Chapter 2: Literature Review

2.0 Introduction

Identifying the requirement of what should be built is the hardest part of any design process. It is also what separates excellent web sites from the average ones. The methods chosen, and the time taken before a single line of code is written or a single concept design is applied, are the one that make difference. Thus is important to take into consideration expect of human computer interaction.

In the first part of the review of the literature, discussion will be done on the three major principles in relevant of web site design. The three principles are recognizing the diversity, the eight golden rules of interface design and preventing errors. The relevancies of the three issues are critical because the relationship between information systems and human behavior has been studied for several decades and the application of motivational theories to a constantly evolving technological context has many precedents (Shneiderman, 1998).

The discussion then concentrates on the paper by Olsina et al (1999). In this paper, a quantitative evaluation approach to assess the quality of sites called Web-site Quality Evaluation Method (QEM) is proposed. This prescriptive and descriptive approach might be useful to evaluate and compare quality characteristics and attributes in different phases of a Web product lifecycle. Particularly, in discussing this methodology, the level of accomplishment of required quality characteristics (like usability, functionality, reliability, efficiency, and derived sub characteristics) in six typical academic sites is evaluated. At the end of the evaluation process, a ranking for each selected site is obtained. Specifically, the evaluation process generates elemental, partial, and global indicators or quality preferences that can be easily analyzed, backward and forward traced, justified, and efficiently employed in decision-making activities. Hence, conclusions about the state-of-the-art of the quality in the operative phase of these sites can be drawn. In addition, recommendations for improvements can be given. The outcomes are indicators of the percentage of
fulfillment of stated quality requirements. Finally, concluding remarks and in-progress research is presented.

After studies on requirements are done, the literature review will concentrate on studying evaluation methods on websites. After consideration of relevancy, a model named 2QCV2Q model (Mich & Franch, 2002) i.e. a model of website design and evaluation is chosen. This model is based on the medieval treatise of Cicero, in particular the rhetorical principles of loci, which originally function to explain the rules of communication. The principle, although well known in the journalism studies, are not generally associated with the modern development cycles of website and software content. The evolution of this model came about after it had originally been developed as a market research tool using online questionnaires. According to Mich & Franch, (2002) proposed in their paper, a website evaluation model based on these principles can be developed statically.

The review will also concentrate in evaluating information, which concentrates on test of information quality. All issue regarding the quality of information will be discussed in detail before the information is published into the academic web sites. This includes issues such as information pre-evaluation, reliability, source evaluation and CARS (Credibility, Accuracy, Reasonableness, Support) checklist (Harris, 1997).

Next, the review will cover the issue of website usability assessment model. This model promotes customer satisfaction as an integral part of online business that promotes stakeholders satisfaction as an integral part of online application development. This usability assessment model is an outgrowth of our collaboration with industry in the pursuit of more effective online development efforts. From a global perspective, this issue is an exploratory phase. However, with the current expansion of online applications in the global market, this study can be useful.

The discussion continues on designing successful website in respect to commercial scenarios for the web. The segment will study the issue of academic website as an active model of marketing communications.
Finally, the literature review concentrates on discussing the importance of XML in academic web site and a brief overview on XML. XML is chosen after comparison has been done with other static and dynamic computer and markup languages.

### 2.1 Absorbing Human Computer Interaction Concepts in Building an Effective Web Sites

In designing an effective web page, the issue of human-computer interaction should not be put aside. Human computer interaction concepts can be divided into three major principles. These groups will be discussed independently throughout this section in relevancy of the stakeholders of academic web sites. The three principles are recognizing the diversity, the eight golden rules of interface design and the needs to minimizing errors (Shneiderman, 1998).

![Figure 2.1 HCI Considerations principles adopted from Shneiderman, (1998).](image)

### 2.1.1 Principle One: Recognize the Diversity

A good academic institution web site should be suitable for different kind of stakeholders. In this context, the academic audiences consist of students, staffs and external capitals. These are the targeted audiences of any academic web sites. However, according to Shackel (1990), every user comes from different kind of background such as education levels, age range and objectives. Therefore, before web site operators decide to start designing, they should start by characterizing users completely and precisely.
Studies have to be done to understand the users, the users’ tasks and thing they want to accomplish. This study includes understanding the potential users – population profiles that reflect age, gender, physical abilities, education level, cultural, ethnic background, training, motivation and personality (Hackos, & Redish, 1998).

According to Preece et al (1994) as a first step, the target group of the web site must be defined clearly. At this stage of the process, existing customer satisfaction such as observation, survey or interview is used. However, using these techniques, audience definition based on traditional market research may be insufficiently detailed to create a highly usable and competitive web site. Only a precise knowledge of user needs enables the development of web sites with high user value. To obtain this kind of information market data research can be extended by user surveys and log file analysis to find specific user patterns.

2.1.1.1 Group Academic Audiences

In education community, which is dynamic, the user attributes always change. There is a major need in trying to understand these changes. Web sites developer should avoid from thinking that the users know how the operators think. Every single visitor is treated accordingly by breaking them into the following groups (Dix et al, 1993).

1. Novice or first-time users
2. Knowledgeable intermittent user
3. Expert frequent users

2.1.1.1.1 Novice or first-time users

The members of this group are usually assumed to know a bit of the task or interface concept. Usually first-time users are professionals who know the task concepts, but have shallow knowledge of the interface concept. According to Neilson (2000) on novice users, about less that 10% of the web readers ever scroll beyond top of the page.
According to December and Randall (1995), novice users benefit from overview pages, hierarchical maps, and design graphics and icons that trigger memory about where information is stored within the website. A glossary of terms, acronyms, abbreviations, and a listing of frequently asked questions can be useful to novice users.

### 2.1.1.1.2 Knowledgeable intermittent user

There are many people who are knowledgeable but intermittent users of a variety of systems. They have stable task concepts and broad knowledge of interface concepts, but they will have difficulty retaining the structure of menus or the location of features. Most external capitals providers fall under this category.

### 2.1.1.1.3 Expert frequent users

These users demand rapid response times, brief and capacity to carry out actions with just a few keystrokes or selections. These users depend on the website to obtain information quickly and accurately. Expert users are very impatient with multiple low-density graphic menus that only offer two to six at a time. They also crave stripped-down, fast loading text menus. Graphical image may be confusing. They also have specific goals in mind, and will appreciate detailed text menus, site structure outlines, or a comprehensive site index that allows fast search and retrieval (December & Randall, 1995).

These characteristics of these three classes of usage must be refined for each environment. However, under normal circumstances, it is difficult to design a website for different kinds of users.

### 2.1.1.2 Identifying tasks and services

After defining the stakeholders of the website, the operators have to start identifying the tasks and services. Tasks and services analysis usually take time. The set of tasks
must be determined before design process starts, but too often the task analysis is
done informally or implicitly. This is a mistake that operators always do.

High-level task actions can be decomposed into multiple middle-level task actions
that can be further refined into atomic actions that the user executes with a single
command or menu selection. The relative task frequencies will be important in
shaping, for example, a set of commands or a menu tree. Frequently performed tasks
should be simple and quick to carry out, just like DELETE command (Johnson,

When the task and services analysis is complete and the task objects and action have
been identified, the developers may start from this primary interaction styles
(Shneiderman, 1998):

Menu selection – This method shortens users’ learning time, reduces keystrokes, also
permits user of dialog-management tools, and allows easy support of error handling.

1. Form filling – This method simplifies data entry, requires modest
training, gives convenient assistance, and permits use of form-
management tools.

2. Command language – This method is designed for frequent users. It
provides a strong feeling of locus of control and initiative. Users learn
the syntax and can often express complex possibilities rapidly, without
having to read distracting prompts.

3. Natural language – This method hopes that computer will respond
properly to arbitrary natural-language sentences or phrases engage
many researchers and system developers, in spite of limited success
thus far. It usually provides little context for issuing the next
command, frequently requires clarification dialog, and may be slower
and more cumbersome than the alternatives.

4. Direct manipulation – An operator may choose to create a visual
representation of the world of action, the users’ tasks can be greatly
simplified because direct manipulation of familiar objects is possible, it
allows easy learning of the system, and errors also can be avoided, and affords high subjective satisfaction.

Blending several interaction styles may be appropriate when the required tasks and users are diverse. Commands can lead the user to a form filling where data entry is required, or menus can be used to control a direct-manipulation environment when a suitable visualization of actions cannot be found.

![Figure 2.2: Principle 1: Recognize the Diversity adopted from (Shneiderman, 1998)](image)

Generate requirements

Generate requirements

Generate requirements

**Figure 2.2: Principle 1: Recognize the Diversity adopted from (Shneiderman, 1998)**
2.1.2 Principle 2: Use the Eight Golden Rules of Interface Design

The underlying principles of design are applicable in most interactive systems as illustrated in figure 2.3 below. These underlying principles of interface design, derived heuristically from experience, should be validated and refined.

1. Strive for consistency
2. Enable frequent users to use shortcuts
3. Offer information feedback
4. Design dialogs to yield closure
5. Offer error prevention and simple error handling
6. Permit easy reversal of action
7. Support internal locus of control
8. Reduce short-term memory load

*Figure 2.3: Principle 2: 8 Golden Rules of Interface Design adopted from* (Shneiderman, 1992)

2.1.2.1 Strive for consistency

There are many forms of consistency. Consistent sequences of actions should be required in similar situation; identical terminology should be used in prompts, menus, and help screens; and consistent color, layout, capitalization, and fonts. This rule is the most frequently violated. In designing web site, a page should use the ‘same’ template throughout the navigation. In this context, navigation can be done easily without creating any sense of confusion. As example, the university banner should be the same banner from page-page in order to avoid confusion.
2.1.2.2 Enable frequent users to use shortcuts

Frequent knowledgeable users appreciate abbreviation, special keys, hidden commands, and macro facilities. Short response times and fast display rate are other attractions for frequent users. Even though shortcuts are encourageable, web site should reduce on using graphical presentation. By using fewer graphic, it will improve the response time. However, in order to cater frequent knowledgeable and novice users, it is advisable for web site developer to concentrate on the later one i.e. with the usage of micro-content. Micro content is a simple textual user presentation interface.

2.1.2.3 Offer information feedback

For every user action, there should be a system feedback. For frequent and minor actions, the response can be modest, whereas for infrequent and major actions, the response should be more substantial. Interactive forms should be designed to handle exception handling or wrong inputs by the user.

2.1.2.4 Design dialogs to yield closure

Sequences of action should be organized into groups with a beginning, middle, and end. The informative feedback at the completion of a group of actions gives operators the satisfaction of accomplishment, a sense of relief, the signal to drop contingency plans and options from their minds, and an indication that the way is clear to prepare for the next group of actions.

2.1.2.5 Offer error prevention and simple error handling

Web site should be designed such that to minimize any serious errors by users. For example, prefer menu selection to form filling and do not allow alphabetic characters in numeric entry fields. If users make an error, the web site can detect the error and offer simply instructions for recovery. Erroneous actions should leave the state unchanged, or the web site should give instructions about restoring the state.
2.1.2.6 Permit easy reversal of action

An action should be reversible. This feature relieves anxiety, since the user knows that errors can be undone, thus encouraging exploration of unfamiliar option, such as entry of a name and address block.

2.1.2.7 Support internal locus of control

Experienced operators strongly desire the sense that they are in charge of the web site and that the web site responds to their actions. Surprising web site actions, tedious sequences of data entries, inability or difficulty in obtaining necessary information, and inability to produce the action desired can lead to anxiety and dissatisfaction.

2.1.2.8 Reduce short-term memory load

The limitation of human information processing in short-term memory requires that displays be kept simple, multiple page displays be consolidated, window-motion frequency be reduced, and sufficient training time be allotted for codes, mnemonics, and sequences of actions.

These underlying principles must be interpreted, refined, and extended for each environment. The principles presented in the ensuing sections focus on increasing the productivity of users.

2.1.3 Principle 3: Prevent Errors

According to Shneiderman (1992) there are three techniques that can be used to reduce errors in an academic web site as stated below:

1. Correct matching pairs
   A common problem is the lack of correct matching pairs. It has many manipulations and several simple prevention strategies. For example the failure to provide the right parenthesis to close an open left
parenthesis. A matching pair of markers is necessary for operation to be complete and correct. The omission of the closing marker can be prevented by use of an editor, preferably screen oriented that puts both the beginning and ending components of the pair on the screen in one action.

2. Complete sequences
An action requires several steps or commands to reach completion. Since users may forget to complete every step of an action, web site developer attempt to offer a sequence of steps as a single action. For example, many users frequently execute the sequence of dialing up, setting communication parameters, logging on, and loading files. Users of a word processor should be able to indicate that section titles are issuing a series of commands each time they enter a section title. User should be allowed to define sequences of their own; the macro or subroutines concept should be available at every level of usage. Web site developer can gather information about potential complete sequences by studying sequences of commands that users actually issue, and the patterns of errors that user actually make.

3. Correct commands
Web site should include automatic command completion that allows users to type just a few letters of meaningful command. A more effective prevention method for errors is to apply direct-manipulation strategies that emphasize selection over command-language typing. The computer presents permissible commands, menu choice, or file names on the screen, and the users select their choice with a pointing device. This approach is effective if the screen has ample space, the display rate is rapid and the pointing device is fast and accurate.
2.2 Quality Characteristics and Attributes for Academic Web Sites

Olsina et al (1999) discussed about what an academic institution web site should have. One of the main views presented in this study is that the modern era of information systems, in particular web-based systems having given rise to increasingly sophisticated web sites that cater to the needs of a wide range of users. However, in order to achieve their full functionality, many of these web sites de-evolve into a confusing mess of links and text.

The study identifies attributes that might be used in the evaluation of quality websites, primarily in the creation of a quality requirement tree figure 2.4. A model named Quality Evaluation Method is also used, along with the Logic Scoring of Preference approach to aggregate and evaluate the attributes and characteristics presented in the study. Additionally, an integrated tool called SiteSweeper was used to measure attributes such as broken links, image title, and static page size. It should be noted that this paper focuses primarily on the evaluation of a website at the operational phase of its lifecycle, but also can be adapted to other stages of the traditional developmental lifecycle.

The Quality Evaluation Method entails the completion of several steps in order to arrive at a working model for assessment, they are; the selection of an evaluation and/or comparison domain, the determination of assessment goals and user standpoint, the definition of quality requirement, the definition of evaluation criterion for each attribute, the aggregation of elementary attributes to produce a global quality preference and finally the analyses and assessment of partial and global quality preferences. In this study, the authors selected 6 international academic websites throughout the four continents. They also focused on the three main types of stakeholders to these websites; namely prospective students, academic sponsors and research sponsors. Furthermore the outline requirement tree presented within was created based on IEEE and ISO/IEC standards for software quality metrics and guidelines.
Olsina et al (1999) outlined over 120 quality characteristics and attributes for the evaluation of website quality. These seemingly disparate criteria are then ordered and grouped into a requirement tree by selecting those elements that might be grouped into one of the four main high level characteristics previously decided upon;

1. Usability
2. Functionality
3. Reliability
4. Efficiency

Therefore, the individual elements are grouped into single or multiple levels of sub-characteristics, which then make up the four high level characteristics. By doing so, the authors hope that a comprehensive conceptual view of all the primary elements that a quality website is composed of can be created. For the selection of these attributes, the authors primarily looked at the perspective of the current or prospective user for this paper, giving emphasis to features that would be of importance to this segment such as enrollment information, course listings, housing and healthcare information, etc, etc.

Some attributes in the quality requirements tree do not appear in all cases, such as the image map and student-oriented guided tours features, and as such the evaluation for these attributes categorized as ‘non-existent’. Other attributes may have more than one incarnation, for example the ‘Guestbook’ may also be a ‘Comments’ or ‘Questionnaire’ section, which is all valid and acceptable. Also, those attributes which are seemingly too general are continually broken down into more specific sub-attributes to enable an evaluation. The Logical Scoring of Preference model (Dujmovic, 1996) used in assessing the websites is interpreted as a continuous logic variable. The value 0 denotes that X does not satisfy the requirements, and the value 1 denotes a perfect satisfaction of requirements. The values between 0 and 1 denote a partial satisfaction of requirements. Consequently, all preferences are frequently interpreted as a percentage of satisfied requirements, and defined in the range [0,100%].
To facilitate the understanding of the evaluation procedure, the authors have enclosed samples of attribute definitions, in which the title(name), code high level characteristic and super characteristic of each attribute is listed. This is followed by a definition or general comments regarding the nature of the attribute itself(such as other possible incarnations, exclusions, etc). Other information such as data collection type and examples are also provided.

The Quality Characteristics and Attributes for Academic Web Sites model as shown in figure 2.4 allows the comparison of various websites using predefined and concrete attributes that can be backed up. As all of the attributes are designed to fit within four distinguishable primary high level characteristics, it is possible to customize the model depending on specific user requirements or target audience, where elements such as maintenance would not be of importance to the user’s standpoint and newsgroups would not be highly important to the manager’s view.

1. Usability
   1.1 Global Site Understandability
      1.1.1 Global Organization Scheme
         1.1.1.1 Site Map
         1.1.1.2 Table of Content
         1.1.1.3 Alphabetical Index
      1.1.2 Quality of Labeling System
      1.1.3 Student-oriented Guided Tour
      1.1.4 Image Map (Campus/Buildings)
   1.2 Online Feedback and Help Feature
      1.2.1 Quality of Help Features
         1.2.1.1 Student-oriented Explanatory Help
         1.2.1.2 Search Help
      1.2.2 Website Last Update Indicator
         1.2.2.1 Global
         1.2.2.2 Scoped (per sub-site or page)
   1.2.3 Address Directory
      1.2.3.1 E-mail Directory
      1.2.3.2 Phone-Fax Directory
      1.2.3.3 Post Mail Directory
1.2.4 FAQ Feature
1.2.5 Online Feedback
   1.2.5.1 Questionnaire Feature
   1.2.5.2 Guestbook
   1.2.5.3 Comments
1.3 Interface and Aesthetic Features
   1.3.1 Cohesiveness by Grouping Main Control Objects
   1.3.2 Presentation Permanence and Stability of Main Controls
      1.3.2.1 Direct Controls Permanence
      1.3.2.2 Indirect Controls Permanence
      1.3.2.3 Stability
   1.3.3 Style Issues
      1.3.3.1 Link Color Style Uniformity
      1.3.3.2 Global Style Uniformity
      1.3.3.3 Global Style Guide
   1.3.4 Aesthetic Preferences
1.4 Miscellaneous Features
   1.4.1 Foreign Language Support
   1.4.2 What’s New Feature
   1.4.3 Screen Resolution Indicator

2. Functionality
2.1 Searching and Retrieving Issues
   2.1.1 Scoped Search
      2.1.1.1 People Search
      2.1.1.2 Course Search
      2.1.1.3 Academic Unit Search
      2.1.1.4 Global Search
   2.1.2 Retrieve Mechanisms
      2.1.2.1 Level of Retrieving Customization
      2.1.2.2 Level of Retrieving Feedback
2.2 Navigation and Browsing Items
   2.2.1 Navigability
      2.2.1.1 Orientation
         2.2.1.1.1 Indicator of Path
         2.2.1.1.2 Label of Current Position
   2.2.2 Navigational Control Objects
      2.2.2.1 Presentation Permanence and Stability of Contextual (sub-site) Controls
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2.2.2.1 Contextual Controls Permanence
2.2.2.1.2 Contextual Controls Stability

2.2.2.2 Level of Scrolling
2.2.2.2.1 Vertical Scrolling
2.2.2.2.2 Horizontal Scrolling

2.2.3 Navigational Prediction
2.2.3.1 Link Title (link with explanatory help)
2.2.3.2 Quality of Link Phase

2.3 Student-oriented Domain-related Features

2.3.1 Content Relevancy
2.3.1.1 Academic Unit Information
2.3.1.1.1 Academic Unit Index
2.3.1.1.2 Academic Unit Sub-sites
2.3.1.2 Enrollment Information
2.3.1.2.1 Entry Requirement Information
2.3.1.3.1 Degree Index
2.3.1.3.2 Degree Description
2.3.1.3.3 Degree Plan/ Course Offering
2.3.1.3.4 Course Description
2.3.1.3.4.1 Comments
2.3.1.3.4.2 Syllabus
2.3.1.3.4.3 Scheduling

2.3.1.4 Student Services Information
2.3.1.4.1 Services Index
2.3.1.4.2 Healthcare Information
2.3.1.4.3 Scholarship Information
2.3.1.4.4 Housing Information
2.3.1.4.5 Cultural/Sport Information

2.3.1.5 Academic Infrastructure Information
2.3.1.5.1 Library Information
2.3.1.5.2 Laboratory Information
2.3.1.5.3 Research Results Information

2.3.2 Online Services
2.3.2.1 Grade/Fees online Information
2.3.2.2 Web Service
2.3.2.3 FTP Service
2.3.2.4 News Group Service
### 3. Site Reliability

#### 3.1 No deficiency

##### 3.1.1 Link Errors

- 3.1.1.1 Broken Links
- 3.1.1.2 Invalid Links
- 3.1.1.3 Unimplemented Links

##### 3.1.2 Miscellaneous Errors or Drawbacks

- 3.1.2.1 Deficiencies or absent features due to different browsers
- 3.1.2.2 Deficiencies or unexpected results independent of browsers
- 3.1.2.3 Dead-end Web Nodes
- 3.1.2.4 Destination Nodes (unexpectedly) under construction

### 4. Efficiency

#### 4.1 Performance

- 4.1.1 Static Page Size

#### 4.2 Accessibility

- 4.2.1 Information Accessibility
  - 4.2.1.1 Support for text-only version
  - 4.2.1.2 Readability by deactivating Browser Image Feature
    - 4.2.1.2.1 Image Title
    - 4.2.1.2.2 Global Readability
- 4.2.2 Window Accessibility
  - 4.2.2.1 Number of pages regarding frames
  - 4.2.2.2 Non-frame version

*Figure 2.4: Quality Characteristics and Attributes Requirement Tree for Academic Websites* cite from (Olsina et al., 1999).

#### 2.3 2QCV2Q: A model for website design and evaluation

The model 2QCV2Q (Mich & Franch, 2002) is a statistical evaluation model to evaluate a website. Given its flexibility, this model will be used as the model to evaluate performance of Malaysian academic institutional web site in chapter three.

This model is based on the medieval treatise of Cicero, in particular the rhetorical principles of loci, which are namely quis(who), quid(what), cur(why), ubi(where), quad(when) and qoumodo(how), which originally function to explain the rules of...
communication. These six principles, although well known, are not generally associated with the modern development cycles of website and software content. The evolution of this model came about after it had originally been developed as a market research tool using online questionnaires. However, as proposed in Mich & Franch (2002), a website evaluation model based on these principles can be developed.

In this model, the view of quality is not limited to the end product, but also takes into account the process of creating the product itself. The authors of this paper emphasize that the finished product must be not only technologically competent, but also meet the requirements and ideals of the owners and end users, especially as, in their view, the completeness of the site takes into account various criteria which must be determined and understood in a case by case basis, and not merely the functionality of the website. The features that must be evaluated in a website according to this evaluation model encompass both the technical (ease of access, navigation, compatibility with various browsers, etc.) and the functions offered by the site, which must be judged based on the context and audience the website was intended for.

Several major considerations in developing the 2QCV2Q evaluation model are put forward in the study. Firstly, that the quality of a website can by judged by both the product(ends) itself and the process of arriving at the product(means). This is validated by stating that a complete approach must include both the traditional developmental lifecycle and also the unique characteristics of web-based content and information systems (interactivity, high-speed access, dynamic links, etc, etc.). A closer participation of end users is made possible by employing a development prototyping method. According to the study the personnel involved in the development of websites possess differing skills where their differing job backgrounds could cause some inadequacies to occur in the finished product.

On the basis of all those observations, the authors expound that a website evaluation and design model must be general in order to be applied to various types of sites, domain independent, and the use of the model itself must not depend on highly specialized expertise. The 2QCV2Q model consists of 6 primary section according to Mich & Franch (2000, p. 586-589). They are as follows;
1. **Quis(who) – Identity**
   This part of the model deals with the personification of a website, where elements like a strong brand identity and corporate image are important and must be reiterated to the user. The ability of the site to personalize itself to its target audience are also emphasized, for example, by offering language and text-character support options.

2. **Quid(what) – Content**
   Content covers aspects such as the validity and accuracy of information found on the website, and also the reliability of the information itself. The availability of links that connect users to useful information.

3. **Cur(why) – Services**
   This element examines the functions available to both the owner and the users of a website, as well as the security and privacy of the services provided.

4. **Ubi(where) – Location**
   This covers both the reach and interactivity of a site. It covers issues such as how easy it is to find a site by performing a search, what communication options are available to users. As example mailing addresses, telephone/fax numbers, mailing lists, chat rooms, membership plans

5. **Quando(when) – Management**
   The management of the website in general, in particular aspects such as the continual update of information, latest revision of the site, the detection and correction of broken links and maintenance of the site to ensure it stays up-to-date and compatible in its technology and tools.
6. Quomodo(how) – Usability

All aspects concerned with the ease of use of the site, such as the hardware and software requirements, online help facilities available, use of icons and color coding, options for people with disabilities.

In order to apply the 2QCV2Q model, first the model must be customized to take into account the specific requirements and goals of the user and owner. This is relevant for distinguishing the different objectives of sites which offer e-commerce to those which offer academic advice or recreational information. In order to achieve this to maximum effect, the authors suggest consultations with the organization directly, as well as interacting with actual users. Then, after the attributes that are relevant to the particular case are determined, the suitable weights are assigned to each attribute.

The next stage is the actual evaluation itself where each attribute identified is assigned a score of 0 to 4 (0 = nonexistent, 1 = poor, 2 = adequate, 3 = good, 4 = excellent). The tabulation of these attributes and scores would present a representation of the sites fulfillment of the requirements and objectives intended. Based on the results for each attribute, it is possible to provide a graphical representation of the website using the 7 major elements of the 2QCV2Q model. However, this model is open-ended at best and does not specify concrete techniques for evaluating websites and leaves much to the interpretation of the reader.

The next section discusses some of the quantitative statistical evaluation methodologies available followed by a section on overview of graphical representation of statistical evaluation data.

**2.3.1 Statistical Evaluation Methodology**

This section discusses various quantitative methods that can be used for evaluation together with 2QCV2Q model. Quantitative methods use a numeric scoring system. Quantitative methods that can be used for evaluation purpose are, band method, desirability ration method and assigned point method. In paper by Mich & Franch (2002) the evaluation method used is the band method.
All evaluation method mentioned above basically involves the following general processes (Alberta Infrastructure 1999):

1. Establishing essential and desirable criteria. – Before criteria or attributes are evaluated, the criteria should be defined and prioritized. Weighting factors are used to give more weight to the more important criteria and less weight to the less important criteria.

2. Weighting each criterion - In the quantitative method a numerical value is assigned to each desirable criterion to represent its relative importance.

3. Scoring each criterion. - In the quantitative method each criterion is scored using a numerical value from a predetermined scale.

4. Evaluating the results – Depends on the method used.

<table>
<thead>
<tr>
<th>Method</th>
<th>Method description</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Band Method</td>
<td>• The band method is based on a band ranging from very acceptable (positive value) to totally unacceptable (negative value). In the middle of the band is the median range of acceptability (0 values).</td>
<td>• Scoring method is intrinsically meaningful without further interpretation. • Allows evaluators flexibility to exercise their judgment</td>
<td>• Weighting system, if used, reduces the advantages provided by the scoring system unless values are readjusted to fit within the band. • Scoring range is very narrow.</td>
</tr>
<tr>
<td>Desirability Ratio Method</td>
<td>• Vertically linear scoring system where the</td>
<td>• A finer, more precise score can</td>
<td>• System may promote a level</td>
</tr>
</tbody>
</table>
candidates with higher numerical scores are deemed to be progressively better qualified.

- The weighting factor for each criterion is applied using a desirability ratio formula.

be applied. Points can be awarded in one point increments rather than the effective three, five, or ten point increments which result from weighting the scores after the fact.

of scoring that is more precise than is practical or desirable.

- System does not have a built-in benchmark of acceptability. Evaluators will have to define an arbitrary pass fail point.

<table>
<thead>
<tr>
<th>Assigned Point Method</th>
<th>A vertically linear scoring system where the candidates with higher numerical scores are deemed to be progressively better qualified.</th>
<th>Easiest for evaluators to score if candidates have provided all information.</th>
<th>Leaves little room for evaluator to exercise judgment.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Point values are assigned to a range of possible answers for each criterion prior to commencing the evaluation.</td>
<td></td>
<td>Scores can become distorted if questions and assigned points are not very well set out.</td>
</tr>
<tr>
<td></td>
<td>Scoring is usually done on a zero to five points system.</td>
<td></td>
<td>System should be tested for unintentional bias before use.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No benchmark or level of acceptability. The evaluators will have to establish a cut off level of acceptability.</td>
</tr>
</tbody>
</table>
2.3.2 Spider Chart

Based on the results for each attribute gathered from statistical evaluation method, a graphical representation of the website using the 7 major elements of the 2QCV2Q model is generated. The graphical representation used by the 2QCV2Q model is the spider chart. Spider chart provides a better representation of statistical data in graphical form. Strength and weaknesses based on the attributes selected identified and compared easily. Furthermore representation of data in this manner allows differences between academic web sites more evident.

2.4 Test of information quality

Information has becoming a key role for every aspect of life. Most web sites are information distribution oriented. Information exists in large quantities and continuously being created and revised. This information exists in a large variety of kinds. As example, facts, opinions, stories, interpretations, and statistics and is created for many purposes (to inform, to persuade, to sell, to present a viewpoint, and to create or change an attitude or belief). For each of these various kinds and purposes, information exists on many levels of quality or reliability.

Harris (1995) suggested a model to evaluate information. In the context of the research, information needed to published by any universities need to be varied for accuracy, reliability, etc. The steps given below are the steps need to be taken in evaluating information. The steps are.

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</tr>
<tr>
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<td>Author's Credentials</td>
</tr>
<tr>
<td>3.3.1.2</td>
<td>Evidence of Quality Control</td>
</tr>
</tbody>
</table>
3.3.1.3. Meta-information

3.3.1.4. Indicators of Lack of Credibility
   3.3.1.4.1. Anonymity
   3.3.1.4.2. Lack of quality control
   3.3.1.4.3. Negative Meta-information
   3.3.1.4.4. Bad grammar or misspelled word

3.3.2. Accuracy
   3.3.2.1. Timeliness
   3.3.2.2. Comprehensiveness
   3.3.2.3. Audience and Purpose
   3.3.2.4. Indicators of a Lack of Accuracy
      3.3.2.4.1. No date on the document
      3.3.2.4.2. Vague or sweeping generalizations
      3.3.2.4.3. Old date on information known to change rapidly
      3.3.2.4.4. Very one sided view that does not acknowledge opposing views or respond to them

3.3.3. Reasonableness
   3.3.3.1. Fairness
   3.3.3.2. Objectivity
   3.3.3.3. Moderateness
   3.3.3.4. Consistency
   3.3.3.5. World View
   3.3.3.6. Indicators of a Lack of Reasonableness
      3.3.3.6.1. Intemperate tone or language ("stupid jerks," "shrill cries of my extremist opponents")
      3.3.3.6.2. Over claims ("Thousands of children are murdered every day in the United States.")
      3.3.3.6.3. Sweeping statements of excessive significance ("This is the most important idea ever conceived!")
      3.3.3.5.4. Conflict of Interest ("Welcome to the Old Stogie Tobacco Company Home Page. To read our report, 'Cigarettes Make You Live Longer,' click here." or "The products our competitors make are dangerous and bad for your health.")

3.3.4. Support
   3.3.4.1. Source Documentation or Bibliography
   3.3.4.2. Corroboration
   3.3.4.3. External Consistency
   3.3.4.4. Indicators of a Lack of Support
      3.3.4.4.1 Numbers or statistics presented without and identified source
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3.3.4.4.2 Absence of source documentation when the discussion clearly needs such documentation
3.3.4.4.3 You cannot find any other sources that present the same information or acknowledge that the same information exists (lack of corroboration)

4. Linking with information (Café)
   4.1 Challenge
   4.2 Adapt
   4.3 Files
   4.4 Evaluate

Figure 2.5: Information Testing Model adopted from (Harris, 1995)

2.4.1 Pre-evaluation

The first stage of evaluating sources takes place before searching. Some of the elements that need to be pre-evaluated are facts, opinions, reasoned arguments, statistics, narratives, eyewitness reports, descriptions. Once decision is done on particular sources, website operator will be able to screen sources much more quickly by testing them against the research goal. For example, when a researcher is writing a research paper, and if he or she is looking for both facts and well-argued opinions to support or challenge a position, he or she will know which sources can be quickly passed by and which deserve a second look, simply by asking whether each source appears to offer facts and well-argued opinions, or just unsupported claims.

2.4.2 Select sources likely to be reliable

Reliable sources are sources that are likely to be fair, objective, lacking hidden motives and showing quality control. It is important to keep these considerations in mind. By thinking about these issues while searching, operator will be able to identify suspicious or questionable sources more readily. With so many sources to choose from in a typical search, there is no reason to settle for unreliable material.
2.4.3 Evaluating information

The process of evaluating information is vital. Once the information has passed the two stages stated earlier, the information is going to be evaluated. It can be divided into three major groups.

2.4.3.1 Reliable Information is Power

The first group is to understand that reliable information is important. Information serves as the basis for beliefs, decisions, choices, and understanding. Wrong judgement in making decision may result a defeat.

2.4.3.2 Source Evaluation is an Art

The second group handles with understanding that the source evaluation is an art. Source evaluation may be defined as the determination of information quality. That is, there is no single perfect indicator of reliability, truthfulness, or value. Instead, decision maker have to make an inference from a collection of clues or indicators, based on the use the decision maker plan to make of the source. For example, what a decision maker needs is a reasoned argument, then a source with a clear, well-argued position can stand on its own, without the need for a prestigious author to support it.

2.4.3.3 The CARS Checklist

The CARS Checklist is designed for ease of learning and use. Few sources will meet every criterion in the list, and even those that do may not possess the highest level of quality possible. If an operator decides to use this checklist, they will be much more likely to separate the high quality information from the poor quality information.

The CARS checklist according to article published by McGraw-Hill Companies (2004), consist of four major elements;
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1. **Credibility**
   People have always made important decisions based on information, evidence of authenticity and reliability or credibility, believability – has always been important.

2. **Accuracy**
   The source of the information should show some evidence of being knowledgeable, reliable, and truthful.

3. **Reasonableness**
   The test of reasonableness involves examining the information for fairness, objectivity, moderateness, and consistency.

4. **Support**
   The area of support is concerned with the source and corroboration of the information. Much information, especially statistics and claims of fact, comes from other sources. Citing sources strengthens the credibility of the information.

2.5 **Usability assessment model**

Although many organizations have succeeded in developing online applications, numerous of others have failed. Many of the failures resulted from lack of vision by not taking Web usability into account. In the paper by Becker & Mottay (2002), stated that approximately 70 percent of retailers lack a clearly articulated e-commerce strategy and considered their site as testing the waters for online demand.

Many Internet analysts correctly predicted that a significant number of business-to-customer sites would fail during the year 2000 due to a lack of customer retention and repeat sales. Webmerges estimated that 150 dot-coms failed during 2000 and more will follow in the next year. Those sites that continue to succeed have and will expand significant resources modifying their sites to improve customer satisfaction (Weisman, 2000).
2.5.1 Usability assessment model

In simple terms, web usability is allowing user to manipulate the site’s features to accomplish particular goals. Targeted customer assesses usability for simplicity, understandability, and ease of use. The perception of usability is influenced by user characteristics, such as gender, age, educational level, and technical skills. Usability perceptions are also affected by cultural differences associated with for example, design layout, use of color and animation, and information content. The model states that there is few factors need to be considered in developing effective web site (Powell, 2000).

2.5.1.1 Page Layout

Page layout is the visual presentation of the web page by means of background color, white space, horizontal and vertical scrolling. Font size and color, and other design elements. The layout affects ease of use and quick identification of page components. Layout can be influenced by cultural differences in usability, such as the significance of a particular color, use of graphics, or textual organization.

2.5.1.2 Navigation

Navigation is the navigational schema in terms of breadth and depth of search paths and traversal mechanisms. Simplicity is promoted through the effective use of links, frames, button, and text. Navigational considerations, from a global perspective, include ready access to other country sites from a web site or via a navigational schema on each page.

2.5.1.3 Design consistency

Design consistency is the consistent location of page components within and across pages. Various components requiring consistency include textual descriptions, labels, prompts and messages. Consistency in color is required for links, background, and
text, among others. Design consistency promotes ease of use by applying a common look and feel to each page, in a particular site or across global sites.

As example, Yahoo! Homepages are consistent in every single page regardless of the geographical location. Every intermediate user knows that the page belongs to Yahoo! Every time they visit the website.

### 2.5.1.4 Information content

Information content includes time and correct error messages, prompts, button, labels, textual descriptions, help, and customer service information. From a global perspective, information translated from one language to another should be grammatically correct, and appropriate cultural differences.

### 2.5.1.5 Performance

Performance is measured according to customer wait and system response times. Currently, there is significant global disparity in terms of modem speed and personal access to the Internet.

### 2.5.1.6 Customer service

Customer service is an additional information and support mechanisms that are readily available from the organization to enhance the shopping experience. This includes e-mail addresses, phone numbers and maybe an interactive chat room.

### 2.5.1.7 Reliability

Reliability is defined in terms of sites crashes, downtime, error messages, and consistent response time. A common usability problem related to reliability results when SQL, java Script, and other cryptic error boxes are displayed to the user.
2.5.1.8 Security

Security is concerned with privacy and limited access to personal information. For example, the security misuse and authorizes distribution of credit card numbers, addresses, phone numbers, income and other personal data.

2.5.1.9 Other usability components.

Other usability components includes a user profile of the targeted customer base and customer’s computing environment which is important in ensuring that modem speed, browser type, and screen size are taken into account during assessment process. A usability assessment also considers other environmental issues. Moreover, the user profile and environment data might need to be localized based on a particular country’s or region’s characteristics.

The usability assessment model also includes the organization’s strategic goals to ensure that these are weighted during usability decision-making. Typically, strategic goals require a balance of financial, customer, business processes and internal earning perspectives. Strategic goals will dictate whether cultural sensitivity or cultural insensitivity take priority in the development of online applications.

2.6 Determining performance of web site application – technical view.

Following are elements from technical point of view that is deemed necessary in determining the performance of web site (Morris, 2004).

2.6.1 Busy Background.

The best background for an academic web site is using black or white. A background image is not very suitable. For an analogy do books and magazines have background images? It is important in the context of academic web site for people to read the material instead of being distracted (and slowed down) by cute graphics.
If a background image could not be avoided, it should be extremely light, so it does not obscure the text in front. A test should be carried on every single page to make sure it doesn't interfere with the text.

2.6.2 Busy Graphic in General.

Graphics should only be used when they really add something necessary to the presentation. It should be simple and their file sizes small. Plain HTML text for things like headings and navigation bar should be used instead of graphics. This is because text has several other advantages: It loads faster, is visible to people who surf with images off (and to disabled surfers), and is far easier to change. This is a very important trait especially in academic web site as academic web sites emphasizes on content and too many graphics may not only distract visitors to the web site but also increases the download time.

2.6.3 The Linear Look.

In the early days of the Web, pages were laid out in a straight line. Images, paragraphs of text, headings - all came one after another in a vertical line down the page. Long pages were the order of the day, where the visitor has to scroll down a screen or two just to see what was on a page.

In order to solve this problem, table feature can be used. Tables are one of the most important design elements in HTML. Columns make pages easier to read, and allow much more information to be presented at one time, so they are used on most academic sites nowadays, as one of the most important features of an academic web site is organizations of information.

2.6.4 The “Under Construction” Sign

Web surfers have short attention spans, and very few have the slightest interest in anything that's "coming soon." The number of Web surfers who have ever returned to a link where they found a "coming soon" is probably on the order of one in ten
trillion. Furthermore it reduces the creditability of an academic web site. For this is better to mention upcoming site features in body copy, but not to have a link to a section that does not yet exist. Some search engines like Google will refuse to list sites that contain "under construction" links.

2.6.5 Endorsement of Particular Endorsement

Professional Web sites should be designed to look acceptable in all major browsers. Even if a visitor has the same browser as the environment the web site being developed, they may have a different screen resolution, different browser preferences, or simply a different window size.

2.6.6 Not Understanding Your Target Market.

If the site is devoted to art, thumbnail graphics is a better choice to display the pages. It is important to make sure that the site is not only text, this is simply because the users are visual. Similarly if the audience is the academic community, it is crucial to have textual information that is organized in an easy to find format rather than graphical information. It is also necessary to have complete information about the school information such as the courses are offered and the fees. As a conclusion it is important to know the target market for the message to be conveyed clearly.

2.6.7 Infrequently Asked Questions in FAQ

Too many web sites have FAQ’s those list questions the company wished users would ask. FAQs have a simplistic information design that does not scale well. They must be reserved for frequently asked questions, since that's the only thing that makes a FAQ a useful web site feature. Infrequently asked questions undermine users' trust in the web site and damage their understanding of its navigation.
2.6.8 Inflexible Search Engines

Overly literal search engines reduce usability in that they're unable to handle typos, plurals, hyphens, and other variants of the query terms. Such search engines are particularly difficult for elderly users.

A related problem is when search engines prioritize results purely on the basis of how many query terms they contain, rather than on each document importance. Much better if your search engine calls out "best bets (In google.com is I’m feeling lucky")" at the top of the list, especially for important queries, such as the names of your products (Jakob Nielsen, 2002).

2.7 Importance of Separating Content and Layout in an Academic Web Site

The Internet grew from an academic network to a distributed library connecting millions of users worldwide. The use of relatively easy protocols and languages like HTML (Hypertext Markup Language) provided for this growth. Academic institutions who have discovered the Internet as a medium to efficiently reach the academic community as well as students find that maintaining the information using plain HTML pages requires a lot of resources.

HTML is easy to use for data representation, and this can be clearly seen that most of the academic portal in Malaysia is encoded using HTML. However the possibilities in creating structure for data is limited using HTML. As far as academic portal is concern the structure of data is very important rather than formatting. It is also necessary that data in academic portal can be searched, retrieved and managed easily. Furthermore data that is not structured enough makes it less efficient to find the right information.

Meanwhile in HTML, the introduction of meta-information, primarily keywords included in the HTML headers, only help through looking at the titles of sites that one can vaguely classify into useful information, and the ultimate decision can only be
taken by actually visiting the site and browsing through it (Graham, 1995). Therefore, new and more efficient ways to convey information accurately is needed that is trough XML.

**XML** (eXtensible Markup Language) is one of these evolutionary languages. It allows separating formatting and structuring of data through the use of DTD, so the formatting can be changed without having to alter the structure and vice versa. XML is about structuring data through use of markup, without adding rendition-oriented markup to the data (T. Decruyenaere 1999). This feature is deemed necessary for the academic community for ease of maintenance. This is because the academic data need to be updated frequently to ensure its quality. Furthermore according to Zhang et al. (2000) by separating the structure and formatting, results in less error in maintenance of data and increases integrity and quality of data. Integrity and quality is one important expect determining credibility of an academic web site. XML is also easy to learn and thus any changes or maintenance to data need not depend on the web administrator, for authorized academician that understands the data can do the changes to maintain quality and integrity. Thus the web administrator needs only to concentrate on formatting of the web site. As mentioned above search and retrieval on data structured using XML is more accurate and efficient.

In conclusion separation of structural and presentational aspects allows reducing costs in serving a wide range of platforms and media (text, paper, projector...). Easy change of the looks of a document (for example, when academic style changes). Documents or data can be reused for different media and increase efficiency in information search and retrieval.

### 2.7.1 Extensible Markup Language (XML)

This part presents brief introduction to XML (eXtensible Markup Language). XML is a simplified subset of SGML that maintains the SGML features of validation, structure, and extensibility. Like SGML, XML is a metalanguage for describing the markup of different types of documents; however, XML's standardized text format was designed specifically for transmitting structured data to Web applications. In
addition, XML's goals of being easier to learn, use, and implement than full SGML will make it easier for users to define and validate document types, to author and manage SGML-defined documents, and to transmit and share them across the Web.

The XML specification describes XML documents, a class of data objects stored on computers, and partially describes the behavior of XML processor programs used to read such documents and provide access to their content and structure. XML documents are composed of entities, which are storage units containing text and/or binary data. Text is composed of character streams that form both the document character data and the document markup. Markup describes the document's storage layout and logical structure. A well-formed XML document is unambiguous, so that a browser or editor can read the tags and create a tree of the hierarchical structure without having to read its Document Type Definition (DTD).

XML provides a standard way for information providers to add custom markup to information-rich documents, so that complex documents can be rendered (and published) in a dynamic way. The simplicity of HTML significantly constrains how users can represent and use documents and databases. XML provides the means to publish and receive any information, regardless of format or origin, in any way desired (McGrath, 1998).

Below is a sample of xml document:

An example of an XML document:

```xml
<?xml version="1.0"?>
<Person ID="BeLef">
  <Name>Lefever</Name>
  <First_Name>Bert</First_Name>
  <Address>
    <Type_Address>Work</Type_Address>
    <Street>Grote Steenweg</Street>
    <Number>15</Number>
    <Postal_Code>9840</Postal_Code>
  </Address>
</Person>
```
2.8 Summary

In designing an effective academic web site one should take into consideration aspect of human computer interactions. It is also important to measure effectiveness of an academic web site using a proven model. Finally emphasis on academic web site should be given to the content to ensure the validity and accurateness. Thus is necessary to separate the content and design aspect of an academic web site.