on the design of websites have been undertaken (eg Congar and Mason, 1998; Eighmey, 1997; Forbes and Rothchild, 2000) however, few have examined the area of customer satisfaction. Zhang and von Dran (2000) did examine factors that influence the satisfaction of users, but their study did not include influences on user's quality expectations. Kotler (1994) posited that "delighted customers" are more effective advocates for a company than advertising campaigns. As argued in the introduction above, a company's website has been found to be central to its success (Neilsen, 1999); a company's website design affects potential customers' perception and attitudes toward the company (Evans and Wurster, 1999). Therefore, paying attention to the design and quality of websites is important and can potentially be an important investment.

Zhang and von Dran (2002) developed a website quality model that identified common quality factors that users thought important:

1. Navigation
2. Site technical features
3. Completeness / comprehensiveness of information
4. Currency (timeliness of updating)
5. Readability / comprehension / clarity
6. Information reliability / reputation
7. Security / privacy
8. Visual design

9. Engaging
10. Product and service concerns

Table 1 illustrates the similarities between the factors identified by Zhang and von Dran and those identified by Barnes and Vidgen.

Factor	Barnes and Vidgen	Zhang and von Dran
1	Tangibles ❑ Aesthetics ❑ Navigation	❑ Visual design ❑ Engaging ❑ Navigation
2	Reliability ❑ Reliability ❑ Competence	❑ Product / service concerns ❑ Site technical features
3	Responsiveness ❑ Responsiveness ❑ Access	
4	Assurance ❑ Credibility ❑ Security	❑ Information reliability / Reputability ❑ Security / privacy
5	Empathy ❑ Communication ❑ Understanding the individual	❑ Readability / comprehension / clarity ❑ Currency (timeliness of updating)

Table 1: Comparison of website quality factors

As can be seen from Table 1, the Barnes and Vidgen WEBQUAL 2.0 instrument appears to be cover a broader range of factors than does the Zhang and von Dran instrument.

Usability

There has been substantial research into the concept of the "usability" of websites, ranging from evaluation using more traditional methods (eg Instone, 1997; Levi and Conrad, 1996; Neilsen, 1993; Schneiderman, 1998) to more web-specific studies (eg Alexander and Tate, 1999; Flanders and Willis, 1998). Small (1998) developed a tool

called WebMAC, whilst other studies focused on customer expectations (eg Jarvenpaa and Todd, 1997; Romano, 2001). Such studies, Zhang and von Dran argue, do not have an underlying model or theory to test. They based their research on a model developed by Kano et al. (1984).

Wexler (2001) discusses a paper written by Venkatesh (2000) that identifies "objective usability" as a factor that contributes to the way in which users perceive a computerised information system's ease of use. By defining such a factor, Venkatesh brings the concept of "usability" very much into the realm of the Technology Acceptance Model (TAM) described by Davis et al., 1989. Venkatesh concluded that, over time, objective usability and enjoyment were found to influence user acceptance.

Other Factors

Earlier research has identified a number of other influences on Internet usage: For example, economic and demographic factors, psychological and personality dispositions, computer skills and experience, social environment and the use of other media (Kraut et al., 1996). Particular factors included the central role of teenagers, race and gender on home use of the Internet. Whilst such knowledge is important, it does not necessarily help to identify why one website is more "usable" than another. However, one important factor relevant to this discussion was identified by the research: The observation that *communication* was key in driving Internet use, especially e-mail. This might infer that interactivity with a website via e-mail or discussion fora could be key to perceptions of usability.

Research question and hypotheses

From the review of prior research presented above, the following research question and associated hypotheses were developed:

Question: What influences the usability of an Internet website?

- H1: Aesthetics of a website such as aesthetics positively influence website usability.
- H2: Navigational properties of a website positively influence website usability.
- H3: Website reliability positively influences website usability.
- H4: Website responsiveness positively influences website usability.
- H5: Website assurance positively influences website usability.
- H6: Website empathy positively influences website usability.

METHODOLOGY

In this research, a survey using the WEBQUAL 2.0 instrument (Barnes and Vidgen, 2001) provided the data used to describe the relationships between the variables. The WEBQUAL instrument was piloted on a population of 126 professional services employees to validate its reliability. The pilot study of WEBQUAL is described in Section 4 below. The questionnaire was then used to survey a sample of 1,000 procurement executives across industry. The list of procurement executives was obtained from a specialist market intelligence company, supplying only verified names and organizations. The survey was administered using the method described below.

Design and administration of the survey instrument

The survey portion of the research was conducted on a sample of approximately 700 procurement managers representing a cross section of industrial sectors and company

sizes. The survey was a mail survey, being sent by mail and offering a range of options for return. The specific steps in sending the survey are described below. The questions on the survey were modified from the original questions on the Barnes and Vidgen survey to reflect the fact that the survey subject was business-to-business electronic markets. Every effort was made to ensure that the meaning of the questions was not altered; the survey was piloted (see section 4). The methods employed in designing and administering the survey encompassed best practice recommendations (Bickman and Rog, 1998, p399-421).

1. A respondent letter describing the aims of the research and its sponsorship was included with the survey.
2. Pre-notification that the survey was being sent was carried out by telephone; in effect, asking permission to send the survey.
3. A reply-paid envelope was included as well as a Fax number, in case that was a preferred option.
4. The letter clearly stated that the survey was confidential.
5. Telephone reminders were employed to encourage a higher response rate.
6. A summary report of the research was offered as an incentive to return the survey.

The particular method chosen for administering the survey questionnaire excludes the ability for respondents to complete the results online. The reasons for this are straightforward: Firstly, the survey included questions about peoples' intention to use the Internet and therefore, online completion would bias the result. Secondly, there are other advantages to a mail – administered survey, including that for longer

questionnaires, a web survey with mail or e-mail solicitation produces a smaller error and that respondents prefer a paper questionnaire. (Vehovar et al., 2001).

The quantitative analysis is conducted using the technique of Factor Analysis (Hair et al., 1998) to validate the hypotheses on previously developed scales. Structural equation modelling was used to study the interrelationships between the constructs (Hair et al., 1998). Analysis of the data collected using the WEBQUAL instrument was also subjected to factor analysis and Structural Equation Modelling (SEM). A detailed description of the methods used is given below.

Limitations of methodology and analytical techniques

Whilst the researcher has endeavoured to ensure that the research methodology and the analytical techniques used are robust, the nature of the research and the sample chosen do impose a number of potential limitations:

- The sample of electronic markets chosen is relatively small and has been subject to turbulent market conditions. Therefore, the degree to which generalisations can be made may be limited.
- The quantitative data gathering targets both users and potential users of electronic markets; sample sizes may limit the extent of analysis that can be carried out.
- Whilst Structural Equation Modelling is a powerful method of analysis, it may be that there are alternative models that work.

RESULTS

The results of the research were as follows:

Pilot study

The Survey questionnaire utilises the structure and scales used by Barnes and Vidgen, 2001. However, the target audiences are different and it was decided to pilot the questionnaire on a sample of professionals employed in a large UK Professional Services organization. This Field Pretesting (Bickman and Rog (1998)) consisted of a sample of Professional Services Managers and Staff within the organization completing the questionnaire and using a business-to-business procurement site with which they were familiar as the target when answering the questions.

Study Context and Sample

The approach taken by Barnes and Vidgen for their study was a field study in which students rated three online bookshops using the WEBQUAL survey instrument. They did this online. They collected data from a sample of 54 students enrolled in various courses related to management. In this study, the same instrument as Barnes and Vidgen developed (having obtained their permission to do so) is used, but conducted on a different sample: The sample used in this study consisted of 126 professionals and support staff working for a large professional services organization, many in outsourced Client processes. They were asked to evaluate a business-to-business procurement electronic market website with which they were familiar. Why choose such a sample? The choice was appropriate for several reasons:

- Professional Services employees are generally familiar with the Internet.
- They were asked to provide unbiased answers.
- The sample was chosen so that the respondents either had Clients who operated electronic markets or the respondents regularly used electronic markets for procurement.

Subjects were surveyed over a period of one week and were asked to respond honestly to the questions. As this was a pilot study, they were also asked for their feedback on the questions and to provide ideas for improving the survey instrument. The study utilises Factor Analysis and SEM in place of the statistical methods used by Barnes and Vidgen. Factor Analysis was one of the suggestions made in the "Extending the WEBQUAL framework" section of their paper. SEM was chosen because of its powerful modelling ability and its ability to provide a transition from exploratory to confirmatory analysis (Hair et al., 1998, p578).

Operationalisation of research variables

The research variables were measured using multi item scales. The questions and scales were those utilised by Barnes and Vidgen (2001). The scales used were validated by Barnes and Vidgen and gave an average value for Cronbach's alpha of 0.95.

Results

The analysis in this research used Factor Analysis and Structural Equation Modelling techniques (Chin, 1998a, 1998b; Fornell and Bookstein, 1982; Lohmoller, 1989). A Factor Analysis was performed on the data collected. Factor Analysis can be used in two ways: ***Exploratory Factor Analysis*** – used to determine the structure of a Construct and the items that are to be used in measuring the dimensions; ***Confirmatory Factor Analysis*** – is used to validate hypotheses on previously developed scales. In this study, Exploratory Factor Analysis was used. The methodology used the seven steps for performing a Factor Analysis (Hair et al., 1998, p 120).

In this research, the following assumptions and criteria were used for the Factor Analysis:

- A sample size of 126 was achieved.
- For this sample size, variables with Factor Loadings of less than 0.50 should be deleted (Hair et al., 1998, p 112).
- One measure that is often used to establish whether a factor analysis will be worthwhile is the Kaiser Meyer-Olkin (KMO) index. It measures whether partial correlations among variables are small. KMO values less than 0.7 are generally not acceptable (Kaiser, 1974).

The objective of the pilot analysis was to summarize the data in the minimum number of factors. Therefore, the component analysis method was used and the following steps employed to interpret the factors: (Hair et al., 1998, p 106):

- Computation of the unrotated factor matrix.
- Factor rotation. In this pilot study the Varimax method was used (Kinnear and Gray, 2000, p 383)
- Interpretation of the factor matrix.

In this research, EFA was used on the pilot data to identify factors from the data collected. SEM was used to create a model that described the relationship between the factors. For the main study, CFA was utilised in conjunction with SEM. This pilot study is an EFA study; the original work of Barnes and Vidgen did not utilise Factor

Analysis, but does suggest it as a possible analytical technique. In this pilot study, SEM was carried out using AMOS v4 software.

Measurement Model

The characteristics of the sample used in this study are displayed in Table 2 below.

Years	Mean	Standard Deviation
Age	23.3	3.19
Web experience	3.1	1.41
Work experience	4.8	2.1
Gender	Male: 47.6% Female: 52.4%	

Table 2: Sample characteristics

A Factor Analysis (FA) was carried out on the data collected: Correlations below 0.50 are not considered significant on samples of 126, so loadings below that were eliminated (Hair et al., 1998, p112). The result was a factor model with five factors. In this model, 73.19% of the variance is accounted for by the first five factors and maintains the principle of parsimony (Hair et al., 1998). The loading matrix for the rotated factor analysis is displayed as Table 3, below. The five - factor model eliminated one variable.

	Factor				
	1	2	3	4	5
WQ1	.863				

WQ2	.897				
WQ3	.789				
WQ4	.742				
WQ5					.595
WQ7	.533				
WQ8	.674				
WQ9		.689			
WQ10		.851			
WQ11		.798			

	Factor				
	1	2	3	4	5
WQ12		.776			
WQ13			.696		
WQ14			.751		
WQ15			.657		
WQ16		.596			
WQ17				.852	
WQ18				.872	
WQ19					.824
WQ20					.841
WQ21			.604		
WQ22				.709	

Table 3: Varimax rotated factor matrix for Webqual

The Factor Analysis identified five factors and this might be considered analogous to the five factors the comparison of SERVQUAL and WEBQUAL (see pg 3) discussed by Barnes and Vidgen (2001, p 14). Consequently, the new factors were assigned names (see Table 8) that reflected their composite nature. None appeared analogous to the SERVQUAL counterparts, as defined by Barnes and Vidgen; however, there were some similarities between "Trust" and the SERVQUAL factor "Assurance" and between "Empathy" and the SERVQUAL "Empathy" factor.

Structural Model

The factors derived from the FA are described in Table 4.

Factor	Construct
1	Usability
2	Reputability
3	Communicative Effectiveness
4	Trust
5	Empathy

Table 4: Factors from analysis

Each of these five new Constructs (factors) was tested for reliability by calculating the Cronbach's Alphas. These are given in Table 5 below.

Construct	Cronbach's Alpha	Standardised Item Alpha
Usability	0.9106	0.9139
Reputability	0.8780	0.8793
Communicative Effectiveness	0.7963	0.8178
Trust	0.8339	0.8317
Empathy	0.7706	0.7659

Table 5: New Construct Cronbach's Alphas

Higher values of Cronbach's alpha (on the scale 0 to 1) indicate a higher reliability (Hair et al., 1998, p 579). All of the Factors (Constructs) have Cronbach's alpha scores greater than 0.7 and must be considered to be reliable. Descriptive statistics were run on the new constructs. The Kurtosis figures for Reputability and Communicative Effectiveness both appear on the high side: This indicates a sharp peak in the distribution of the data for these two Factors. For the study of the

interrelationships between the constructs, structural equation modelling estimation was applied. SEM was applied to generate a model that described the relationship between the constructs. The analysis in this study was conducted using AMOS 4, developed by James L. Arbuckle. The reason for using this software was twofold: Firstly, its ease of use and secondly, the fact that it interfaces directly with SPSS version 10. The seven stages for conducting Structural Equation Modelling, SEM, (Hair et al., 1998 p 592) were applied (see above). The result of the SEM exercise is described in Table 6 and figure 1 below:

Type of Measure	Statistic	Value
Absolute Fit	Degrees of Freedom	6
	Sample size	126
	Chi Square	87.54
	GFI	1.0
	NCP	0
Parsimonious Fit	AGFI	1.0
Incremental Fit	NFI	1.0
	IFI	1.0

Table 6: Modified SEM statistics

WEQUAL; Pilot Study

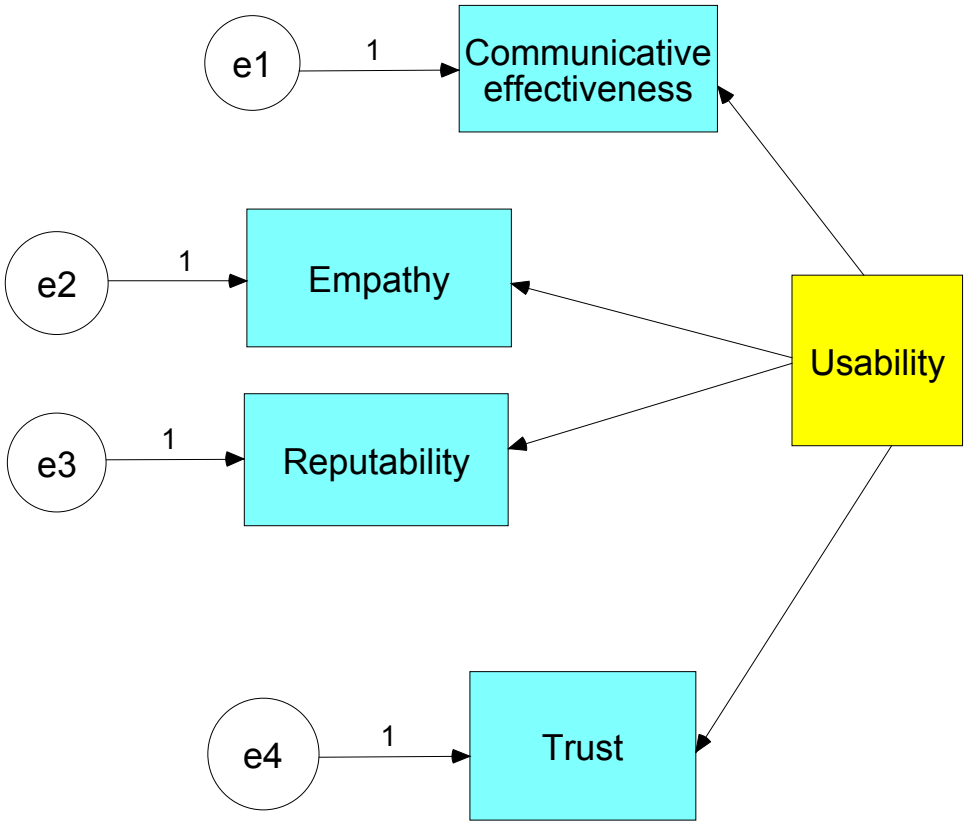


Figure 1: Pilot Webqual SEM Model

The model that best fits the results obtained and that is illustrated in Figure 1 above indicates a relationship between usability of a website and the other constructs identified by the factor analysis. In the first instance, a model was constructed that tried to relate the five factors to a construct labelled "Website Quality", but this model was not statistically supported by Structural Equation Modelling. The model described by figure 1 depicts a simple relationship and infers that the usability of a website is dependent on reputability, trust, communicative effectiveness and empathy that the website instils in users. A relationship between the constructs was identified through factor analysis; SEM was used to identify this model as being a likely fit. The model indicates that the usability of a website is dependent on the constructs of trust, communicative effectiveness, empathy and reputability; constructs similar to those identified by Barnes and Vidgen (2001) and Zhang and von Dran (2002).

Limitations

It is important to understand any limitations to the research that should be considered when reading the conclusions and discussion that follow. The population sampled was a group of professionals working for a large firm, together with a sample of support staff. The sample population were familiar with procurement processes and many used Internet business-to-business electronic markets regularly. Because of the recruitment strategies used by the company, the population might not be typical of the general UK industrial workforce and that may result in differences between the results obtained in this research and studies of the working population at large.

Main study

A sample of 705 procurement professionals from a broad range of industries was sampled. A total of 331 responses were received, giving a response rate of 46.95%.

The responses received represented a total purchasing spend of approximately £396,130,000. Of this sum, £9,750,000 is currently spent through electronic markets (2.46%). Table 7 illustrates the purchasing spend by industry segment of the respondents. Four electronic markets were studied; by analysing the responses to determine which were customers or potential customers of the electronic markets being studied, the following sample sizes resulted: *Integrated Solution.com: 154; Purchasing.com: 271; Industry.com: 55 and Evolve.com: 145*

Segment	Total Spend	Spend with EMs
Aerospace	£1,000,000	£10,000
Automotive	£50,000,000	£900,000
Broadcasting	£12,000,000	£1,200,000
Cabling	£13,000,000	£65,000
Carbon products	£30,000,000	£1,500,000
Ceramics	£3,000,000	£30,000
Chemicals	£67,000,000	£500,000
Computing	£250,000	£87,500
Defence	£35,000,000	£700,000
Electromechanical Engineering	£10,000,000	£100,000
Electronics	£7,500,000	£375,000
Engineering	£11,000,000	£0
Food	£7,100,000	£351,000
Furnishings	£8,000,000	£120,000
Manufacturing	£41,000,000	£2,300,000
Marine	£8,000,000	£80,000
Medical Equipment	£20,000,000	£20,000
Paint	£250,000	£0

Robotics	£5,000,000	£500,000
Telecoms	£20,000,000	£200,000
Test Equipment	£47,000,000	£715,000

Table7: Purchasing spend by industry segment

FACTOR ANALYSIS

The detail of the method used in the Factor analyses was as follows: In this study, Confirmatory Factor Analysis was used. The seven steps for performing a Factor Analysis (Hair, Anderson, Tatham and Black, 1998, p 120) were used, as previously.

Integrated Solution.com

154 responses were received from customers or potential customers of this company. On that basis, Factor loadings below 0.45 were not considered significant (Hair et al.,1998, p112). A confirmatory factor analysis was conducted, seeking 5 Factors as per the pilot study (see above). Varimax rotation was used and the Factor loading matrix of the rotated factor analysis is displayed as Table 8 below. The best fit was a four-factor model. The four-factor model eliminated three variables from the analysis. For each variable, the highest loading on any one factor was selected, thus ensuring that the variables for each factor were identified (Hair et al., p113). The four-factor model accounted for 73.14% of the variance.

	Factor			
	1	2	3	4
WQ1			.836	
WQ2			.797	
WQ3			.819	
WQ4			.827	
WQ5	.861			
WQ7				.707
WQ8	.823			
WQ9			.569	
WQ10				.840
WQ11	.600			
WQ12		.611		
WQ13	.727			
	Factor			
	1	**2**	**3**	**4**
WQ15	.908			
WQ16		.626		
WQ17		.894		
WQ18		.756		
WQ19				-.789
WQ20				-.787
WQ21		.763		

Table 8 Four-factor Webqual model

Purchasing.com

271 responses were received from customers or potential customers of this company. On that basis, Factor loadings below 0.35 were not considered significant. The Factor loading matrix of the rotated factor analysis is displayed as Table 9 below. The best fit was a five-factor model. The five-factor model eliminated two variables from the analysis. The five-factor model accounted for 82% of the variance.

	Factor				
	1	2	3	4	5
WQ1		.800			
WQ2		.865			
WQ3		.833			
WQ4		.849			
WQ5					.615
WQ6		.582			
WQ8		.625			.609
WQ9	.731				
WQ10	.652				
WQ11	.655				
WQ12	.647				
WQ13			.779		
WQ14			.841		
WQ15			.771		
WQ16					.707
WQ17	.910				
WQ18	.860				
WQ19				-.750	
WQ20				-.827	
WQ21	.798				

Table 9 Five-factor model for Purchasing.com Webqual

Industry.com

55 responses were received from customers or potential customers of this company. On that basis, Factor loadings below 0.75 were not considered significant. The Factor loading matrix of the rotated factor analysis is displayed as Table 10 below. The best fit was a three-factor model. The three-factor model did not eliminate any variables from the analysis. The three-factor model accounted for 88.3% of the variance.

	Factors		
	1	2	3
WQ1	.767		
WQ2	.752		
WQ3	.858		
WQ4	.858		
WQ5		.778	
WQ6			.779
WQ7	.816		
WQ8	.756		
WQ9			.885
WQ10	.802		
WQ11	.816		
WQ12	.799		
WQ13	.788		
WQ14		.751	
WQ15	.783		
WQ16			
WQ17		.846	
WQ18		.844	
WQ19		.880	
WQ20		.921	
WQ21			.752
WQ22	.980		

Table 10 Four-Factor Webqual model for Industry.com

Evolve.com

145 responses were received from customers or potential customers of this company. On that basis, Factor loadings below 0.45 are not considered. A confirmatory factor analysis was conducted, seeking 5 Factors as per the pilot study (see above). The Factor loading matrix of the rotated factor analysis is displayed as Table 11 below. The best fit was a five-factor model. The five-factor model did not eliminate any variables from the analysis. The five-factor model accounted for 90.5% of the variance.

	Factor				
	1	2	3	4	5
WQ1		.842			
WQ2		.803			
WQ3		.859			
WQ4		.801			
WQ5				-.637	
WQ6				.779	
WQ7				.653	
WQ8	.600				
WQ9	.921				
WQ10	.789				
WQ11	.782				
WQ12	.628				
WQ13			.899		
WQ14			.942		
WQ15			.695		
WQ16				.752	
WQ17	.877				
WQ18	.863				
WQ19			.689		
WQ20					.935
WQ21				.906	
WQ22			.803		

Table 11 Five-Factor webqual model for Evolve.com

All Companies

The researcher conducted a further analysis by pooling all of the responses together in an attempt to gain a view across a broad sample of respondents: 331 responses were received from customers or potential customers of this company. On that basis, Factor loadings below 0.35 are not considered significant (Hair et al., 1998, p112). A confirmatory factor analysis was conducted, seeking 5 Factors as per the pilot study (see above). The Factor loading matrix of the rotated factor analysis is displayed as Table 12 below. The best fit was a four-factor model. The four-factor model did not

eliminate any variables from the analysis. The four-factor model accounted for 74% of the variance.

	Factor			
	1	2	3	4
WQ1	.663			
WQ2	.782			
WQ3	.749			
WQ4	.871			
WQ5	.626			
WQ6			.617	
WQ7			.808	
WQ8			.547	
WQ9		.701		
WQ10		.657		
WQ11		.711		
WQ12		.698		
WQ13	.871			
WQ14	.683			
WQ15	.749			
WQ16			.600	
WQ17		.877		
WQ18		.863		
WQ19				.524
WQ20				.894
WQ21			.609	
WQ22		.583		

Table 12 Four-Factor Webqual model, All Companies

Factor analysis: Interpretation of results

The Webqual pilot study identified five factors:

1. Usability.
2. Reputability.
3. Communicative effectiveness.
4. Trust.
5. Empathy.
6. Behavioural intention.

Through the examination of each of these factors in turn, it will be possible to define similarities and differences for each of the cases:

Usability

The data collected for *integrated solution.com* does have a factor containing most of the variables associated with usability from the pilot study (see above). The data for *purchasing.com* also identified a factor consisting of most of the variables associated with usability. The data for *industry.com* identified a factor that contained the variables associated with usability, but also contained a number of other variables. The factor identified contained the following variables: WQ1-4, WQ7-8, WQ10-13, WQ15 and WQ22. This factor combined elements of usability, reputability, communicative effectiveness and trust. I named this factor "interface confidence". The data for *evolve.com* indicated the existence of a factor for usability.

Reputability

The data for *integrated solution.com* did not identify a factor for reputability. Instead, a number of variables combined (WQ12, WQ16-18 and WQ21) to form a factor I have named "***security***". The data for *purchasing.com* identified a factor containing the

majority of variables associated with the reputability factor. The *Industry.com* data identified the combined factor of interface confidence, as described above. The data for *evolve.com* did identify a factor containing the majority of the reputability variables. Analysis of the *combined data* revealed a factor akin to that named security above. However, the factor contained a few more variables: WQ9-12, WQ17-18 and WQ22.

Communicative effectiveness

The data for *integrated solution.com* did not identify a factor for communicative effectiveness; some of these variables were contained in the factor named security. However, two of the variables were contained in another factor. This factor contained variables WQ5, WQ8, WQ11, WQ13 and WQ15. I named this factor "***information content***". The data for *purchasing.com* identified a factor containing the majority of variables associated with communicative effectiveness. The data for *industry.com* identified the factor interface confidence (see above) as containing most of the variables associated with communicative effectiveness. However, a factor containing variables WQ6, WQ9 and WQ21 was identified. I named this factor "***format***". The data for evolve.com indicated the existence of the communicative effectiveness factor. Analysis of the *combined data* indicated the existence of a factor akin to that termed information content above. The factor consisted of variables WQ1-5 and WQ13-15.

Trust

The data for *integrated solution.com* did not identify a factor for trust. A factor containing variables WQ7, WQ10, WQ19 and WQ20 was identified. I named this factor "***functional format***", reflecting the facts that the variables indicated a lack of communicative format (negative correlation) yet were positive on believability of

information presented and competency. The data for purchasing.com similarly identify a factor akin to that for *integrated solution*.com. *Industry.com* data identified a factor containing the majority of the variables associated with trust, but that factor also contained other variables. The factor contained WQ5, WQ14, WQ17-18, WQ19 and WQ20. I named this variable "***secure comfort***". No stand-alone factor for trust was identified for *evolve.com* data.

Empathy

The data for *integrated solution.com* did not identify a factor for empathy. No factor for empathy could be identified for *purchasing.com*. A factor containing the variables WQ5, WQ8 and WQ16 was identified. I named this factor "***perceived use quality***" because the variables represent appearance, quality of user's experience and reputation. No factor for empathy was determined for the data relating to *industry.com*. The data for *evolve.com* identified a factor containing the following variables: WQ5-7, WQ16 and WQ21. I named this factor "***competent design***", as it is dominated by variables relating to appearance and competence of design. Analysis of the combined data indicated that two factors were present: The first was akin to that termed competent design, described above, but with variables WQ6-8, WQ16 and WQ21. The second was akin to empathy (WQ19 and WQ20).

Summary of Webqual factor analysis

In summary, the factor analysis of the variables relating to Webqual has revealed a number of important points:

1. The results are different from case to case, although substantial similarities exist.

2. The results differ from the pilot study of Webqual described above. The fact that the results differ from the pilot indicates a sensitivity to the sample; an observation that is confirmed by looking at the results of the other analyses.
3. Many of the cases contain substantially similar factors to those found in the pilot study.
4. In some instances, the differences between the factors are minor, only having a change of emphasis, whilst retaining the essential meaning.

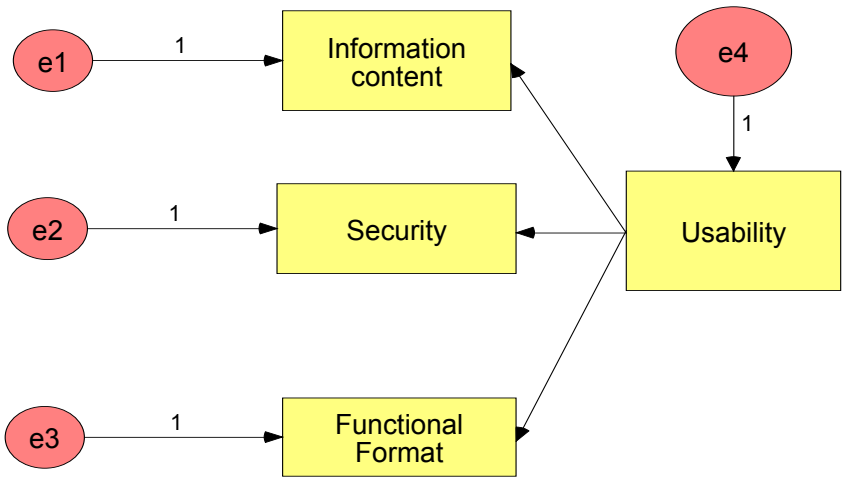
Table 13 below plots the case study companies vs the identified factors from the analysis described above.

	Integrated solution.com	Purchasing .com	Industry. com	Evolve. com	All data	Pilot
Usability	X	X		X		X
Reputability		X		X		X
Communicative effectiveness		X		X		X
Trust						X
Empathy					X	X
Interface confidence			X			
Security	X				X	
Information content	X				X	
Format			X			
Functional format	X	X				
Secure comfort			X			
Perceived use quality		X				
Competent design				X	X	

Table 13 Webqual factors by case

STRUCTURAL EQUATION MODELLING (SEM)

For the study of the interrelationships between the factors identified in the analyses above, structural equation modelling estimation was applied. This technique allows the researcher to conduct a series of separate, but interdependent multiple regression equations at the same time; the technique provides the researcher with the ability to identify and represent unobserved concepts in relationships. The analysis in this study was conducted using AMOS 4, developed by James L. Arbuckle. The reason for using this software was twofold: Firstly, its ease of use and secondly, the fact that it interfaces directly with SPSS version 10. The seven stages for conducting Structural Equation Modelling, SEM, (Hair et al., 1998 p 592) were applied. The following models represent the factor analyses conducted on the Webqual. Figure 7 below illustrates the Webqual SEM for Integrated solution.com.



Webqual SEM, Integrated Solution.com

Figure 2: Webqual SEM for Integrated Solution.com

The model for Integrated Solution.com illustrates a simple relationship between usability and three factors describing the information content of the websites, security and the format of the website. Figure 3 below illustrates the Webqual SEM for Purchasing.com.

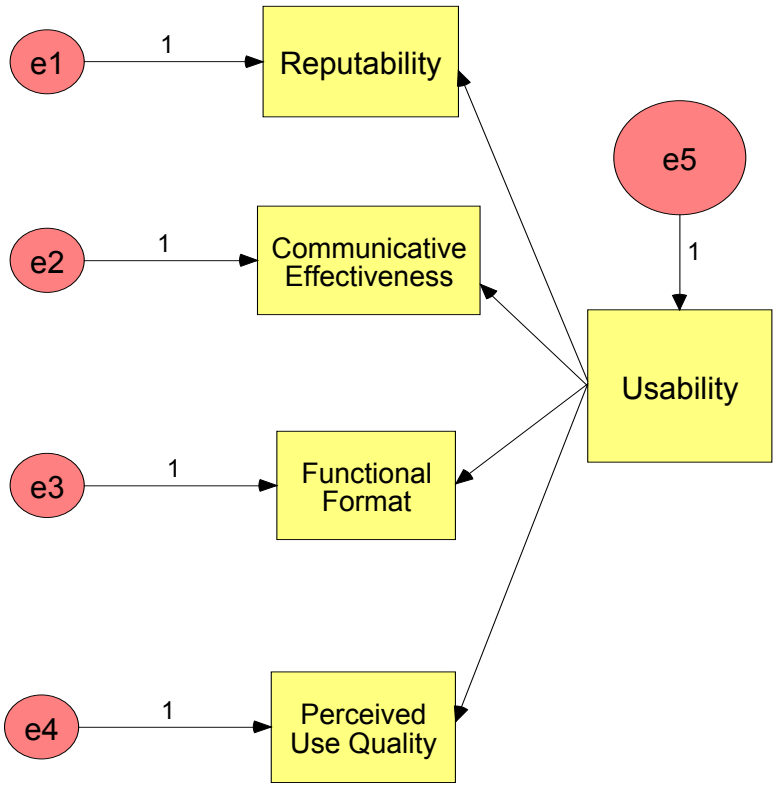


Figure 3: Webqual SEM for Purchasing.com

The model for purchasing.com is more complex, having factors relating to the quality of the website and the effectiveness of how the website communicates with users. Figure 4 below illustrates the Webqual SEM for Industry.com.

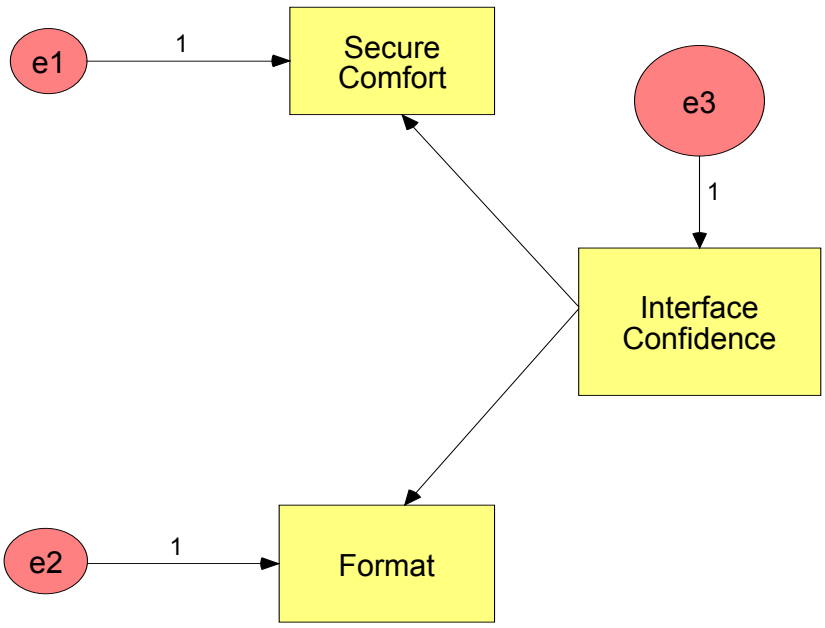


Figure 4: Webqual SEM for Industry.com

For industry.com the model is a simple relationship between a factor named interface confidence, website format and security (secure comfort). Figure 5 below illustrates the Webqual SEM for Evolve.com.

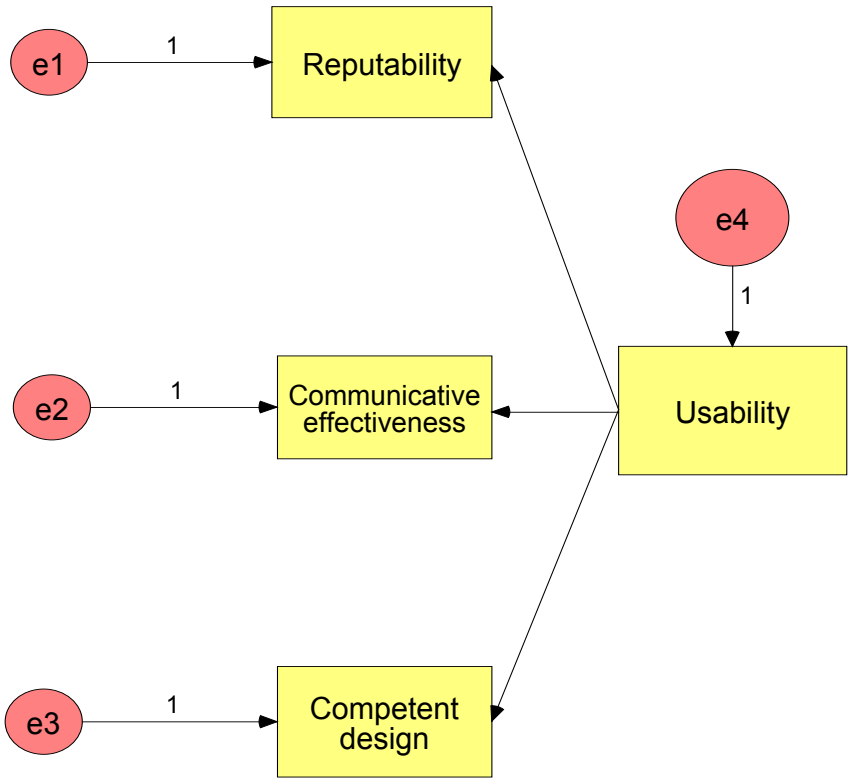
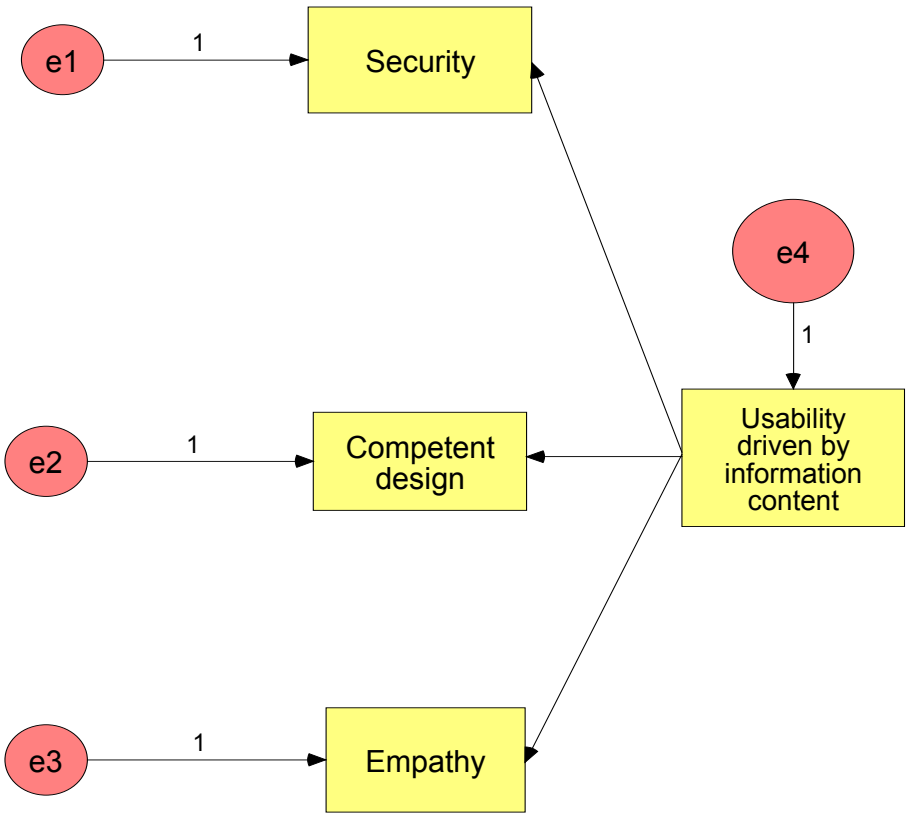


Figure 5: Webqual SEM for Evolve.com

The model describing the factors for evolve.com describe a relationship between usability, reputability, the effectiveness of the way in which the website communicates to users and its design. Figure 6 below illustrates the Webqual SEM for all companies' data together.



Webqual SEM all companies

Figure 6: Webqual SEM for all companies' data

The model resulting from SEM analysis is different to the previous models: A factor for usability "driven by information content" was identified. This was related to three factors: Security, design and empathy (the empathy the user feels towards the website).

Interpretation of SEM results

SEM of the WEBQUAL results by company provided a number of variants (Figures 7 to 11). An interesting aspect of the models is the recurrence of themes relating to "Trust" ("Security", "Reputability", "Secure Comfort"), "Information quality" ("Information content", "Competent design") and "Format" ("Functional Format", "Format"). These factors reflect elements of the factors identified in prior research (Zhang and von Dran, 2002) and research into the delineation of typologies of Trust (Harrision-McKnight and Chervany, 2002). The SEM analysis of the total dataset identified a variant of "Usability" – here it was combined with variables relating to information content quality. The other three factors identified relate to security, design and "empathy", this latter being derived from the construct of empathy seen in SERVQUAL (Parasuraman et al., 1991). The model identified is significantly different from the model posited on the basis of the pilot WEBQUAL survey (Figure 1).

CONCLUSIONS

The key conclusions can be derived from referring back to the hypotheses stated in section 3 above:

5.1. Research question and hypotheses:

The research question and associated hypotheses stated were:

Question: What influences the usability of an Internet website?

- H1: Aesthetics of a website such as aesthetics positively influence website usability.
- H2: Navigational properties of a website positively influence website usability.

- H3: Website reliability positively influences website usability.
- H4: Website responsiveness positively influences website usability.
- H5: Website assurance positively influences website usability.
- H6: Website empathy positively influences website usability.

Has the research proven these hypotheses?

Hypothesis	Result
H1 →	Y
H2 →	Y
H3 →	N
H4 →	N
H5 →	Y
H6 →	Y

General conclusions

The results from the research undertaken identified a number of factors that influenced the usability of an EM website. These factors were grouped and related to concepts identified in prior research (see Table 14, below). However, the research found that the exact nature of these factors did vary according to the electronic market business model – or, to be more precise, the sample population associated with each of the EM business models. Analysis established that the variations between business model sample population results were not huge and a generic model (figure 7) has been constructed on that basis. The generic model has a construct named "Usability" being influenced by four other constructs:

- Information Quality
- Security
- Empathy
- Design

These constructs can be compared to those identified in prior research: Zhang and von Dran (2002) identified Security, Navigation and Readability as commonly occurring constructs relating to website quality. Barnes and Vidgen (2001) identified the following constructs in their work on the development of WEBQUAL:

- Tangibles
    - Aesthetics
    - Navigation
- Reliability
    - Reliability
    - Competence
- Responsiveness
    - Responsiveness
    - Access
- Assurance
    - Credibility
    - Security
- Empathy
    - Communication
    - Understanding the individual

Therefore, the generic model proposed in figure 12 can be seen to have its roots in prior research, yet represents a new development of the theory relating to influences on website quality performance.

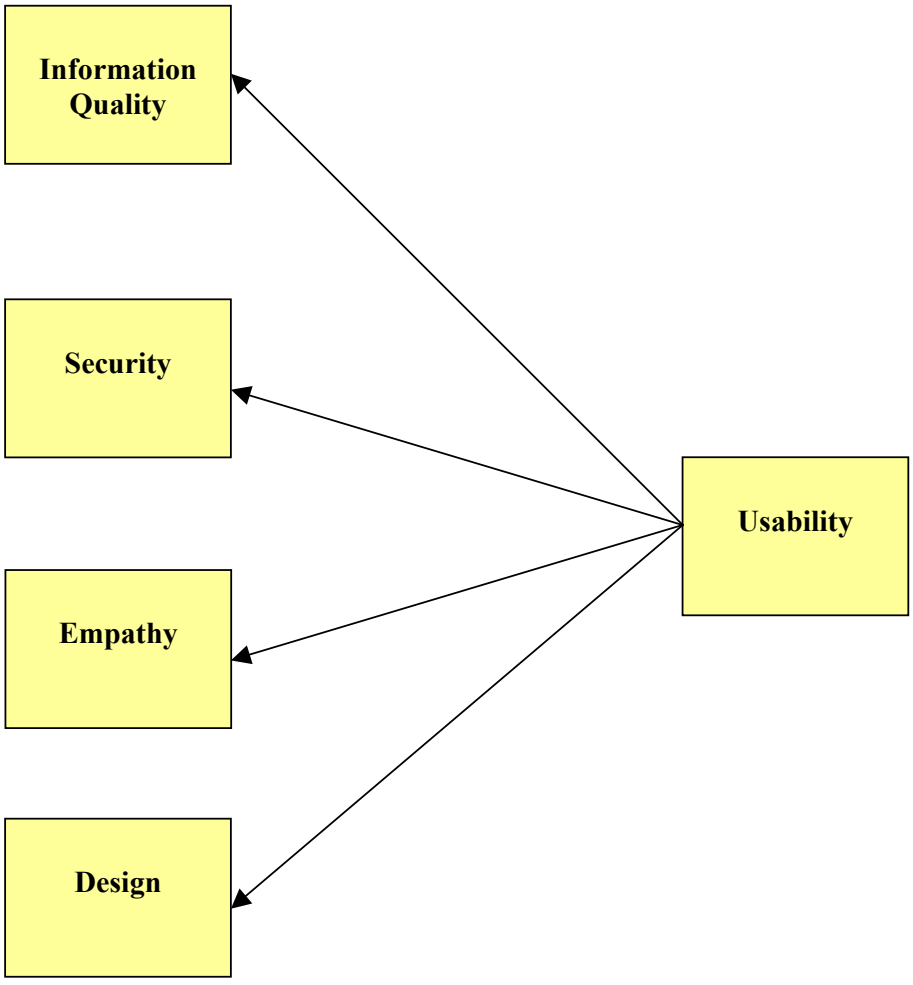


Figure 7: generic WEBQUAL model

The factors identified in the course of this work are analogous with many that relate to prior research: Our work identified a factor we called “usability”, Venkatesh (2000) also identified a concept he termed usability. Barnes and Vidgen’s concepts of Assurance, Communication, Empathy, Tangibles, Site technical features and website quality are related to the factors of “reputability”, “communicative effectiveness”, “trust”, “empathy”, “interface confidence”, “security”, “format”, “functional format”, “secure comfort”, “perceived use quality” and “competent design” that we identified. There also appears to be a relationship with the concepts of “Readability”, “Security and privacy”, “information reliability”, “engaging”, “aesthetics” and “navigation” (Zhang and von Dran, 2002).

The results by company provided a number of variants describing the influences on perceptions of website quality. An interesting aspect of the models is the recurrence of themes relating to “Trust” (“Security”, “Reputability”, “Secure Comfort”), “Information quality” (“Information content”, “Competent design”) and “Format” (“Functional Format”, “Format”). These factors reflect elements of the factors identified in prior research (Zhang and von Dran, 2002) and research into the delineation of typologies of Trust (Harrision-McKnight and Chervany, 2002). The SEM analysis of the total dataset identified a variant of “Usability” – here it was combined with variables relating to information content quality. The other three factors identified relate to security, design and “empathy”, this latter being derived from the construct of empathy seen in SERVQUAL (Parasuraman et al., 1991). The model identified is significantly different from the model posited on the basis of the pilot WEBQUAL survey. However, enough similarities exist to enable the proposition of a generic model to describe the influences on perceived website quality.

LIMITATIONS

Some of the limitations of this research can be summarised as follows:

1. The sample of electronic markets chosen: The number chosen for this study was relatively small. A larger population in terms of breadth and depth could have been used.
2. The population sample of users and potential users was limited to those agreeing to participate in the mail survey. Consequently, the sample size associated with each of the electronic markets is not uniform.
3. Methodology: The use of factor analysis and structural equation modelling were novel to WEBQUAL. As a result, the models presented might not be the only fit or interpretation for the data.
4. The time span over which this research was conducted is limited, therefore the research represents a snapshot in time and not a complete history of electronic markets and their evolution.

FURTHER RESEARCH

From the results and conclusions of the research undertaken and in the context of the limitations noted, a number of opportunities for further research arise: The sample and populations used in the research could be changed and the study replicated. Such changes might involve examining one electronic market only and relating all of the research to that one entity, or the sample could be broadened to include non – electronic market models such as Application Service Providers (ASPs) or Net Services. Another alternative would be to exert further control over the sample of users and potential users chosen to ensure the same numbers are used for each

organization, or to delineate the nature of respondent further and split the respondent populations into pro- and anti- Internet technology. A further focus for the researcher would be the application to online music websites. An important area of future research would be to test the generic model to test whether or not it can be replicated across different business models and sample populations.

ABBREVIATIONS USED:

ASP – Application Service Provider
EM – Electronic Market
QFD – Quality Function Deployment
SEM – Structural Equation Modelling

BIBLIOGRAPHY

Akao, Y. QFD: Past, present and future. (1997).
http://www.qfdi.org/QFD_History.pdf

Alexander, J. and Tate, M. A. Web wisdom: How to evaluate and create information quality on the Web. Mahwah, NJ. Lawrence Erlbaum. .1999.

Barnes, S. J. and Vidgen, R. 'An Evaluation of Cyber-bookshops: The WebQual Method'. International Journal of e-commerce, (6:1) 2001, p 11-30.

Bickman, L. and Rog, D.J. Handbook of Applied Social Research Methods, Sage Publications Inc., Thousand Oaks, CA, 1998.

Business 2.0 (2000), 12th September

Chin, W. ' Issues and Opinion on Structural Equation Modelling', MISQ, (22:1) 1998a p vii-xvi

Chin, W., 'The Partial Least Squares approach to Structural Equation Modeling', in Modern Methods for Business Research, G.A. Marcoulides (ed) Lawrence Erlbaum Associates, Mahwah, NJ. 1998b.

Congar, S. and Mason, R. Planning and designing effective Web sites. Cambridge, MA. Course Technology. 1998.

Davis, F. 'Perceived Usefulness, perceived ease-of-use and user acceptance of information technology'. MISQ, (13:3) , 1989. p 319-338

Davis, F., Bogozzi, R. and Warshaw, P. 'User acceptance of computer technology: A comparison of two theoretical models'. Management Science, (35:8), 1989, p982-1003

Eighmey, J. 'Profiling user responses to commercial Web sites'. Journal of Advertising Research, 37, 1997. p59-66.

Evans, P. and Wurster, T. S. 'Getting real about virtual commerce'. Harvard Business Review (77) 1999, p84-94.

Flanders, V. and Willis, M. Web pages that suck. San Francisco, SYBEX, 1998.

Forbes, M. and Rothchild, M. 'Toward an understanding of consumer experience on the Internet: Implications for Web site design'. Proceedings of the 33rd Hawaii International Conference on system science. Maui, HI:IEEE Computer Society, 2000.

Fornell, C. and Bookstein, F. 'Two Structural Equation Models: LISREL and PLS applied to consumer Exit-Voice Theory', Journal of Marketing Research (19), 1982, p440-452

Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C. Multivariate Data Analysis, Prentice-Hall International, London, 1998.

Harrison – McKnight, D. and Chevany, N. L. 'What Trust means in E-commerce customer relationships: An interdisciplinary conceptual typology'. International Journal of E-commerce (6:2) 2002, p35-59.

Instone, K. Usability heuristics for the Web (webreview.com/97/10/10/usability/sidebar.html)

Jarvenpaa, S. and Todd, P. 'Consumer reactions to electronic shopping on the world wide web'. International Journal of Electronic Commerce (1:2) 1997, p59-88.

Kaiser, H.F. An Index of Factorial Simplicity, Psychometrika, (39), 1974, p31-36

Kano, N.; Seraku, N.; Takahashi, F. and Tsuji, S. Attractive and normal quality. Quality (14:2) 1984.

Kinnear, P.R. and Gray, C. D. SPSS for Windows made simple. Psychology Press, Aberdeen, 2000.

Kotler, P. Marketing Management. 8th Ed. Upper Saddle River, NJ, Prentice-Hall, 1994.

Kraut, R. Scherlis, W. Mukhopadhyay, T., Manning, J. and Kiesler, S. The HomeNet field trial of residential Internet services. Communications of the ACM (39:12) 1996, p55-63.

Levi, M. and Conrad, F. 'A heuristic evaluation of a world wide web prototype'. Interactions (3:4) 1996, p50-61.

Lohmoller, J., Latent Variable Path Modelling with Partial Least Squares, Physica-Verlag, Heidelberg. 1989.

Neilsen, J. Usability engineering. New York, AP Professional, 1993.

Neilsen, J. 'User Interface Directions for the Web'. Communications of the ACM (42:1), 1999, p65-72.

Parasuraman, A., Zeithaml, V.A. and Berry, L., 'Refinement and reassessment of the SERVQUAL scale'. Journal of Retailing (67:4), 1991, p420-450.

Romano, N. ' Customer Relations Management research: An assessment of sub-field development and maturity'. Proceedings of the 34th Hawaii International Conference on system science. Maui, HI:IEEE Computer Society, 2001.

Shneiderman, B. Designing the user interface: Strategies for effective Human-computer interaction. 3rd Ed. Boston, Addison-Wesley, 1998.

Small, R. Assessing the motivational quality of world wide web sites. Syracuse, NY: ERIC Clearinghouse on Information Technology, 1998.

Vehovar, V., Manfreda, K.L. and Batagelj, Z. 'Sensitivity of Electronic Commerce Measurement to the Survey Instrument', International Journal of Electronic Commerce, (6:1), 2001, p31-51

Venkatesh, V. 'Determinants of perceived ease of use: Integrating control, intrinsic motivation and emotion into the Technology Acceptance Model'. (http://isr.commerce.ubc.ca/Abstracts/11-4-venkatesh.html) 2000.

Wexler, J. 'Why computer users accept new systems'. MIT Sloan Management Review (42:3) 2001, p17-19.

Zhang, P. and Von Dran, G.M. 'User expectations and rankings of quality factors in different website domains'. International Journal of Electronic Commerce (6:2) 2002, p. 9-33.