CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter deals with the related works and the topics associated with software quality evaluation methodology and their associated factors. The studies regarding the research topic were associated with many of the ongoing project and the prevailing techniques for selecting quality indicators. The chapter details about the quality models associated with evaluation of software quality, about quality criteria’s involved, the utility of MCDM methods to select the proper quality indicators and also about the web application quality evaluation methods and finally the context of the research.

2.2 QUALITY MODELS

Nimish Kumar et al. (2015) establishes a comparative analysis of various quality models that were proposed by the latest researchers. Quality models like ISO / IEC 9126, Quint2, Ramler, 2QC3Q, Ruiz, D&M IS Success, Malak, PQM, Yang, Sampson and Manouselis, Calero, SQaRE, Caro, Olsina and OO Quality Model for Web Applications (OQMw) were taken for the comparative analysis. The important finding of the comparative analysis is that most of the quality models were an altered version of the ISO / IEC model. It is also found that the analyzed quality models have a limited set of quality characteristics associated with the web application. Here, the basic
idea of adapting to ISO / IEC model to build the proposed quality model was identified.

Anusha (2014) commenced a relative study on various quality models under the evaluation perspective of usability of the web site. It analyses the various characteristics utilized by these models and also deals with quality evaluation frameworks. The analysis has identified the limitation that the prevailing quality evaluation methods are dependent on the domain to which the website was associated. Also the success of the evaluation method depends on the construction of the quality characteristic tree by an experienced quality evaluator. The other notable limitation is its non adherence to the growing new technologies. The limitation of this research was taken in accord and a set of five quality evaluators with various experience and domain is used to select a set quality criteria for quality evaluation.

José P.Miguel & Rodriguez (2014) research focus on various quality models and also deals with their strength and weakness. The study focuses on two limits the models before 2000 as basic models and those after 2000 as tailored quality models. It is identified that the tailored quality models are dependent on the basic quality model and to be specific the ISO / IEC model. The tailored quality models are developed as per the end user requirement or the domain of the application and particularly the component based software development. The limitation identified here is that either the basic model or the tailored model adheres to the specific application and have a limited set of quality characteristics. The integration of these quality models may improvise the quality evaluation process.

Suman & Rohtak (2014) extended a detailed research on various quality model used by various organizations. Various quality models were
identified and analyzed for the available set of quality characteristics and sub characteristics. Advantage of each quality model was identified. The base model used by most of the quality models is the ISO / IEC quality model. Reliability, Efficiency, Functionality, Maintainability, Portability, Usability are the few important criteria spotted in most of the quality models.

Deepshikha Jamwal (2010) has made an extensive study of various software quality models and has compared the quality models for their similarities and key differences. Five quality models, namely McCall’s, Boehm’s, Dromey, FURPS and ISO 9126 Quality Model were analyzed here. The analysis of these quality model states that reliability is the only quality characteristics that is available in all the frequently used quality models. The study also infers that the ISO / IEC quality model is the most useful one.

Yiannis Kanellopoulos et al. (2010) have proposed a software quality evaluation methodology based on the static behavior of the software system using ISO / IEC 9126. The source code attributes of the software are associated with the internal quality attributes of the ISO / IEC 9126 quality model. The quality attributes are ranked by the quality experts and based on the values the source code attributes are assigned weights. Four quality characteristics of ISO / IEC 9126 quality model, namely functionality, efficiency, maintainability, portability and their corresponding sub characteristics are employed to evaluate the static behavior of the source code of the software. The quality attributes weights are evaluated by using the AHP method. It could be understood that the ISO / IEC 9126 quality model is efficient enough to handle both internal and external quality of the software.

Oreste Signore (2005) proposed the formulation of quality model by the identification of internal and external quality characteristics using the automated tools. The quality evaluation is proposed by initially checking the
source code using the tool and then followed by manual evaluation. Presentation, Correctness, Navigation, Interaction and Content are the five characteristics that were used to build the quality model. The characteristics are selected based on the user's perspective and help in the maintenance of the web application. Tool based evaluation gives more concentration towards the usability of the application.

Rafa E. Al-Qutaish (2009) has made a detailed study on ISO / IEC 9126 Quality model and ISO 12207 Software Life Cycle Processes and activities (SLCP) to identify the relation between them. The relation between quality factors, namely internal characteristics, external characteristics, quality in use and various software life cycle process have been studied. Certain sets of difficulties are identified in the ISO quality models. The models lacked the availability of quality indicators to be measured in the Organizational Processes. Most of the quality indicators focus on the Software Life Cycle Processes and not on the different activities of the organizational processes.

Syahrul Fahmy et al. (2012) have performed a study on determining the quality of the e – Book software. The ISO / IEC 9126 quality model was used for the quality evaluation. Functionality, Reliability, Usability, Efficiency and Portability are the five quality characteristics used for the evaluation of the e-Book software. The e - book software was evaluated for the presence of quality characteristic, but did not consider things to be done to enhance the quality of the e - book software.

Ambreen Nazir et al. (2013) established a review regarding the identification of quality attributes under the user perspective. A theoretical web quality model was created to evaluate quality in web2.0 application. Around 13 key features of web2.0 applications were covered using 7 quality
dimensions, namely system quality, service quality, content quality, effort, acceptability, performance, and code quality. For each of the quality dimensions quality attributes were associated and also its corresponding metrics were associated. The construction of the quality model was purely based on the links and references made by the author. The process of attainment measurement of the quality under a different perspective is done here.

Nor Fazlina Iryani Abdul Hamid & Mohamad Khatim Hasan (2013) have devised a software quality model for the telecommunication industry based on the three important dimensions namely the economic dimension, social dimension and technical dimension. The quality attributes associated with the telecommunication industry are collected and consolidated based on the survey conducted amid the stakeholders and calculating the quality index rating. Completeness, Flexibility, Functionality, Testability and Usability are the five important quality characteristics that were used in the building of quality model. The developed quality model was generalized for the telecommunication system alone.

Laxmi Shanker Maurya & Gauri Shankar (2012) have extended an immense effort in creating a maintainability model based on the Oman and Hagemeister maintainability model (OHMM). 92 quality attributes influence the maintainability of the software and falls under three important attribute, namely management, operational environment and target software system. The quality model focuses on the Target software system which has more concern for the maintainability. The metrics were associated with the structural size of the web application and structural complexity of the web application. By the application of this quality model, it could be noted that the web application is maintained based on complexity, coupling, data and size. The quality evaluation is more dependent on the maintainability aspect of the
quality attributes of the software. Other quality aspects were not considered for the quality evaluation.

Anil Kumar Malviya & Laxmi Shanker Maurya (2012) have proposed a basic quality model for maintainability of web based application and its assessment were done using studies conducted over 3 researches. The first work was based on four design attributes, namely Complexity, Coupling, Reusability and Size and the second work was extended towards object oriented metrics namely Response for Classes (RFC), Lack of Cohesion in Methods (LCOM), Data Abstraction Coupling (DAC) and Line of Code (LOC). The last study focuses on the structure of navigation. Only maintainability is considered as the most important attribute to access the quality of the web based applications.

Nabil & Hefny (2011) has addressed a set quality factor and have categorized them for the Web Based Application (WBA). The ISO 9126 quality model addresses the quality attributes that helps in the software quality evaluation, but holds a weakness of addressing the quality requirements of web application. The conceptual quality model for WBA is built in reference to ISO 9126 and few other quality models. The conceptual quality model is built under the perspectives of developers, owners and visitors. WBA Quality Model (WBAQM) is built based on the bottom up approach. Based on the different perspectives obtained, the WBAQM associates the quality factors of the WBA with the characteristics and sub characteristics of the ISO 9126 to build a new model. Certain new quality factors that are not available in the ISO 9126 and other models are identified by using this methodology.

Karzan Wakil & Dayang N.A. Jawawi (2014) conducted a comparison study on the metamodels generated from the methodologies
namely Object Oriented Hypermedia (OOH), UML-Based Web Engineering (UWE) and Web Modeling Language (WebML). The comparison of the metamodels helps the designer to understand the methodologies in a better manner. The UWE is the software engineering approach designed with the aid of Unified Modeling Language (UML). The UWE metamodels are created using case tools, UML objects and the Object Constraint Language (OCL). The WebML is the visual modeling language to represent the web application components. OOH uses notations and semantics to represent elements of web based interfaces. The comparison was established under the perspective of three models, namely Conceptual Model, Presentation Model and Navigation Model. The model elements involved in the three methodologies are analyzed and compared which explains that the WebML is the best one among the others.

Behshid Behkamal et al. (2009) customized the ISO / IEC 9126 quality model so that the proposed quality model adheres to the B2B applications. The quality characteristics suiting the web application and the B2B applications are identified from the developer and end user perspective. These identified quality characteristics are associated with the existing ISO / IEC 9126 quality model. A certain quality criteria associated with B2B applications, namely Availability, Customizability, Navigability and Traceability are introduced into ISO / IEC 9126 quality model. Around 17 experts were involved in the identification of additional quality criteria and the rating process.

2.3 QUALITY CRITERIA AND DECISION MAKING METHODS

Nesrin Alptekin et al. (2015) proposed a methodology for evaluating web sites using the Fuzzy TOPSIS method. The methodology
analyzed five Turkish bookstore websites for quality evaluation. Four criteria and fifteen sub criteria were used for the evaluation process. This investigation was proposed to identify the key quality criteria that help the university students to purchase books from these bookstores. Information Quality, Service Quality, System Quality and Vendor specific Quality are the key criteria used to evaluate the web sites. The criteria and the sub criteria are evaluated using the fuzzy data set. 21 graduates were employed for the quality assessment of 5 different bookstore websites.

Qasim Zia (2015) has conducted a detailed survey in the identification of important quality metrics that helps the Quality Assurance (QA) process associated with the web application. The metrics are identified from the various QA problems of web applications and also from the key areas of the web – commerce application. The noted key areas were Performance, Security, Ease of Use, Search Engine (SE) Optimization, Portability and Reliability. The traditional way of collecting metrics was from the pre-defined set of metrics which is not suitable for web application. To obtain these associated metrics the author has proposed a detailed methodology for metric collection. Initially the business function and user specification are analyzed. Next, identify the key quality attributes associated with the E-Commerce domain and finally mapping the software metric to the real world project. This methodology helps the evaluator to obtain an optimal set of quality metrics based on client specification and also meeting out the business perspective. The set of quality attributes that were identified in the e-commerce application are Performance, Security, Ease of Use, Search Engine (SE) Optimization, Portability and Reliability.

Mohamad Ibrahim Ladan (2012) conducted a survey on web services and tried to classify the metrics that were used to enhance the quality of web services. In conjunction with the earlier researches which focussed on
traditional and object oriented means the author has extended the survey towards web service metrics. The web service selection mainly works on a set of Quality of Service (QoS) which could be further improvised using this set of web service metrics. The survey has classified the metrics in two different contexts namely Structural Metrics and Quality Metrics. The research has its concentration more on the quality metrics and it deals with both functional and non functional quality requirements of web services. Accessibility, availability, integrity, interoperability, performance, reliability and security are the important quality aspects of web services identified in this survey. Web services are the containment of web applications and this study helps to identify the associated quality characteristics.

Kemal Vatansever & Yakup Akgul (2014) has extended an investigation over famous shopping websites that exist in Turkey. The output of this investigation was the evaluation of the e-commerce website. The evaluation has employed Fuzzy Analytic Hierarchy Process (FAHP) for the evaluation process. About 4 main characteristic and 22 sub characteristics were involved in the quality evaluation process of the e-commerce website. Information Quality, Vendor Specific Quality, Service Quality and System Quality were the 4 main characteristics that were used to evaluate the e-commerce website and it was identified that the Vendor Specific Quality is the most important one. The utility of AHP shows that the comparative study over the web sites produces a trust worthy result.

Suomi Ghosh et al. (2012) has incorporated AHP and ISO / IEC 9126 quality model for the selection of object oriented software system. The basic requirements for the selection of object oriented software system are identified from the ISO / IEC 9126 quality model. The desirable characteristics for the selection of an object oriented software system that were identified are Maintainability, Reliability and Usability. Based on the
appropriateness of the quality characteristics of each object oriented software system they are ranked.

Dipendra Nath Ghosh (2011) had used the integrated method of using AHP and TOPSIS to evaluate the performance of the engineering faculty. This combination has worked more efficient than the traditional methods. The relative weight of each criteria was identified using the AHP the alternatives are grater and evaluated using the TOPSIS. This integration efficiently identifies the best engineering faculty in an efficient manner.

The quality of the Asian airlines website was evaluated by Humera Khan & Dominic (2013), this is done by diagnosing it through online web diagnostic tools in junction with AHP. The results from the diagnostic tools are fed as the input to the AHP and the Malaysia airlines was rated the best. Four airlines namely Air Asia, Malaysian Airline, Thai Airline and Singapore Airlines were subjected to the rating process. The criteria were identified from the web diagnostic tools. The associated internal characteristics formed the base for the ranking process.

Alessio Ishizaka et al. (2012) presented a new alternative of AHP namely AHPSort. The methodology was planned to sort the set of alternatives by grouping them into a predefined ordered categories. The advantage of AHPSort is the requirement of less no of comparison than the original AHP. An experimental analysis was performed on the supplier selection process. The suppliers are categorized into two groups, namely accepted supplier and rejected supplier where the no of groups are decided based on the user preference. The classification starts from the least preference to the most preferred. The classes are devised with a set of criteria holding the minimum level and the maximum level. The sorting was devised based on two types
namely limiting profiles and central profiles. This AHPSort had a better performance than the traditional AHP.

Prasath (2014) has performed a research on the identification of the right web service which holds a high quality of protection. The author has employed a greedy approach to identify the quality parameters associated with the security of the web service. Initially, all the criteria associated with the security are identified and the most important one is picked from the utility of greedy method. Next the criteria are compared and rated against each other using the AHP method to know the importance scale of each criteria. Around 30 parameters that influence the security of the web service was identified and compared with each other using the AHP. The security of the web service was customized towards the STRIDE (Spoofing, Tampering, Repudiation, Information disclosure, Denial of Service, and Elevation of privilege) attacks. Sonar web service penetration testing tool was used to obtain the values for the criteria of various web services that has to be ranked. Three different attack details were used to evaluate the web service security. The study has restricted its research towards a single quality characteristic and its associated sub characteristics.

Yusmadi Yah Jusoh et al. (2014) used the AHP methodology for the selection of Open Source Software (OSS). A tool named MyOSST v1.0 was devised for the selection process. The validation of the tool was done by the IT professionals of Malaysian Universities. Their previous work assisted them in the identification of the OSS characteristics based on the ISO standard. The OSS selection was devised on four dimensions, namely Information Quality, Service Quality, System Quality and other parameters associated with the internal constraints of the OSS. Criteria selection depended on these four dimensions. 12 criteria and few other associated sub criteria were selected for these four dimensions. The potential users used the
tool to rank the OSS based on these criteria and sub criteria. By employing the AHP method the criteria and sub criteria were rated and ranked. In association to the generated ranks the OSS was evaluated and ranked using AHP. The Dimensions of evaluation were met with the ISO standards.

Qiushi Wang & Zhao Yang (2012) had utilized the AHP method for the selection of appropriate software architecture style or pattern in a systematic manner. A notable amount of literature survey was conducted and various types of architectural style and their associated quality attributes were identified. The various architectural style collected are classified into 6 categories based on the scope of its application. The Quality attributes used to select the software architecture style are categorized into five categories as the quality attributes vary for each architectural style. These quality attributes are then associated with quality standards to help in the selection process. The existence of the quality attributes in the architecture style will help the evaluators in rating the software architecture style. This selection process would help the software architect to select the required architecture for building the required software. Varied collections of quality attributes were involved and the selection process is enhanced using the AHP process.

Various university websites were ranked by Renuka Nagpal et al. (2015) under the perception of Usability. Four university websites are used as input for the quality evaluation. Informative, Ease of Navigation, Ease of Use and Response Time were the four important criteria that were used for the quality evaluation of the university websites. These criteria are evaluated using the Fuzzy AHP and based on the result the web site is evaluated using the F-TOPSIS. The evaluation process is performed with the assistance of three website developers as decision makers. The two fuzzy methods were used for the evaluation process.
A tool was devised by Jagat Sesh Challa et al. (2011) that used ISO / IEC 9126 software quality factors to evaluate the software quality using the Fuzzy Multi-Criteria Approach. The uncertainty in the rating of quality factors was modified and improvised using the fuzzy multi criteria approach. The quality evaluation was established under the influence of various perspectives, namely the developer’s perspective, the project manager’s perspective and the user’s perspective. For a better quality evaluation the set of quality sub criteria’s is modified. The software quality model is built using the hierarchical structure having the perspectives, ISO characteristics, ISO sub characteristics and metrics. The fuzzy weighted average of all the criteria and sub criteria helps to determine the final quality. The utility of the fuzzy method was justified here to remove the uncertainty in the decision making.

Based on many web quality criteria, Handaru Jati (2009) proposes a methodology to evaluate and determine the best airlines website. The methodology uses the AHP for the generation of criteria weights by using the pairwise comparison on the available set of criteria. The website evaluation is done on various dimensions, namely end users, web site designer or both. Web-site Quality Evaluation Method (QEM) was employed here to identify and evaluate the criteria. Data about the airline website from 5 different Asian countries are taken for the analysis. The rating of the airline website is done using certain parameters like response time, load time, frequency of update, page rank, size, traffic and so on.

A new methodology was proposed by Yan Song & Yinghui Hu (2009), who uses the group decision making for Coal Mine Safety Management using AHP and Clustering. The experts are classified using the clustering algorithm and each expert was given a rate of importance. The experts belonging to the same group will hold the same weight on the expert. The criteria involved in the Coal Mine Safety Management are evaluated to
against each other by the group decision making where each expert hold their own weight which is used to rank the criteria. Adding rating to quality expert would help to enhance the reliability of the rating process.

Mohammed F. Aly et al. (2014) proposed a performance evaluation model for evaluating engineering education system by the application of AHP and TOPSIS method. A balanced scorecard was prepared from the literature survey from where the education criteria were identified, specifically from the SWOT analysis. The balanced scorecard education criteria are selected to meet the university strategic goal. Those criteria were evaluated using the AHP method. Based on the scorecard criteria the faculty is evaluated to check the adherence to the university goals. The output of the AHP method evaluating the criteria was fed as the input to the TOPSIS method. The integration has improvised the rating process. The integrated utility of AHP and TOPSIS would help to reduce the no of comparisons that were to be done on the utility of AHP.

A methodology for managing supplier in the supply chain cycle was developed by Pema Wangchen Bhutia & Ruben Phipon (2012). In the supplier selection process, the co-ordination between the manufacturer and the supplier is always a problem. The criteria that affect the supplier selection dependents on few factors, namely delivery time, price, product quality and service quality. The weight of the criteria affecting the supplier selection is calculated by using the AHP method. The weight of the criteria is given as input to the TOPSIS method to rank the suppliers. By this mean the selection process is optimized and reduces the troubles in the selection process as the selection is done systematically. The combined effect of AHP and TOPSIS makes the selection process an efficient one.
2.4 PREVAILING WEB QUALITY EVALUATION METHODS

A novel approach was proposed by Dalal Ibrahem Zahran et al. (2014), which helps in the selection of the web evaluation method which depends on the purpose and domain for which the evaluation method was required. Web evaluation and Web site evaluation are two different perspectives and the Evaluation Methods vary on the purpose for which they are used. Web site evaluation methods are categorized into three groups, namely User based, Evaluator based and Automatic tool based evaluation. Similarly, Web Evaluation Methods are categorized based on Web Analytic Tools and Link Analysis Methods. The purpose of the evaluation decides the selection of Website Evaluation Method and Web Evaluation Method. Website redesign, web ranking requires the Website Evaluation Methods and the popularity, connectivity analysis requires the Web Evaluation Methods. The study portrait that evaluation methods are either user centric, process centric or product centric.

Quality evaluation model for software project of web application was designed by WanJiang Han et al. (2015). AHP, Fuzzy Mathematical Theory and Expert Method are used to evaluate the quality of the web application in the proposed model. The criteria and sub criteria for the web application are evaluated and rated based on the historical web test data. For the evaluation of system quality the weights concerned for the first quality attribute, second quality attributes and web metrics are derived using Fuzzy Mathematical Theory. Every software bug was rated on 4 different scales and based on these bugs the quality attributes and metrics are evaluated. Later the criteria weights are evaluated based on these values. The web project quality was determined by using the test data of 3 web applications. Around 1465 test
cases are employed in the experimentation process. The second quality attribute is evaluated using the Fuzzy Mathematical Theory and then the first quality attribute is evaluated using the AHP method and finally this determines the quality of the project of web application. The integration of various methods shows improvement in the decision process.

A Web Application Analysis and Testing (WAAT) project was proposed by Alessandro Marchetto & Andrea Trentini (2007) who built a quality model using the Object Oriented model and structural information of the application to be built or evaluated. The structural properties of the web application are obtained from OO metrics and traditional web metrics. The existing web application is used to extract the OO model. Here the web application quality factors are evaluated with the help of structural properties. The structural information is obtained by the construction of meta model using application behavior analysis using static and dynamic analysis, application model building by constructing the Class diagram and State Diagram and model validation based on web server log files. The framework is divided based on the usage into two phases, namely for the utility of model administrator and for the utility of model user. The model administrator task is to build the quality model based on a set of quality rules and the model user task is to analyze the existing application using the clustering algorithm. The proposed methodology evaluates the constructed web application based on the predicted quality rules and is useful for redesigning, re-engineering and so on. The evaluation is done under the user perspective and developer perspective.

Zhao & Luo (2014) initiated a Multiple Attribute Group Decision Making model for Web Software Trustworthiness (WST-MAGDM) for the evaluation of Web Software Trustworthiness. The web application was subjected to evaluation using Principal Component Analysis (PCA). The web
application was evaluated for trustworthiness against a chain of trustworthiness attributes, namely Reliability, Functionality, Usability and Efficiency. The quality model attributes were derived from ISO / IEC 9126 model and web software attribute diagram. The proposed model mainly focuses on external user satisfaction attributes and more importance on security attribute. This model helps to improve the trustworthiness of the software by using the PCA method to rate the trustworthiness attributes based on entropy weight. Except for the evaluation process this model speaks more towards the important qualities to be available on the web application.

Mahdieh Khalilinezhad & Niloufar Dehghani (2013) have strived to assess the quality of the website of the internet stores based on their website attributes. A fuzzy expert system was designed to take the website attributes as the input and determining the web site success level. Success evaluation rules are devised from the comments of the commerce experts. The fuzzy expert system uses the fuzzy interference rules, fuzzy data and derives fuzzy interferences. The website attributes, namely Interface, Navigation, Reliability, Content and Technical are given as the input to the fuzzy expert system and the Website Success Level (WSL) are derived as the output. This system is efficient enough to access the quality of the website and to rank the websites based on the five quality attributes. The rule based evaluation of web application shows lamp light towards the utility of data mining techniques for quality evaluation.

Roberto Polillo (2011) discussed about creating quality model for various web based applications. The methodology insists on incorporating various quality aspects during requirement elicitation, design and development and during site maintenance. The author focus on the organizational mapping of technical people or actors involved in the construction of a web site with the set of quality characteristics and making
them responsible for the quality enhancement. The set of actors is identified by considering the list of people involved in the creation and maintenance of the web site and also the end user in the assessment of the quality. Each quality attributes required is associated with the actor and he is affirmed to hold the control over the quality attribute. Around nine quality characteristics and 32 sub characteristics are identified by analyzing the nature of the web site that is to be developed. There is no specific concentration on the quality indicators involved in the process.

A new methodology that assigns weights to the decision makers was proposed by Z. Srdevic et al. (2011). The weights assigned to the decision makers are derived from the inconsistency in their evaluation process. The decision maker weights are derived from their total Euclidean Distance (ED) and Consistency Ratio (CR). The group decision making process helps to reduce the inconsistency in the decision making. The alternatives are rated and ranked in conjunction with weights of the decision makers, which is more acceptable than the aggregation of individual decision makers.

A new quantitative approach was demonstrated by Rajeev Saha & Sandeep Grover (2011) which helps in the comparison of similar websites. The author tries to identify the interactions between the quality attributes and represents the quality in terms of inheritance and interactions. The utility of graph theory and matrix method would help to evaluate the interactions between the quality attributes and represent it as a single value namely website quality index. The relationship between the quality attributes are represented using the digraph which is converted to the numerical form using the matrix method. Finally by the utility permanent function the numerical index of quality attribute is determined. The calculation of quality loss and
quality gain in association with website quality index helps whether the website has to be improvised or not.

Omar Husain Tarawneh & Faudziah Bt Ahmad (2009) have aimed to identify few quality evaluation methodologies that are used to evaluate various E-commerce web sites and also try to identify the important quality characteristics used in these methodologies. Few important quality evaluation methods, namely Quality Evaluation Method (QEM), Analytic Hierarchy Process (AHP), Gray analysis (GA) method, Data Envelopment Analysis (DEA), The Microsoft Usability Guidelines (MUG), Eye Tracking (ET), Web Assessment Method (WAM) was studied and their features were identified. Based on the occurrence of various quality characteristics in these evaluation methods, the quality characteristics and sub characteristics were rated for their importance. The study helped to identify the important set of quality attributes used in the web applications, namely efficiency, functionality, maintainability, portability, reliability and usability. The highly preferred quality attribute in the e-commerce web site is the usability, which is followed by functionality, reliability and so on.

A survey to select a set of web metrics was conducted by Julian Ruiz et al. (2006) with the help of web technology professionals. The 385 web metrics that were used in the earlier research work was subjected to the survey. The finding of the survey is more astonishing that the web technology professionals give more privilege to the usability metrics. 42 survey results were conducted and 2 participants worked under the user perspective and the remaining held different experience and were from different working environment. The web metric was rated with a scale from 0 stating not important to 9 stating very important. The rating of the different survey was subjected to the arithmetic average to know which metric ranked higher. From
the survey, it could be noted that the developers give more importance to usability criteria.

Coral Calero et al. (2005) utilizes the Web Quality Model (WQM) (Coral Calero et al. 2004) for identifying three dimensions, namely web features, quality characteristics and life cycle process. The classification involved a different set of stakeholders with varying perspectives and knowledge about web quality. Content, Presentation and Navigation are the three web features added to classify the web metrics. The quality characteristic dimensions were identified by the Quint2 model which focuses mainly on the web products. The processes that were included are associated with both primary and organizational processes. 385 metrics were subjected to the classification process. The classification of the metrics is determined using the %Absolute value and the %Pro-rated value where the %Absolute refers to the percentage of metrics selected under each dimension and the %Pro-rated refers to the normalized value. Higher the Pro-rated value the metric fixes to that triplet of web features, quality characteristics and life cycle process.

A framework was demonstrated by Ben Lilburne et al. (2004) where the web based applications quality attributes are evaluated. The framework was modeled based on three attributes, namely maintainability, reliability and usability. Here the maintainability is evaluated under the developer’s perspective and similarly the reliability and usability are evaluated under the user’s perspective. The framework was devised in such a way that Quality Compliance Framework (QCF) holds quality measurement at the top level followed by quality goal or factor and in the next level lays the quality sub-goal or criteria and finally the quality attributes or metrics. It could be identified that different phases of Software Development Life Cycle
(SDLC) have different goals, criteria and metrics where the quality measurements are derived from a set formula to identify the overall quality.

Vassilis S. Moustakis et al. (2004) established a framework that was constructed based on the hierarchical structure holding criteria and sub criteria and evaluate them using Analytic Hierarchy Process (AHP). Content, Appearance and multimedia, Design and structure, Navigation and Uniqueness are the quality criteria that are used to evaluate the websites. The user rating of criteria and the order of preference of the company were used to rate the websites using the criteria and sub criteria.

Website Quality Evaluation Methodology (Web-site QEM) an approach, which was proposed by Luis Olsina & Gustavo Rossi (2000) was used for the systematic evaluation of the quality of the web application. The web applications are evaluated for the attainment of the quality under the set of quality characteristics, namely Functionality, Efficiency, Reliability and Usability administered under the user perspective. The Web-site QEM uses a set of processes to evaluate the product quality and compare them. Based on the domain, the goals are determined under the user perspective and followed by characteristics and sub characteristics selection. On the preference rating the elementary preferences are generated which on aggregation generates the global preference level. Based on the preference value the particular quality attribute has to be improvised to improve the overall quality of the software. The evaluation process

Manjula & Eswar Anand Sriram (2010) had conducted a reliable evaluation of the web application using the click stream data or the web log files. The quality evaluation done in this methodology is mostly associated with two important quality characteristics namely Reliability and Maintainability. Using web log details holding the failure information and
usage details about the web application can help to evaluate the web application. The approach was restricted to two quality attributes only.

Luis Olsina et al. (2008) proposed a quality model based on the ontology of the based on the metrics and indicators identified from the conceptual base. Information Need, Concept model, Attribute, Metric and Indicator (INCAMI) framework was devised in such a way that the information needs are met with the specification of non–functional requirements. Based on this information a specific quality model would be designed using the selection of the right attribute and finally identify the required metric and indicators. Based on this feature analysis the quality of the web application can be evaluated in a consistent manner.

Cristina Cachero et al. (2007) have extended the traditional Web Engineering Development Process in association with ISO / IEC 14598 to confirm that the quality is ensured in the development process. They have associated this WE process to the Model Driven Engineering paradigm. It works on a general business model holding other artifacts namely, use case model, domain model, navigation and presentation model, detailed design flow and implementation work flow. These six artifacts are to be ensured for the quality evaluation so the flaw in one artifact may help to analyze the quality defect in the associated artifacts. Total quality is ensured using this methodology under the user perspective.

Tony Rosqvist et al. (2003) worked on software quality evaluation using the expert judgement. The basic principle behind the approach is that the expert’s knowledge is converted into numerical values stating the attainment measures of the software quality attribute. A framework was defined to support the software developers to associate the software measures to various software development processes. Here the experts make judgement
about the attainment level of each quality factor or attribute. Two values, namely Subjective Achievement Level (SAL) and Consensus Achievement Level (CAL) derived from the expert judgment are used to achieve the overall achievement level of the quality attribute. Certain sets of acceptance rules were used to associate the quality measures to the software development process.

Haifeng Li et al. (2009) proposes framework which involves in the selection of software reliability metrics which uses the expert opinion on the application of AHP. Each quality metric is rated against each quality characteristics and then placed into various phases of the software development life cycle. Based on the experience of the experts the quality criteria are rated under the perspective of a web application. Five experts are used in the evaluation process. The pairwise comparison mechanism was used to compare the criteria, sub criteria and software metrics against each other to know the relative weight of the components involved. The proposed framework was designed for the critical software and the characteristics used were identified from ISO / IEC 9126 and don’t deal with the criteria concerned with web applications.

Olsina et al. (2001) proposed a Website Quality Evaluation method (QEM) that evaluates the web artifact quality in its operational phase. A detailed case study was conducted to evaluate websites of the universities for its attainment of proposed quality characteristics. The quality evaluators fall under the category of student, academic personnel and research sponsors. The evaluation was done under the user perspective. Logic Scoring of Preference (LSP) approach was used to aggregate the rating of criteria and sub criteria attainment of the web sites. The main criteria that were used to evaluate the web site are Efficiency, Functionality, Reliability and Usability and its
corresponding partial and global rating were generated to rank the university websites.

Arvinder Kaur & Diksha Dani (2011) established a systematic review that deals with the web measurement like web quality, web model, web methods and web metrics. This review explains about the existing web measurements and web evaluation methods. The study emphasizes that quality evaluation after the construction of a web site is important and quality evaluation throughout the lifecycle of web site development is more important.

2.5 CONCLUSION

The detailed study of the literature survey has highlighted certain factors that could be incorporated into the proposed integrated methodology.

The literature survey done under the quality model perspective has highlighted a few of the findings which are listed below.

- The most commonly used quality model is the ISO / IEC 9126 Quality Model. The other models used are the tailored models derived from ISO / IEC 9126 Quality Model.
- The Quality criteria identified from these quality models are only used in a limited fashion. Certain literature review explains the utility of only one or two quality criteria for quality evaluation.
- The quality evaluation of web application is done either using an expert or when more experts are involved aggregation of evaluation is done which is not good for evaluation.
Next, the literature survey explains about the various findings under the perspectives of Quality Criteria and Decision making Methods and they are listed below.

- Websites are evaluated for quality using MCDM methods like AHP, TOPSIS, Fuzzy methods and so.
- Most commonly used MCDM method for quality evaluation is the AHP method.
- Integration of one of two methods may improvise the decision making process.

Finally the chapter deals with the literature associated with various web quality evaluation methods and explains about their functionality. Few of the findings are listed below.

- Most of the quality evaluations are associated with error log data, structural data, inheritance property or model driven.
- The quality evaluation process is either under a single perspective or tool based evaluation.
- Involvement of various perspectives for quality may enhance the quality of the web application.
- Integration of quality models with SDLC phases improves the quality of web application from the requirement phase.