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Website Engagibility: A Step Beyond Usability

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Abstract

There is a continuing need for quality eCommerce websites which satisfy their owner's perspective of quality of design and visitor's perspective of quality of use. More particularly there is a need for website owners to be able to specify what constitutes a website that will fully engage site visitors and consequently what needs to be designed into the website in order to insure return on investment. This paper argues that the term usability is inappropriate to quality websites and that website engagibility is a step beyond usability. The paper reports continuing research which seeks to identify the requirements of website engagibility, and to provide a mathematical solution for measuring and comparing website performance. The research relies on the Software Quality Star to provide an end-to-end conceptual model for studying website quality. In particular it focuses on the potential of a website's design to support the engagibility of visitors. Using a comprehensive set of Quality-of-product criteria and counts for a set of eCommerce websites the paper explains how a ratio value can be calculated for a website. These metrics specifically avoid reliance on website traffic data and visitor statistics and the study concerns itself with website structure and design criteria. The approach is influenced by assessment and predictive measurement theory. Then, using Metric Ratio Analysis the paper shows how website engagibility performance ratings can be determined.

1 Introduction

Modern research relating to quality websites has shown that the traditional quality factors as identified by McCall, Richards & Walters (1977) and by Boehm (1978) are incomplete in the context of the World Wide Web (WWW). The WWW has different requirements and offers new challenges which relate to the owner's return on investment issues and to visitor expectations. From an organisational perspective a website is a sales and marketing tool so the concept of what software quality means has a new perspective. This perspective is influenced by strategic advantage and return on investment and there is a continuing need for website owner's to be conscious of their business competitors' performance. From a visitor perspective, quality websites need to be easy to find, download and understand (Nielsen, 1996; Keeker, 1997; Bevan, 1998). Visitors need to be confident with the content and be reassured about the authority and integrity of the website. Increasingly, visitors have requirements and expectations that communication with websites will be a two-way process. So, additional quality factors need to be considered. This research has identified five new quality factors which are WWW domain specific. These are: visibility, intelligibility, credibility, engagibility and differentiation. **Figure 1** presents definitions of these new quality factors.

Quality factor
Visibility - The ease with which a user can visit a Website.
Intelligibility - The ease with which a user can assimilate and interpret Website content.
Credibility - The level of user confidence with the content of the Website.
Engagibility - The extent to which a visitor achieves a complete experience at a Website.
Differentiation - The extent to which a Website demonstrates corporate superiority.

Figure 1: – Definitions of the additional quality factors for the WWW.

For the original explanation of these factors, readers are referred to Fitzpatrick (2000). Engagibility – the subject of this paper – is discussed later in section 3. These additional quality factors present new challenges for the software engineering community. Typically, these challenges include a full understanding as to how the new quality factors should be specified. The challenges also require an understanding of methods and metrics for website estimation, managing quality during the product life cycle, and Quality-of-use measurement. Heretofore, measurement of websites mainly concerned itself with analysing log files and examining visitor statistics. These measures are specifically Quality-of-use. The paper avoids this form of measurement and focuses on the measurement of website design issues which are associated with the quality of the product's design and reports the results of a study of a set of five eCommerce sites. In this case the paper avoids subject expert and heuristic evaluation and concentrates on empirical measures. The paper explains how a conceptual model is used as the foundation for a study. This in turn supports the identification of engagibility as a better description of website usage. The paper explains how a set of eCommerce websites have been measured and presents results from this study. Then, for the purpose of analysing these results the paper introduces Metric Ratio Analysis as a tool for use by website acquirers and owners seeking to match their competitor's achievements. By combining these, the paper presents a comprehensive approach to evaluating the quality of website engagibility and in the process identifies criteria which are appropriate to quality website design. Academics and practitioners who are researching, studying or practicing in areas where quality is a website driver can benefit from this paper. Section 2 explains the use of the Software Quality Star for this study. Section 3 addresses website quality especially engagibility. It explains how in the domain of the World Wide Web usability is a limiting phrase and that website owners and website visitors have higher expectations. The section also introduces eight engagibility ratios which are the basis for measuring Quality-of-product engagibility in this research. Section 4 addresses Metric Ratio Analysis (identifying criteria, measuring counts, deriving formulae, calculating ratios and analyzing results) and illustrates an approach to calculating a typical set of engagibility ratios for five eCommerce websites.

2 The Software Quality Star

The original motivation for the Software Quality Star *(SQ-Star)* was to illustrate the principal points of focus in International Standard 12207 (ISO 12207, 1995) which relates to software life cycle processes. It was intended for use as a conceptual model for teaching third level students taking Software Engineering and Business Management modules (Fitzpatrick, 2003). Its principal focus was the supplier's (producer's) perspective of quality, acquirer's (procurer's) perspective of quality, and the quality characteristics of the software product. The Software Quality Star mark II *(SQ-StarII)* is an enhanced version. Its first enhancement is the incorporation of eight end-to-end perspectives of software quality. Its second enhancement relates to domains like the World Wide Web which are additional to the Management Information Systems domain and which have different quality considerations (Fitzpatrick, Smith, & O'Shea, 2004a). The current version of the model is illustrated in **Figure 2**.

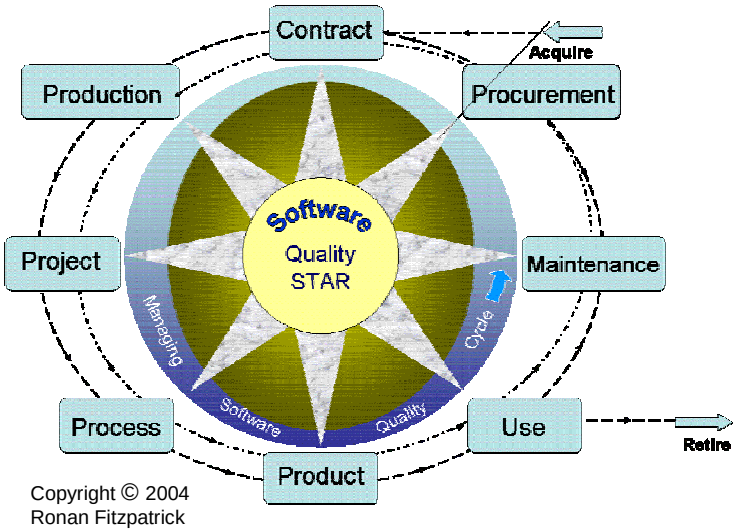

Figure 2: Software Quality Star mark II *(SQ-StarII).*

2.1 Perspectives of software quality

The eight perspectives in the Software Quality Star model are Quality-of-procurement, Quality-of-contract, Quality-of-production, Quality-of-project, Quality-of-process, Quality-of-product, Quality-of-use and Quality-of-maintenance. For each of these perspectives the five new WWW quality factors (i.e., visibility, intelligibility, credibility, engagibility and differentiation) should be individually interpreted and this is the power of the model as a teaching aid. The model can also be used as a foundation for specifying, designing, implementing, and measuring and it is for measuring that it is relied on in this study. The study focuses only on the quality factor named engagibility and for that quality factor considers two of the eight perspectives – Quality-of-product and Quality-of-use. These are now explained in Section 3.

3 Engagibility – a step beyond usability

End user interaction with a system has traditionally been styled usability and ISO 9126 (2001) defines this in terms of effectiveness, productivity, safety and satisfaction. These are considerations that very much impact the user but while using a system the user could not significantly influence the nature of the interaction that could occur. In the main, the nature of the interaction was limited to system-to-user communication that was dictated by the system. The user-dictated communication with the system was not really a consideration and typically was limited to configuring the user interface to suit personal preferences. Successful eCommerce is different and has additional requirements. Companies who have significant investment in their websites seek to retain visitors and to keep them fully engaged in order to secure increased sales. The strategy of this engagement is two way. In addition to the system communicating with the user or visitor, the visitor might also need to communicate with the website or with other visitors. For example, visitors might need to contribute to the content of the website. This contribution might simply be through a mailing list where email communication becomes part of the archived content of the site. Or, the communication might be the full posting of product for sale as in the auctioneer's portal model. Another example of website visitors having a more engaging visit is their ability to configure product that they wish to purchase to suit their own requirements. Visitors are further engaged through the quality of the navigation provided by the website and by the general maturity of the eCommerce functionality. Interactivity is impacted by the nature and extent of the activities provided, and the competitive ability of the site to attract visitors also contributes to the visitors' engagement. Readers will be aware that the quality of some websites can be negatively impacted by the ability of visitors to leave and surf to competitor sites. So, the website is not simply a software artefact to be sold to a purchaser, it is now a strategic sales and marketing tool with significantly different quality requirements. In the context of the World Wide Web the term usability limits the user's experience. What needs to be addressed is engagibility, which is a step beyond usability (Fitzpatrick, Smith & O'Shea, 2004b). In the same way that usability is a significant issue of software quality, engagibility is a significant issue of website quality.

3.1 Engagibility and engagibility ratios

The characteristics of engagibility are Navigability, Interactivity and Appeal which are respectively defined as The ability of website visitors to access any part of the website or to link to other websites; Support for website visitors to engage in meaningful activity during a website visit; and An experience unique to the website – see **Figure 3**.

These characteristics are each further divided to identify their Quality-of-product and Quality-of-use ratios. ISO 9126 (2001) explains that good feedback from product use (Quality-of-use) will enhance product design and that enhanced product design (Quality-of-product) will improve product use. So, mindful of the requirements of ISO 9126 (2001) and conscious of the appropriateness of predictive and assessment measurement theory (Fenton 1994), both sets of ratios (product design and product use) have been identified such that this exchange of feedback and design applies. The full set of engagibility characteristics with their corresponding Quality-of-product and Quality-of-use ratios are set out in the taxonomy in **Figure 3**.

The focus of this study is Quality-of-product and is concerned with measuring each of the eight Quality-of-product ratios for a set of five eCommerce websites which form the study. For this study the five eCommerce websites selected were: Two budget airlines operating from Ireland into Europe; An online Irish china gift store; An Irish-based international florists; and An Irish telecoms provider. Due to the limits of the size of this paper it is not

possible to illustrate all eight of the Quality-of-product ratios, so, the Activities ratio (part of the Interactivity characteristic of engagibility) is presented as typical of the approach.

Characteristics of Engagibility	Quality-of-product ratios	Quality-of-use ratios
Navigability The ability of website visitors to access any part of the website or to link to other websites.	**Navigation ratio** The degree of a website's support for sitebound hyperlinking.	**Mining ratio** The degree that website visitors locate sitebound objects.
	Surf ratio The degree of a website's support for outbound hyperlinking.	**Excursion ratio** The degree that website visitors engage in linking to external websites.
Interactivity Support for website visitors to engage in meaningful activity during a website visit.	**Activities ratio** The degree that a website implements activity components.	**Interaction ratio** The degree that website visitors use the provided website activity components.
	Contribution ratio The degree that a website implements visitor contribution functionality.	**VCC ratio** (Visitor Contributed Content) The degree that website visitors use a website's visitor contribution functionality.
	Commerce ratio The degree that a website implements mature eCommerce functionality.	**Consumer Engagement ratio** The degree that website visitors engage in a website's eCommerce.
Appeal An experience unique to the website.	**Assistive ratio** (special needs) The degree that a website implements functionality to support special needs visitors.	**SNA ratio** (Special Needs Appeal) The degree that a website's special needs functionality is used.
	Community ratio The degree that a website implements functionality to support common interest visitors.	**SIA ratio** (Special Interest Appeal) The degree that a website's common interest functionality is used.
Copyright © 2004 Ronan Fitzpatrick	**Competitive ratio** The degree that a website supports a unique visitor perspective.	**CIA ratio** (Competitive & Innovative Appeal) The degree that a website's competitive and innovative functionality is used.

Figure 3: Taxonomy of Quality-of-product and Quality-of-use engagibility ratios

4 Metric Ratio Analysis ®™

Metric Ratio Analysis (MRA) is the approach that is being used in order to compare the website ratings. This involves the defining of a set of criteria that should be measured for each website. Once these criteria are defined it is then necessary to examine each of the eCommerce websites being analysed, and for each website, the metrics (or counts) for each of the criteria are established. These counts become values in a set of formula which calculate the Quality-of-product ratios listed in **Figure 3** and the results are analysed for the purpose of establishing individual website engagibility. The approach uses a similar model to that suggested by Kitchenham, Pfleeger & Fenton (1995). In their publication they explain a general approach to modelling measurement of any entity and its attributes by collecting values. Their approach applies to software in general but is not website specific. While MRA might be considered an extension of Kitchenham et al's theory, MRA is specific to websites. In this instance the entity is a website, the attributes are the criteria and a value is a count, and MRA adds further granularity by sub-dividing a website to include feature, quality factor, characteristic and ratio. Also, having determined counts for the criteria MRA has its own approach to creating a formula for calculating Individual ratio values. Like Kitchenham et al., MRA also deals with indirect values derived from simple equations, and MRA also guards against invalid indirect measures, e.g., division by 0.

4.1 Engagibility criteria

The study has identified a set of 66 criteria that are counted for each website. A selection is shown in **Figure 4**.

Typical website Quality-of-product engagibility criteria	
• Size of active website in KB. (html pages + images + other objects)	• Number of outbound links from Home page (including those in menus)
• Number of active html pages in website	• Total occurrences of outbound links in website
• Number of levels below Home page	• Number of pages containing outbound links
• Number of html pages at level 0 (Home page)	• Total occurrences of outbound links in horizontal menus
• Number of html pages at level 1	• Total occurrences of outbound links in vertical menus
• Number of html pages at level 2	
• Number of html pages at level 3	
• Number of html pages at level 4	
• Number of html pages at and below level 5.	
• Number of different horizontal menus in site	• Number of core activity components
• Total occurrences of horizontal menus in site	• Number of competitive activity components
• Number of different vertical menus in site	• Number of community activity components
• Total occurrence of vertical menus in site	• Number of innovative activity components
	• Number of content contribution activity components
• Number of sitebound links from Home page (including those in menus and links to Home)	
• Total occurrences of sitebound links in website	
• Number of pages containing sitebound links	
• Total occurrences of sitebound links in horizontal menus	• Occurrences of activity components accessed at level 0 (Home page)
• Total occurrences of sitebound links in vertical menus	• Occurrences of activity components accessed at level 1
• Total occurrences of links to Home	• Occurrences of activity components accessed at level 2
• Total occurrences of links to Top	• Occurrences of activity components accessed at level 3
	• Occurrences of activity components accessed at level 4
• Number of pages supporting site search engine	• Occurrences of activity components accessed at and below level 5

Figure 4: A selection of website Quality-of-product engagibility criteria. Copyright 2004 © Ronan Fitzpatrick

These criteria relate only to engagibility as identified as one of the additional quality factors for the WWW and they are also specific to Quality-of-product only – there are no criteria or counts associated with Quality-of-use (traffic and visitor statistics) included at this stage.

Only the highlighted criteria are used in the calculation of the Activities ratio. The remainder, together with those not listed in this figure are used in the calculation of the other seven ratios.

4.2 Determining the counts

Some of the criteria can be automatically counted using commercially available software. Others have to be manually counted at this time. In this case the results are equally as accurate as automatic measurement but manual measurement suffers from the disadvantage of being very time consuming. For the Activities ratio a total of 35 possible activities were identified during observational studies of a broad range of websites since the start of the research project. These were then counted for each website in order to determine counts for 13 criteria (shown highlighted). As part of this counting, the occurrences of these activities at each level of the website were documented and from these further indirect values were established.

4.3 Deriving ratio formula

An individual formula is necessary for calculating each of the eight Individual ratios. In this paper the Activities Ratio Formula is used. The research is conscious that, in software engineering, solutions of a similar nature often rely on three categories of formula. For example, Function Point Analysis uses the categories of simple, average and

complex while CoCoMo uses basic, intermediate and advance categories and organic, semi-detached and embedded project types (Pressman, 2000). In Metric ratio Analysis the formula used is classified as 'ordinary' and there is opportunity for studying enhanced and detailed alternatives. A requirement of the result is that as certain values in the formula change the calculated ratio should predictably change too. For example, as values in the formula increase the calculated ratio might predictably decrease. The formulae reflect this predictability.

4.4 Calculating ratio values

Having determined the counts as explained in Section 4.2 they are next combined to form four values which are used in the Activities Ratio Formula. The five website sets of four values are set out in **Table 1**.

Table 1: Summary of Activity ratio values – Copyright 2004 © Ronan Fitzpatrick

Activities ratio values

		Websites				
		a.	**b.**	**c.**	**d.**	**e.**
AOP	*1*	2620	309	98	448	861
Activities	*2*	10	7	4	5	4
Pages	*3*	118	96	104	89	130
Levels	*4*	5	2	4	2	3

In the left column of Table 1 ***Levels*** is a count of the number of levels below the Home page, ***Pages*** is a count of the number of active html pages in the Website and ***Activities*** is a count of the number of all activity components in the Website. The Activity Occurrences Product (***AOP***) is an indirect value derived from the distribution of the total occurrences of all possible 35 activities across all levels of the website. These are labelled *1, 2, 3* and *4*. The websites are represented by **a.**, **b.**, **c.**, **d.** and **e**. However, in this summary form these values provide no meaningful insight into the quality of the websites. So, the first step towards interpreting these figures is to evaluate them using acknowledged formula for similarity graphs (Johnsonbaugh, 2004) as explained and illustrated in **Table 2**.

Table 2: Website Activities similarity (*as*) – Copyright 2004 © Ronan Fitzpatrick

For each pair of Websites [v and w] $v = (p_1, p_2, p_3, p_4)$ and $w = (q_1, q_2, q_3, q_4)$ we set

$$as(v,w) = |p_1 - q_1| + |p_2 - q_2| + |p_3 - q_3| + |p_4 - q_4|$$

$as(a,b) = 2339$			
$as(a,c) = 2543$	$as(b,c) = 224$		
$as(a,d) = 2209$	$as(b,d) = 148$	$as(c,d) = 368$	
$as(a,e) = 1779$	$as(b,e) = 590$	$as(c,e) = 790$	$as(d,e) = 456$

A low value indicates website activity component similarity.

Using Johnsonbaugh's formula - $as(v,w) = |p_1-q_1|+|p_2-q_2|+|p_3-q_3|+|p_4-q_4|$ - website Activities similarity is calculated for all of the websites in the study. From these calculations it can be seen that companies **b.** and **d.** are the most similar. However, the calculations do not indicate whether this similarity is rich or poor, i.e., whether the sites indicate high engagibility through interactivity. Furthermore, the similarity values do not suggest a target value that a website owner might seek to achieve in order to insure improved Quality-of-product. The reader will realise that the values returned by the similarity formula are for pairs of websites, but these pairs may be combined into larger clusters called similarity classes. An individual value for each website is missing. The Activities Ratio Formula

addresses this by using the values already set out per **Table 1** and retuning an Individual ratio for each website. The set of ***Individual ratios*** as calculated using the Activities Ratio Formula is illustrated in **Table 3**. The ***Individual ratios*** are converted to a ***scale*** of ***0-100*** as illustrated. The Activities Ratio Formula is formulated by the research so that divergence from the target solution is in proportion to the numerical divergence.

Table 3 has three additional columns of values, Target, Average and 1-page Website. The column headed Average is included for completeness. The other two columns are used for the purpose of testing the Activities Ratio Formula and to obtain a target ratio for the upper limit.

The lower limit is a 1-page website which is considered to be a minimum (**m**.) or worst case example. In this case there are no activities, there are no levels below the Home page and the Activity Occurrences Product (AOP) has a value of zero. These values are illustrated at the right of **Table 3** in the column headed 1-page website. The Activities Ratio Formula calculates an Individual ratio at 1 for this lower limit website.

Table 3: Activities ratio table – Copyright 2004 © Ronan Fitzpatrick

Activities ratio								
			Websites					
	Target **t.**	Average	**a.**	**b.**	**c.**	**d.**	**e.**	1-page website **m.**
AOP	*2620*	*429*	2620	309	98	448	861	*0*
Activities	*35*	*6*	10	7	4	5	4	*0*
Pages	*100*	*107*	118	96	104	89	130	*1*
Levels	*3*	*3*	5	2	4	2	3	*0*
Individual ratio	234	7	40	9	1	10	8	1
Scale 0-100	100	3	17	4	0	4	4	0
A high value indicates potentially rich engagability through interactivity.								

For the upper limit, the research sets and accepts a 'given' target (**t.**) website with a page count of 100 for this study. In this case the maximum of 35 activities (the full set of activities identified as part of the criteria) would be included and it is considered that there would be three levels below the Home page in the target website. A value for the Activity Occurrences Product (AOP) is based on the maximum AOP value of the sites in this study. This represents a target to be achieved by the other website owners seeking to match their competitor's achievements. These values are illustrated at the left of **Table 3** in the column headed Target. The Activities Ratio Formula calculates a positive figure at 234 for this upper limit website. The research concludes that a high value returned by the Activities Ratio Formula indicates a potential for rich engagibility through interactivity.

4.5 Analysing and using results

The sites in this study return Activities ratios well below the target ratio which indicates that they do not support visitor interactivity as defined by this research and that there is opportunity for these website owners to obtain better return on their investments. This is the continuing focus of this research which is investigating the impact of the numeric values and how they can be used to characterise a website by benchmarking several sites against a 'typical' reference site.

The focus of this paper has been to suggest how the results can be used by website owners in order to compare their website with those of their competitors with a view to improving competitive advantage. The method might also be used by website estimators. In this case four of the websites might represent projects that they have previously completed and for which they have historical data relating to cost, effort and duration. The fifth website might

represent a project they are tendering for. Similarity and Metric Ratio Analysis calculations will support their cost, effort and duration estimating endeavours.

5 Discussion

This work is one part of a larger research project which aims to define an entire methodology for assessing the quality of websites. The work to date has defined an overall framework (The software Quality Star) and a set of quality attributes (Additional quality factors for the WWW) that can and should, in the authors' view, be measured for websites. Such measurement should be done to gain a better understanding of website design and in order to move toward better quality websites in the future. The work described in this paper has drilled down to two particular areas of measurement and has proposed metrics which can be used to quantify theses. It is important to emphasis that the work relates to the evaluation of the design structure of a website and is different to the quality-of-use perspective which evaluates user effectiveness, productivity, safety and satisfaction during website usage.

In this research, measurements have been achieved without reference to or support from any of the website owners in the study. All criteria have been counted from the online and publicly available websites in the study. So, using the same methods any website owner can repeat the process in order to compare their website with a competitor's.

In our paper Software Quality Challenges (Fitzpatrick, Smith & O'Shea, 2004a) we define quality as 'a measure of excellence' and using a Metric Ratio Analysis we have now illustrated an approach to how that excellence might be quantitatively measured for quality websites.

6 Conclusion

This paper explains that the term usability when used as a driver of quality websites is insufficient and that the term engagibility better reflects the perspectives of both website owners and website visitors. The paper clarifies how engagibility is a step beyond usability. The paper also explains that engagibility is interpreted, specified and measured differently depending on the perspective being considered. Eight pairs of Quality-of-product and Quality-of-use ratios are presented. Then, for the purpose of showing how engagibility might be specified and measured the paper reports part of a study of five eCommerce websites and explains how Metric Ratio Analysis can be used as a model for evaluating website Quality-of-product. There are eight engagibility ratios considered as part of the Quality-of-product study but due to space limitations only one of these is used to clarify the concept. The results are primarily appropriate to a website owner wishing to compare a website with competitor engagibility offerings. This evaluation model is also suitable to a benchmarking solution where Metric Ratio Analysis would support website statistical evaluation in an industry sector. The study contributes to our understanding of how quality websites can be designed and engineered in order to support website engagibility.

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