Chapter 3

Web Quality Models

Chapter Objective

In this chapter the existing web quality models were critically analyzed to understand the evolution of models. This is performed with a view to identify the limitations and to categorize the web quality factors. The categorized web quality factors are utilized to develop a web quality system.

3.1 Introduction

A quality model essentially consists of a set of criteria used to determine if a website reaches certain levels of quality. Websites have a huge variation in quality due to certain limitations of applicability of the existing quality models and its contemporary relevance. A web development team can understand, control and improve the web development process for better website using appropriate quality model. Web quality model can enable development and maintenance processes to consistently achieve higher quality standards based on standardized data acquisition and measurement methods.

A portal is also a website which presents information from diverse sources in a unified way. A portal is a web presence that consolidates a variety of information and services for example, searching, news, e-mail, discussion groups, and e-commerce having cross-platform usability, distributed access, management, and security of information and services(Ma et al., 2006). The aim of Web portals is to select, organize, and distribute content (information, or other services and products) in order to satisfy its users/customers (Domingues et al., 2006).

In general, quality models should consider criteria that satisfy the needs of the developers, maintainers, buyers, and end users (ISO/IEC, 2001). Quality models can be split into two different types, general quality models, which can be adopted as-is and specify what has to be measured and how (Brajnik, 2001), and specific models. Specific models, which are only valid for a concrete context, can stem from a generic model that has been tailored for such concrete context.

Most of the web quality models have a root in ISO 9126 model which was presented basically for softwares.
3.2 ISO 9126 Model (2001)

Working Group 6 (WG 6) of Subcommittee 7 (Software and Systems Engineering Standardization) under Joint Technical Committee 1 (JTC1) of the International Organization for Standardization and the International Electrotechnical Commission is developing standards and technical reports for software product evaluation and metrics. WG 6 has developed ISO/IEC 9126-1 (quality model), 9126-2 (external metrics), 9126-3 (internal metrics), and 9126-4 (quality in use metrics). WG 6 has also developed the ISO/IEC 14598 series of technical reports, which provide guidance for evaluating software product quality on the basis of ISO/IEC 9126.

JTC1 publishes six types of documents. Each type follows all or part of the following development stages: preliminary, proposal, preparatory, committee, approval, and publication. ISO/IEC 9126-1 is the international standard and 9126-2, 9126-3, and 9126-4 are technical reports.

![ISO 9126 Model](image)

Figure 3.1 ISO 9126 Model
The quality characteristics and underlying sub characteristics are shown in figure 3.1. The model specifies six characteristics including Functionality, Reliability, Usability, Efficiency, Maintainability and Portability; which are further divided into 21 sub characteristics. Though ISO model was not intended for website quality, the metrics defined bore remarkable resemblance to metrics required for website quality model.

3.3 Quint2 Model (Niessink, 2002)

The Quint2 model, modified version of Quint model is an extension of ISO 9126 model, but sparsely used. Figure 3.2 shows the Quint2 model which adds 11 sub characteristics to the 21 of ISO 9126 model. Availability and Degradability sub characteristics were added to Reliability; Traceability was added to Functionality; Explicitness, Customisability, Attractivity, Clarity, Helpfulness and User-friendliness were added to Usability; while Manageability and Reusability were added to Maintainability.
3.4 Model by Ramler et al. (2002)
Ramler et al. (2002) introduced the three dimensions quality, features, and phases – together, the result of which can be visualized as a three-dimensional cube like in Figure 3.3, since each of the three dimensions represents a discrete and finite aspect. Quality has a limited amount of aspects, the system has a limited amount of features, and the lifecycle usually has a limited amount of phases. The cube describes a generic scheme to organize tests for quality aspects of web applications. The node at the intersection point of a certain quality, feature, and phase represents a test within this scheme.

![Figure 3.3 Model by Ramler et al. (2002)](image)

The tests themselves are nodes inside this cube, residing at the intersection points of quality aspects, features, and phases. Thus, the question of how a certain quality aspect corresponding to a certain feature is ensured in a certain phase leads to a clearly defined point within this three-dimensional cube.

3.5 Model by Mich et al. (2003)
Mich et al. (2003) presented 2QCV3Q model for evaluation of website quality from both owner and user viewpoints. The 2QCV3Q model takes its name from the initials of the Ciceronian Loci as shown in Table 3.1.
To account for specific site purposes, 2QCV3Q permits a multistakeholder approach that considers the viewpoints of all involved: the site’s sponsor (usually the owner), its users, and those involved in its design and implementation. This becomes crucial when we consider that people involved in site development—graphic artists, marketing staff, webmasters, software engineers, and so on—have different skills and therefore different priorities and attitudes.

Table 3.1 The 2QCV3Q model

<table>
<thead>
<tr>
<th>Ciceronian Loci</th>
<th>Attributes</th>
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<tbody>
<tr>
<td><strong>Quis</strong></td>
<td><strong>Identification</strong></td>
</tr>
<tr>
<td>(Persona: Who?)</td>
<td><strong>Identification</strong></td>
</tr>
<tr>
<td><em>Identity</em></td>
<td>Brand (organization or company); charisma (individual)</td>
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<tr>
<td></td>
<td>Image</td>
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<td></td>
<td><strong>Characterization</strong></td>
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<td></td>
<td>Design</td>
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<td></td>
<td>Personalization</td>
</tr>
<tr>
<td><strong>Quid</strong></td>
<td><strong>Coverage</strong></td>
</tr>
<tr>
<td>(Factum: What?)</td>
<td><strong>Coverage</strong></td>
</tr>
<tr>
<td><em>Content</em></td>
<td>Domain referred to owner’s and users’ goals</td>
</tr>
<tr>
<td></td>
<td>Value of information and links</td>
</tr>
<tr>
<td></td>
<td><strong>Accuracy</strong></td>
</tr>
<tr>
<td></td>
<td>Quality of information</td>
</tr>
<tr>
<td></td>
<td>Source(s), author(s)</td>
</tr>
<tr>
<td><strong>Cur</strong></td>
<td><strong>Functionalities</strong></td>
</tr>
<tr>
<td>(Causa: Why?)</td>
<td><strong>Functionalities</strong></td>
</tr>
<tr>
<td><em>Services</em></td>
<td>Adequacy to owner’s goals</td>
</tr>
<tr>
<td></td>
<td>Adequacy to users’ goals</td>
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<td></td>
<td><strong>Control</strong></td>
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<tr>
<td></td>
<td>Correctness</td>
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<td></td>
<td>Security, ethics, and privacy</td>
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<tr>
<td><strong>Ubi</strong></td>
<td><strong>Reachability</strong></td>
</tr>
<tr>
<td>(in Latin V stands for U)</td>
<td><strong>Reachability</strong></td>
</tr>
<tr>
<td>(Locus: Where?)</td>
<td>Intuitive URL</td>
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<tr>
<td><em>Location</em></td>
<td>Retrieval</td>
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<td></td>
<td>Contact information</td>
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<td></td>
<td>Community building</td>
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<tr>
<td>Quando</td>
<td>Currentness</td>
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<td>--------------</td>
<td>----------------------------------</td>
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<tr>
<td>(Quando: When?)</td>
<td>Updates and revisions</td>
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<tr>
<td>Management</td>
<td>Dates</td>
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<td></td>
<td>Maintenance</td>
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<td>Check-up</td>
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<td>Tools</td>
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<td>Quomodo</td>
<td>Accessibility</td>
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<tr>
<td>(Modus: How?)</td>
<td>Hardware and software requirements</td>
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<td>Usability</td>
<td>People with disabilities</td>
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<td>Navigability</td>
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<td>Structure, orientation</td>
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<td>Download times</td>
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<td>Understandability</td>
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<td>Languages</td>
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<td>Level of terminology</td>
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<td>Quibus Auxiliis</td>
<td>Resources</td>
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<td>(Facultas: With what means and devices?)</td>
<td>Financial and human resources</td>
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<tr>
<td>Feasibility</td>
<td>Time</td>
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<td></td>
<td>Information and Communication Technology</td>
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<td></td>
<td>Hardware (computer, networks)</td>
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<td></td>
<td>Software (implementation, integration)</td>
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</tbody>
</table>

### 3.6 Model by Ruiz et al. (2003)

Ruiz et al. (2003) utilized the concept of three dimensional model presented by Ramler et al. (2002) and developed web quality model as shown in Figure 3.4. The dimension ‘Phases’ was duly replaced by ‘Lifecycle Processes’.

The three dimensions and their factors proposed by the model are:

**Quality characteristics:** Factors represented by this dimension are Functionality, Reliability, Usability, Efficiency, Portability and Maintainability.

**Features:** Factors represented by this dimension are Functions, Content and Infrastructure & Environment.

**Lifecycle Processes:** Factors represented by this dimension are Development, Exploitation and Maintenance.
DeLone and McLean (2003) presented an update of their IS Success Model (Figure 3.5) which was earlier presented in 1992 (DeLone and McLean, 1992). DeLone and McLean discussed the utility of the updated model for measuring e-commerce system success.

“System quality” in the Internet environment, measures the desired characteristics of an e-commerce system. Usability, availability, reliability, adaptability, and response time (e.g., download time) are examples of qualities that are valued by users of an e-commerce system.
“Information quality” captures the e-commerce content issue. Web content should be personalized, complete, relevant, easy to understand, and secure if prospective buyers or suppliers are expect to initiate transactions via the Internet and return to site on a regular basis.

“Service quality”, the overall support delivered by the service provider, applies regardless of whether this support is delivered by the IS department, a new organizational unit, or outsourced to an Internet service provider (ISP). Its importance can be gauged from the fact that users are also prospective customers and poor user support will translate into lost customers and lost sales.

“Usage” measures everything from a visit to a website, to navigation within the site, to information retrieval, to execution of a transaction.

“User satisfaction” remains an important means of measuring customers’ opinions of an e-commerce system and should cover the entire customer experience cycle from information retrieval through purchase, payment, receipt, and service.

“Net benefits” are the most important success measures as they capture the balance of positive and negative impacts of the e-commerce on the customers, suppliers, employees, organizations, markets, industries, economies, and even societies. “Net benefits” measures must be determined by context and objectives for each e-commerce investment. “Net benefits” success measures are most important, but they cannot be analyzed and understood without “system quality” and “information quality” measurements.

3.8 Model by Malak et al. (2004)

Malak et al. (2004) presented 3-dimensional model (Figure 3.6) influenced by the models presented by Ramler et al. (2002) and Ruiz et al. (2003). Noticeable difference in this model was the absence of features dimension duly replaced by application domain. The model was constructed on GQM (Goals, Questions, and Metrics) paradigm supporting a top-down approach for defining the goals behind measuring software processes and products.
3.9 Model by Moraga et al. (2004)

In Moraga et al. (2004) a model for portals, namely PQM (Portal Quality Model) is proposed. This model has been made using as a basis the SERVQUAL model, presented by Parasuraman et al. (1998) and the GQM (Goal Question Metric) method (Basili et al., 1994).

The different dimensions of the SERVQUAL model have been adapted to the portal context and some of them are split up into subdimensions, in order to create a quality model for web portals. The dimensions identified for the PQM model are shown in Figure 3.7 and discussed below.

- **Tangible:** Characteristic of the portal that indicates whether it contains all the software and hardware infrastructures needed, according to its functionality. The subcharacteristics are:
  - Adaptability: Ability of the portal to be adapted to different devices (for instance PDA’s, PCs, mobile phones, etc.).
  - Transparent access: Ability of the portal to provide access to the resources, while at the same time isolating the user from their complexity.

- **Reliability:** Ability of the portal to perform its functionality accurately. In addition, this characteristic will be affected by:
  - Fault Tolerance: Capability of the portal to maintain a specified level of performance in the event of software faults (e.g., a fault during the sending of information or the execution of a job).
Resource utilization: Capability of the portal to offer its resources to the user according to his profile or particular role or privileges.

Availability: Capability of the portal to be always operative, so that users may be able to access it and use it anywhere, anytime.

Search Quality: Appropriateness of the results that the portal provides when undertaking a search/request made by the user.

- Responsiveness: Willingness of the portal to help and provide its functionality in an immediate form to the users. In this characteristic, the subcharacteristics are:
  - Scalability: Ability of the portal to adapt smoothly to increasing workloads which come about as the result of additional users, an increase in traffic volume, or the execution of more complex transactions.
  - Speed: Ability of the portal to remain within the response time boundaries tolerated by portal users.

- Empathy: Ability of the portal to provide caring and individual attention. This dimension has the following subcharacteristics:
  - Navigation: Simplicity and intuitiveness of the navigation paths provided by the portal.
  - Presentation: Clarity and uniformity of the interface.
  - Integration: Degree of global portal coherence achieved after the inclusion of the components that make up the portal. All the components of the portal must be integrated in a coherent form.
  - Personalization: The portal’s capability to adapt to the user’s priorities.

- Data quality (DQ): This characteristic is defined as the quality of the data contained in the portal. It has four subcharacteristics:
  - Intrinsic DQ: Degree of care taken in the creation and preparation of information.
  - Representation DQ: Degree of care taken in the presentation and organization of information for users.
  - Accessibility DQ: Degree of freedom that users have to use data, define or refine the manner in which information is input, processed or presented to them.
  - Contextual DQ: Degree to which the information provided meets the needs of the users.

- Security: Capability of the portal to prevent, reduce, and respond to malicious
attacks adequately. Its subcharacteristics are:

- **Access control**: Capability of the portal to allow access to its resources only to authorized people. Thus, the portal must be able to identify, authenticate, and authorize its users.
- **Security control**: Capability of the portal to carry out auditing of security and to detect attacks. The auditing of security shows the degree to which security personnel are enabled to audit the status and use of security mechanisms by analyzing security-related events. In addition, attack detection seeks to detect, record, and notify attempted attacks as well as successful attacks.
- **Confidentiality**: Ability to guard the privacy of the users.
- **Integrity**: Capability of the portal to protect components (of data, hardware, and software) from intentional or unauthorized modifications.

**Figure 3.7 Model by Moraga et al. (2004)**

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**3.10 Model by Yang et al. (2004)**

The objective of Yang et al. (2004) is to develop and validate an instrument to measure user-perceived overall service quality of IP Web portals (Information Presenting Web portal). This information is useful for researchers and for portal managers. The authors adopt the Technology Adoption Model (TAM) and consider that an IP web portal is an information system. For these reasons, the following conceptual foundations are taken into account (Figure 3.8):

- **Information Quality (IQ)**: Web-based information is defined as “users’ perception of the quality of information presented on a website.” Under this point, the dimensions are classified into:
• Usefulness of content: Value, reliability, currency, and accuracy of information.

• Adequacy of information: Extent of completeness of information.

• System Quality (SQ): This refers to customers’ perception of a website’s performance in information retrieval and delivery. Factors are categorized into four dimensions:

  • Usability: This is related to user friendliness. Here, various factors have been identified: content layout and classification, Website structure, user interface, Website appearance and visual design, intuitiveness, readability/comprehension/clarity, search facilities, and ease of navigation.

  • Accessibility: Customers expect the Web-based services to be available at all times and they also desire speedy log-on access, search, and web page download. This dimension involves two aspects: availability and responsiveness.

  • Privacy/Security: Some frequently used measures are: to include vendor guarantees of protection of personal information, confidence resulting from promises on the site, and the reputation of the organization.

  • Interaction: Although using an IP Web portal is primarily a self-served process, users may still expect to receive personalized or customized services from a knowledgeable, responsive, and caring contact person.

![Proposed Quality Dimensions Diagram](image)

Figure 3.8 Model by Yang et al. (2004)

Sampson and Manouselis (2004) present an evaluation framework for addressing the multiple dimensions of web portals that can affect user satisfaction. As a first step, the authors defined several dimensions related to the main satisfaction factors:

- **Web portal content:** The dimensions were:
  - Satisfaction from content organization: This aspect refers to the categorization of information so as to enable efficient search and retrieval.
  - Satisfaction from content creditability: This aspect refers to the trust and reliability of the information and the content provider and has multiple facets, such as the accuracy and clarity of the content and the trustworthiness, recognition and reputation of the content author or provider.
  - Satisfaction from content usefulness: This aspect concerns the focus of the content, the use of appropriate language, and the usefulness of information according to the needs of the audience to whom it is directed.
  - Satisfaction from content integration: This aspect concerns all content services related with the integration of external sources of information and the provision of links to external resources.

- **Design of a web portal:**
  - Satisfaction from information architecture: It is closely related to the organization of content. In this context, however, it is approached rather from the system design perspective, and it can therefore be considered independent.
  - Satisfaction from usability: Addresses all issues related to the interaction and navigation of the user in the portal.
  - Satisfaction from graphical design: The Web portal design should be subject to periodical revisions and redesigns from time to time, with the minimum possible effect to the portal operation.
  - Satisfaction from technical integrity/ performance: The dimension concerned with proper operation of the Web portal services and the satisfactory performance of the overall services.

- **Personalization:**
  - Satisfaction from the personalization of navigation: All issues related to the adjustment of the navigation mechanism and functions to the needs of individual users.
Satisfaction from the personalization of information/content: All issues related to notifying users about new relevant content and providing them with information tailored to their needs and preferences.

Satisfaction from the personalization of interface: All issues related to the adaptation of the interface to the needs and preferences of the users and the properties of their equipment.

Community support: With the following dimensions:

- Satisfaction from the communication support: It refers to tools and services related to the communication between the members of a virtual community.
- Satisfaction from the collaboration support: Related to the tools and services allowing effective and efficient collaboration between users.

In Figure 3.9, the evaluation framework proposed by Sampson and Manouselis (2004) is summarized.

![Evaluation Framework](image)

**Figure 3.9 Model by Sampson and Manouselis (2004)**

### 3.12 Model by Calero et al. (2005)

Calero et al. (2005) modified the model presented by Ruiz et al. (2003). The concept of three-dimensional model was kept as such while modifying the underlying factors and metrics (Figure 3.10).

The three dimensions are Quality Characteristics, Web Features and Lifecycle Processes.
Quality Characteristics: This dimension consisted of six factors viz. functionality, reliability, usability, efficiency, portability and maintainability.

Web Features: This dimension consisted of three factors viz. content, presentation and navigation.

Lifecycle Processes: This dimension consisted of five factors viz. development, operation, maintenance, effort and reuse.

The number of web quality metrics enlisted in the research paper was 385.

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Figure 3.10 Model by Calero et al. (2005)


Abramowicz et al. (2007) presented Web Services Quality Model based on ISO/IEC Software product Quality Requirements and Evaluation (SQuaRE) model. Model consists of three perspectives: Internal Web Service Quality, External Web Service Quality and Web Service Quality in Use as shown in Figure 3.11.

Justifying this approach, authors point out that Web Services similarly to software are intangible objects purposed to be used by automata or other applications, having real impact on End User Experience, and overall quality delivered.
3.14 Model by Caro et al. (2008)

Caro et al. (2008) presented data quality model for web portal. The model proposes a set of 33 attributes which are relevant for portal data quality as shown in Figure 3.12.
Caro et al. (2008) also conducted case study to show the validity of Data Quality attributes within a concrete domain of web portals (the bank portal domain), thus demonstrating that the set of DQ attributes is correct and complete. Authors have argued that proposed set of attributes could be an important step towards achieving a DQ model for web portals, as they can be used in the definition of a quality assessment process.

### 3.15 Model by Olsina et al. (2009)

Olsina et al. (2009) presented web quality model for web 2.0 by extending ISO 9126-1 quality model. The model added Content quality besides existing six quality characteristics as shown in Figure 3.13.

![Figure 3.13 Model by Olsina et al. (2009)](image-url)
3.16 Limitations in Existing Models

Major revolution in web quality model started with the work of Quint2 model which extended ISO 9126 model (2001) for software quality, wherein the software quality was essentially divided into three major dimensions as extrinsic, intrinsic and ease of use. This model was insufficient to present an overall web quality system due to lack of following:

a) Lifecycle Processes were not considered.
b) Website Features which is the foremost thing a user interacts with and decides the quality of a website, was missing.
c) Emotional and similar attributes were not considered.


Noticeable difference in Malak et al. (2004) model was the absence of features dimension and cognition factors. Portal Quality Model presented by Morega et al. (2004) was based on the SERVQUAL model, presented by Parasuraman et al. (1998) and the GQM (Goal Question Metric) method (Basili et al., 1994). The model lacked the attributes of lifecycle processes. Model by Yang et al. (2004) lacked lifecycle processes attributes and cognition factors. Model by Sampson and Manouselis (2004) concentrated only on attributes of Web portals that can affect user satisfaction.

Model by Calero et al. (2005) may be considered as the best three dimensional model presented which enlisted 385 factors. Yet this model lacked cognition factors.

SQuaRE based Web Services Quality Model presented by Abramowicz et al. (2007) discussed about web quality in service only. It lacked the lifecycle processes and cognition factors.

Caro et al. (2008) presented data quality model for web portal. This model focussed on the quality of data presented rather than an overall web quality model.

Olsina et al. (2009) presented web quality model for web 2.0 by extending ISO 9126-1 quality model to include content quality as seventh quality characteristic.

As we can see that web quality models presented till date lacked one or other important dimension. Something was lacking in the presented models necessitating the requirement of a new web quality model complete with critical factors.
3.17 Concluding Remarks

Various authors presented web quality models at different point of time reflecting stages of development in conceptual framework of web quality.

The pace of development of web technologies has provided users with a platform wherein they are in close relationship with the websites matching their interests. Rather users develop a rapport with website as an integral part of their life. Such a scenario is created in the mind of users on the basis of certain reasoning and perception of website. These criteria is now important from quality point of view as perception and reasoning of a website will trigger kind of a chain reaction among users to accept and suggest it to their near and dear ones. The factors identified in the previous chapter of Literature Review may now be further analysed for the purpose of development of new web quality model as shown in next chapter of Research Methodology.