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B.Sc.(Honours) in Statistics\Computer, University of Gezira (2009)

A Dissertation
Submitted to the University of Gezira in Partial Fulfillment of the Requirements for the Award of the Degree of Master of Science

In

Computer Sciences
Department of Computer Science
Faculty of Mathematical and Computer Sciences
University of Gezira

October 2013

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Date: October, 2013

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<td>Dr. Mohammed AbdAlla Elmaleeh</td>
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Date of Examination: 22 October 2013
DEDICATION

To My parent
To My Sisters and Brothers
To My Friends
To Classmates (My batch)
ACKNOWLEDGEMENT

First, thanks to the supervisor Dr. Osman Ahmed Abdalla for his advise and He Did not Stingy any information for me, Thanks to Co-supervisor Dr. Sally Dafaalla Awad Alkareem for her help. Also I thank Mohammed Abdurrahman Aljemabi very much for his assistance and support. Also I will never forget my little brother Abubaker abdalla.
Abstract

Website quality is a new topic in the software quality. Web-based applications can be used and accessed by more users than non web-based applications. The importance of websites creates a demand from the users for quality and fast delivery, unfortunately the complexities of websites and technology which supports these applications make testing and quality control more difficult to handle. Automation of testing website quality is a new method. Each definition of quality leads to lists of criteria about what constitutes a quality site. The objectives of the research are to propose a new methodology for evaluating the quality of universities websites, determine the best university website based on the criteria proposed in the new methodology,determine the best ranking method used to evaluate website quality Application development refers to the software development process used by the application developer to build applications systems. This is a process generally known as systems development life cycle (SDLC), and it includes all activities aimed at the development of the application system and put it into production, including analysis, planning, design, implementation and testing phases. The Analytic Hierarchy Processes (AHP) method is a mathematical method applied to many sciences and engineering areas. This method is based on the multi criteria decision making principle where the most suitable alternative is selected out of a group of available alternatives on the basis of a defined number of decision making criteria. This method is particularly suitable for use in cases when there is no enough information on the reviewed alternatives in the decision making. This research identifies the application of the AHP method in the selection of an optimal university website. Nowadays, the ranking of universities is based on many criteria, however the university website is an extremely important one. Unfortunately there is no available evaluation method to evaluate the Sudanese universities websites. Data have been collected from five Sudanese universities and five criteria have been carefully selected to assess the websites of these universities. Lastly, an automatic evaluation tool has been developed to evaluate the quality of universities’ Websites. The results show that the proposed method gives a satisfying factor to evaluate the quality. In future work we recommend the design of a website that analyzes the components when we type the URL of a website, after getting the final scores we can determine which one is the best.
تصميم وتطوير طريقة لتقييم جودة مواقع الجامعات باستخدام نموذج عملية التحليل الهرمي

إسراء محمد الحسن عثمان النقيب

أكتوبر 2013

قسم علوم الحاسوب
كلية العلوم الرياضية والحاسب
جامعة الجزيرة

ملخص الدراسة

جودة الموقع هو موضوع جديد في جودة البرمجيات. التطبيقات المتغيرة، المواقع المتغيرة، والمواقع المتغيرة التي تدعم هذه التطبيقات جعل الاختبار وроверة جودة أكثر صعوبة في التعامل معها. أثبتت اختبار جودة الموقع هو فرع جديد وتقنية جديدة. كل تعرف للجودة يقود إلى قائم من المعايير حول ما يشكل جودة الموقع. أهداف البحث هي اقتراح منهجية جديدة لتقسيم جودة مواقع الجامعات، وتحديد أفضل موقع جامعية على أساس المعايير المحترمة في المنهاجية الجديدة، وتحديد أفضل طريقة ممثيلة لترويج تقييم جودة الموقع. شيء تطور التطبيقات لعملية تطور البرمجيات المستخدمة من قبل مطور التطبيق بناء نظام التعليلات (SDLC) وأنه يشمل جميع الأنشطة الرامية إلى تطوير نظام التطبيق ووضعها في الإنتاج، بما في ذلك التحليل والتصميم والتنفيذ وعملية الاختبار. تأتي التحليل الهرمي في طريقة تطبيق في كثير من العلوم والمجالات الهندسية. هذه الطريقة تستند على مبدأ صنع القرار ذو المعايير المتغيرة. حيث يتم اختيار البدائل الأكثر أوائل من بين مجموعة من البدائل المتاحة استنادًا على عدد معين من معايير صنع القرار. تأكد هذه الطريقة من استخدام الأنشطة في حالات عدم وجود معلومات كافية عن البدائل المستعرضة لاختيار القرار. يُعرف هذا البحث بتطبيق طريقة تحليل الهرمي. في الوقت الراهن، يستند تقييم الجامعات على معايير كثيرة ولكن موقع الجامعات يعني صعبًا. وللأسف ليست هناك طريقة تتبعية لتقسيم مواقع الجامعات السودانية. تم جمع البيانات من خمس جامعات سودانية وتم اختيار خمسة معايير بعناية لتقسيم مواقع هذه الجامعات. اختبارًا تم تطوير أداة تقسيم آلي لتقسيم الجودة. أظهرت النتائج أن الطريقة المشرفة لتقسيم مراقبة عملياً مرضي للموقع كونها يقوم بتحليل مكوناته عند وضع الURL الخاص بالموقع وبعد الحصول على العلامات النهائية يمكننا أن نحدد أيها الأفضل.

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<td>International Organization for Standardization</td>
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<tr>
<td>QM</td>
<td>quality model</td>
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<td>AHP</td>
<td>analytical hierarchy process</td>
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<td>SDLC</td>
<td>Software Development Life Cycle</td>
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<tr>
<td>LRTs</td>
<td>likelihood ratio tests</td>
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<td>QFD</td>
<td>Quality Function Deployment</td>
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<td>QEM</td>
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<tr>
<td>XML</td>
<td>Extensible Markup Language</td>
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<td>DTDs</td>
<td>Document Type Definition</td>
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<td>FAHP</td>
<td>Fuzzy analytical hierarchy process</td>
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<td>DEA</td>
<td>Data Envelopment Analysis</td>
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<td>MCDM</td>
<td>Multiple Criteria Decision Making</td>
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<td>B2C</td>
<td>Business to Consumer</td>
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<td>C2C</td>
<td>Consumer-to-Consumer</td>
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<td>RAD</td>
<td>Rapid Application Development</td>
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Introduction

A recent topic in the subject of software quality is Website quality. More users can reach and use web-based applications than those using non web based applications. These users demand Websites to be of a high quality and a fast deliver. However, the complexities of Websites and technology which supports their application make the handling of testing and controlling quality more difficult. Automation of testing Website quality is a new method. In addition, each definition of Website quality leads to lists of criteria about what constitutes a quality site. These criteria, combined together, on web quality form a comprehensive tool for evaluating the quality of a Website.

The principle states that 'if information can pass a test of quality, it is most likely to prove trustworthy and because of this belief, should have higher credibility'. Thus, the challenge is to create a method that acts as a Website evaluation tool and that does not consume a lot of time.

There exists many factors of quality evaluation, and each one pertains to a particular Website in varying degrees. Here are some of them:

The first factor is time, a credible site should be updated frequently. The information about latest update also should be included on the homepage.

The second factor is structural, all of the parts of the Website hold together and all links inside and outside the Website should work well. Broken links on the webpage are also another factor that always downgrades the quality of Website. Users expect each link to be valid, meaning that it leads successfully to the intended page or other resource.

The third factor is content; number of the links, or link popularity is one of the off page factors that search engines are looking to determine the value of the webpage. The idea of this link popularity is that to increase the link popularity of a Website, this Website must have large amount of high quality content. The number of links to Website improves access growth and helps to generate traffic.

Fourth factor is response time and latency; a Website server should respond to a browser request within certain parameters, from 2003 to 2008 the average web page grew from 93.7K to over 312K. Popular sites averaged 52 objects per page, 8.1 of which were ads, served from 5.7 servers, and object overhead now dominates the latency of most web pages[1].
The last criterion is performance. Technology continues to make an important impact in service industries and fundamentally shapes how services are delivered. One of the research finding mentioned that a Website which has slow download time is less attractive than a Website with faster download time. Another important aspect is information fit-to-task, information presented on a Website should be accurate and appropriate for the task at hand [1].

1.2 Problem Definition
A quality model (QM) is a "defined set of characteristics, and of relationships between them, which provides a framework for specifying quality requirements and evaluating quality"[1]. QMs are very important in web engineering. Having a good QM at hand can be extremely useful in all phases of a Website life cycle. For this reason we want to assess Websites according to some characteristics and determine if they are good or not. These characteristics are load time, response time, number of items in page, web page size and image size.

This illustrates the existence of this problem:
There are no model used to determine the preference between Sudanese universities sites depending on the evaluation criteria (load time, response time, image size, page size and number of items).

1.3 Objectives
The main objective of the research is:
- To propose a new methodology for evaluating the quality of universities Websites.

The other secondary objectives are:
- To determine the best university Website based on the criteria proposed in the new methodology.
- To determine the best ranking method used to evaluate Website quality.

1.4 Methodology
This research examined selected university Websites using a new methodology for determining and evaluating the best university Websites based on many criteria of Website quality. The approach has been implemented using the Analytical Hierarchy Process (AHP), the proposed model uses the AHP pair wise comparisons and the measure scale to generate the weights for the criteria which are much better and guarantee more fairly preference of criteria. Applying AHP approach for Website evaluation has resulted in a significant
acceleration of implementation, raised the overall effectiveness with respect to the underlying methodology and ultimately enabled more efficient procedure. Also using the Software Development Life Cycle (SDLC) is a process of building or maintaining software systems. Typically, it includes various phases from preliminary development analysis to post-development software testing and evaluation. It also consists of the models and methodologies that the development teams use to develop the software systems, which the methodologies form the framework for planning and controlling the entire development process.

1.5 Structure of Research
This research consists of several stages, it starts with introduction, problem identification followed by objectives, and ends with data analysis methodology, all presented in chapter one. Chapter two consists of the background of the research and literature review followed by chapter three which consists of methodology and related concepts. In Chapter four the application screens is explained and the result of the research is presented, finally chapter five presents the conclusion and recommendations.
2.1 Background

A great number of new Websites are launched every day. Those with similar content will not have the same degree of quality. If the quality is poor, the user will simply leave the Website and go elsewhere. Generally, there is no second chance to get a user back to the Website. The quality of a Website makes a Website profitable, user friendly and accessible, and it also offers useful and reliable information, providing good design and visual appearance to meet the users’ needs and expectations. This can be done by defining the measurable Website criteria. The quality assurance process became the challenges for the new discipline of Website application. There are a number of experts or organizations who researched on different proposals to improve Website quality, including quality frameworks, criteria, evaluation methodologies, approaches and metrics. In fact, the Website quality process became a particularly valuable topic especially in Website quality metrics. A set of metrics has been proposed for quantifying Website quality attributes since the 1990s. Although quality of Website has valuable background and has been well developed in recent years, a big question is “why is the quality of Websites still poor and lack quality characteristics which cause user dissatisfaction.

The application domains of Websites are developing widely. Websites are becoming the preferred media instrument for information search, company presentation, shopping, entertainment, education, and social contacts. Traditional quality of Websites issues does not fit the new multiple-technology Websites application. Based on some factors, the new Website quality features determine the establishment of a new Website quality metrics which will have more practical measurement criteria and appropriate approaches for Website quality evaluation needs [1].

2.2 Website Quality and Quality Models

D. Tom DeMarco says "Quality is the function of a product that changes the world for the better ". The planning phase means project initiation. The main activities that will be executed during the planning phase include AHP application model[2]. The required standards will be selected according to the requirements of the system and the application of the model to the data. The selection of a system supplier is applied to make sure one applies it correctly to give satisfactory results. The first thing to do is to collect data. Website quality is defined as how well a Website is designed and how well the design meets with the user’s satisfaction. The quality of a Website could be measured from two...
perspectives: Programmers, and End-users. The aspects of a Website quality from programmers perspective focus on the degree of Maintainability, Security, Functionality, etc. Whilst the end-users pay more attention to Usability, Efficiency, Creditability, etc.

The usages of Website quality may depend on:

1. Task-related factors that affect end users such as presentation quality and contrast.
2. Performance-related factors that affect the efficiency for end users and the technologies of Websites, for example, response time, transaction output and reliability.
3. Development-related factors that affect developers and maintainers of a Website. For instance code complexity, code readability, portability and modifiability.

"How to clearly define these factors?" A concept (quality model) will be the leading factor in achieving Website success and will apply to the majority of current live Websites [2].

### 2.3 The Relevance of Models of Evolution:

It is well established that the use of one evolutionary model or another may change the results of a phylogenetic analysis. When the model assumed is wrong, branch lengths, transition/transversion ratio, and sequence divergence may be underestimated, whereas the strength of rate variation among sites may be overestimated.

Simple models tend to suggest that a tree is significantly supported when it cannot be, and tests of evolutionary hypotheses (e.g., the molecular clock) can become conservative. In general, phylogenetic methods may be less accurate (i.e., recover an incorrect tree more often) or inconsistent (i.e., converge to an incorrect tree with increased amounts of data) when the assumed evolutionary model is wrong.

Cases in which the use of wrong models increases phylogenetic performance are the exception; they represent a bias toward the true tree due to violated assumptions. Indeed, models are not important just because of their consequences in phylogenetic analysis, but also because the characterization of the evolutionary process at the sequence level is itself a legitimate pursuit[3].

The simplifying evolutionary models often make assumptions in order to turn a complex problem into a problem that can be computationally traced. Powerful models fit the data and make accurate predictions about the problem under consideration. The performance of a model is maximized if its assumptions are satisfied. Some indications of the fit of the data to the phylogenetic model are also necessary. However, the unjustified use of evolutionary models is still a common practice in phylogenetic studies. Since the model used may influence results of the analysis, it is therefore crucial to decide which is the most appropriate model should be used [3].
2.4 Basic Process Steps of the Website QEM

There are six process steps that evaluators should follow by applying the Website QEM, these are:

1. Selecting a site or a set of competitive Websites to evaluate or compare.
2. Specifying goals and the user's viewpoint.
3. Defining the Website quality characteristics and attributes requirement tree.
4. Defining criterion function for each attribute, and applying attribute measurement.
5. Aggregating elementary preferences to yield the global Website quality preference.
6. Analyzing, assessing, and comparing partial and global outcomes. Selecting a Website or a set of competitive Websites to evaluate and compare them [4].

2.5 Quality Models for Websites: Different Tools

2.5.1 Websites Peculiarities

A very general conceptual framework for defining QMs for complex systems with a substantial software component is provided by the ISO standard. This ISO model is the result of two decades of discussions about the basic quality dimensions of software-based systems. Its categorization and terminology can be discussed and - in a few cases - may also be considered somehow obscure, but certainly cannot be ignored in any approach to quality in software engineering. A quantitative measure of characteristics which provides a sound foundation for defining any QM, in any domain can be obtained by aggregating hierarchies of quality characteristics, and measurable properties. It should be clearly understood that the ISO models only provide a conceptual framework, and not a ready-to-use QM [5].

When practically used, this ISO framework should be adopted to the specific [class of] system[s] under consideration. This adoption to specific systems is a simple task, especially when these systems do not fit well with the systems considered in classical software engineering, such as ERP, command & control, embedded systems. This is typical case for Websites which possess a number of peculiarities that greatly differentiate them from the above systems. They are:

1. Information Content

In a large majority of Website cases, unstructured information content dominate structured data. This is because the emphasis is on user navigation, not on data management and algorithmic computation. Information architecture should be a fundamental dimension of quality. Information architects should be more and more
involved, especially in large Websites, together with content editors, who create and manage its information content. Also, information-rich Websites have to employ large editing staffs in ways similar to that of traditional magazines.

2. Communication

Mostly Websites are considered machines whose main function is communication, rather than computing and data management. This is typically true for e-commerce Websites or other Websites that offer online services or Websites addressing a global audience, in a strongly competitive open environment. In such Websites there is no user lock-in: competition is only a few clicks away and their visitors’ loyalty are solely won on a day-by-day basis. In general, users' attention span can be extremely short, so their interest must be captured in brief time-intervals. For Websites, big efforts are required on their communication and branding, and professionals including visual designers, art directors, communication experts etc should be involved.

3. Continuous Evolution

Websites are similar to living organisms in the sense that their contents should be constantly updated, and their information architecture are subject to frequent changes. This is true for any Website, not only for information portals. Generally, users and visitors of a Website often expect the content to be updated practically in real time. Website managers should act hard to comply with these expectations in order to keep their site reputation. Interactive services and the user interface are frequently modified and improved. In addition and according to the perpetual-β concept, the software behind these services is continuously modified for the betterment of the user needs. These in turn – change as new possibilities are discovered, in a constant co-evolution of usage patterns and system functions. In a word, managing the evolution of a Website sets pressing requirements to site administrators, and this should be taken into account seriously in any QM designed for these systems [5].

2.6 Selecting Models of Evolution

Generally, more complex models are better in fitting the data than simpler models. However, using complex models necessitates the estimation of numerous parameters which has several disadvantages. These are: first, the analysis becomes computationally difficult, and consumes much time and second, as more parameters need to be estimated from the same amount of data, more errors are included in each estimate. Ideally, it is advisable to incorporate as much complexity as needed i.e. choosing more complex models to explain
the data. However, they should not be complex to the extent that they require impractical long computations or large data sets to obtain accurate estimates.

Through statistical testing the best-fit model of evolution for a particular data set can be selected. Also through Likelihood Ratio Tests (LRTs) or information criteria the fit to the data of different models can be contrasted to select the best-fit model within a set of possible ones. In addition, LRT can be used to test the overall adequacy of a particular model to fit the data [3].

There a mechanism measurement implications the Web site page component towards performance The quality of the site. This mechanism measure the size, Component, and time needed by the client to load Site. key factor that will impact this loading The time is the page size (bytes), the number and kinds of component, A number of the server from the Internet access[19].

<table>
<thead>
<tr>
<th>Tested factor</th>
<th>Quality standard</th>
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<tbody>
<tr>
<td>Average server response time</td>
<td>&lt; 0.5 second</td>
</tr>
<tr>
<td>Number of component per page</td>
<td>&lt; 20 objects</td>
</tr>
<tr>
<td>Webpage loading time</td>
<td>&lt; 30 second</td>
</tr>
<tr>
<td>Webpage size in byte</td>
<td>&lt; 64 Kbytes</td>
</tr>
</tbody>
</table>

2.7 Analytic Hierarchy Process (AHP)

AHP is a tool available for the decision makers and researchers; and it is the most widely used multiple criteria decision-making tool. Many remarkable studies been published based on AHP including its application in different fields namely planning, selecting the best alternative, resource allocation, resolving conflict, optimization, and numerical extensions of AHP (Vargas, 1990; Zahedi, 1986). A bibliographic review of the multiple criteria decision-making tools carried out by Steuer (Steuer, 2003) should also be noted here.

AHP is defined by Saaty as a multiple criteria decision making tool (Saaty, 1980). AHP is used as a methodology that standardizes the numeric scale for the measurement of quantitative as well qualitative performance. The comparison spectrum of this scale in AHP model ranges from 1/9 for "least valued than", to 1 for "equal", and to 9 for "absolutely more important than".

A first step in using AHP is the decomposition of the decision problem into a hierarchy of more easily comprehended sub-problems, each of which can be analyzed independently.
Then, the elements of the hierarchy are related to an aspect of the decision problem for instance if they are tangible or intangible, carefully measured or roughly estimated, well or poorly-understood – anything at all that applies to the decision at hand[6].

After building a hierarchy, the decision makers then systematically evaluate its various elements by comparing them to one another two at a time. To do this, the decision makers can either use concrete data about the elements, or they can use their judgments about the elements' relative meaning and importance. This is true because the essence of the AHP is that human judgments are used in performing the evaluations, and not just the underlying information, (Saaty, 2008).

A capability that distinguishes AHP from other decision making tools is that it works by converting evaluations to process-able and comparable numerical values over the entire range of the problem. Then, a numerical weight or priority is derived for each element of the hierarchy, allowing diverse and often incommensurable elements to be compared to one another in a rational and consistent way. Finally, numerical priorities are calculated for each of the decision alternatives which represent relative ability to achieve the decision goal, so they allow a straightforward consideration of the various courses of action.

There are three groups of AHP applications, namely:

(1) Applications based on a theme,
(2) Specific applications, and
(3) Application combined with some other methodology (Vaidya, 2006).

**Application Based on a Theme:** Themes are selection, evaluation, benefit-cost analysis, allocations, planning and development, priority and ranking, and decision making.

**Specific Applications:** consists of the specific applications in forecasting, and medicine and related fields.

**Application Combined With Some Other Methodology:** Here, AHP is applied with Quality Function Deployment (QFD). AHP is characterized by flexibility and can be integrated with different techniques such as Linear Programming, Quality Function Deployment, and Fuzzy Logic. Such an integration enables the user to extract benefits from all the combined methods, and hence, achieve the desired goal in a better way.

Actually, AHP was developed and documented primarily by Thomas Saaty (Saaty, 1980; Saaty, 1982). AHP as a theory can be applied in several fields including transportation planning, portfolio selection, corporate planning, marketing, and others.

Saaty stated that AHP strength lies in its ability to structure a complex technological, economic, and socio-political problems with militiaperson, multi-attribute, and multi-period hierarchically (Saaty and Vargas, 1991). In its application process, pair wise comparisons of
the elements (usually, alternatives and attributes) can be established using a scale indicating the strength with which one element dominates another with respect to a higher level element. This scaling process can then be translated into priority weights (scores) for comparison of alternatives (Canada, 1989) [6].

AHP mathematical foundations are simple, and its purpose is to make a contribution towards unity in modeling real-world problems. According to Saaty, the major of assumptions in this methodology (methods to pursue knowledge, to predict, and to control the world) are relative, and the goal to use the methodology is itself relative (Saaty, 1991).

He uses the term “element” to apply to the overall objective, attribute, sub attributes, sub sub attributes, and so on; and alternatives of a problem are as follows:

- The top level, called the focus, consists of only one element
- The broad, overall objective.
- Subsequent levels may each have several elements, although their number is very small i.e. between 5 and 9.

Since the elements in each level are to be compared with one another against a criterion in the next higher level, the elements in each level must be of the same order of magnitude (Saaty, 1982).

In a typical four level hierarchy applied to a car choosing problem for instance, the focus is at the top level and the alternatives are at the lowest level. If any of the sub-attributes were further divided into sub sub attributes, those sub sub attributes would have constituted a new level.

As mentioned earlier, the general approach of the AHP is to decompose the problem and to make pair wise comparisons of all elements (attributes, alternatives, etc.) on a given level with respect to the related elements in the level just above. The degree of preference or intensity of the decision maker in the choice for each pair wise comparison is quantified on a scale of 1 to 9, and these quantities are placed in a matrix of comparisons.

Below is a high-level view of major phases and procedures required for quality assessment:

- The specification of goals and the user standpoint.
- The evaluators define and refine the goals and scope of the evaluation process.
- They can evaluate a web development project or a web application, and can assess the quality of a set of characteristics of a component, a whole product, or compare characteristics and global preferences of selected ones.
- The evaluators agree and specify the quality characteristics and quality criteria, grouping them in a requirement tree.
- The elementary criteria and measurement procedures are defined (also called the determination of the elementary quality preference).

- The evaluators define the basis for elementary evaluation criteria and perform the measurement and rating process[6].

- The elementary preferences are aggregated to yield the global quality preferences.

- The evaluators make decisions that prepare and perform the evaluation process to obtain a global preference indicator for each selected Website.

- The analysis, the assessing, and comparison of partial and global quality preferences.

- The evaluators assess and compare elementary, partial and global quantitative results regarding the established goals and user standpoint.

This approach, shown above, is valuable for general web quality metrics. However, it also has some limitations. First, evaluating a Website through Website QEM (Quality Evaluation Management) requires the creation of a quality requirement tree usually by a specific assessor who acquires professional skills. Second Website QEM has to relocate in a different domain (e.g. e-commerce, academic).

This why people are looking for an easily applicable (automatic) evaluation tool that measures a Website quality. Such evaluation should be efficient and simple according to the most common quality indicators and in a way that the user can type a web address and then click a button and obtain the result in the user’s interface [6].

2.8 Website Quality Actors

Quality actor is defined as any system stakeholder that has an active role in creating/maintaining some quality attribute including web designers, visual designers, content editors or software developers. Actors of a Website are numerous and varied and different from those in traditional software systems. Therefore, the development of any Website is actually a multi-disciplinary project, involving many actors with different roles[5].
It should be noted that in a typical Website, end users have a passive role, therefore they are not considered actors who actively contribute to its quality. They only navigate the Website and possibly interact with it in predefined transactions (as for example in e-commerce). While in Website the situation is completely different where users typically create and upload content, embed content from other Websites, tag, comment or rate content created by other users and share it with other users, and interact with them publicly. This active role of users is not only true for large social networks such as Facebook, Twitter, Youtube, but also for an increasingly large number of small Websites which through the use of many available tools easily implement these functions, such as share buttons, plugins, html snippets etc. Therefore, in Website, the users themselves must be considered critical quality actors who have a big impact on the global functioning of the Website. Accordingly, even a perfectly designed and implemented Website may fail because of “bad” (or unexpected) user behavior. Therefore, users must be continuously be monitored and in some way controlled or stimulated, requiring the presence of new roles (denoted as community management). A typical example of this is the evolution of the community content moderation mechanisms in "Yahoo! Answer", where they had to oppose the unexpected volume of user spam and troll activity, that seriously risked crashing the site [5].

Figure 2.1 Shows the Website Quality Actors [5]
2.9 Literature Review

In 2010 P.D.D Dominic and Handaru Jati prepared a study titled "the Evaluation Method of Malaysian University Website: Quality Website Using Hybrid Method" in which they evaluated the quality of university Websites. To get results on the quality of a Website, they measured sample data from five university portals and calculated response time, page size, number of item, load, mark validation, and broken link, number of link in search engine, optimization score, accessibility errors, and colorblind webpage filter test. Their proposed model uses a hybrid model which combines Linear Weightage Model and FAHP (Fuzzy Analytical Hierarchy Process) pair wise comparisons and the measure scale to generate the weights for the criteria which are much better and guarantee more fairly preference of criteria. The limitation of this research occurred in the sample size and time factor because it used limited sample size 30 data and taken during short period observation time [1].

P.D.D. Dominic and Handaru Jati, 2010 prepared a study titled "Performance Evaluation on Quality of Asian e-government Websites: an AHP approach." In which they evaluate the quality of Asian e-government Websites. The result of their study confirmed that the Asian e-government Websites is neglecting performance and quality criteria. They present the same result of their previous paper without any additions. Also they have the same limitation and future directions that were noted in their previous research [9].

"Investigating the Effect of Website Quality on e-business Success: an Analytic Hierarchy Process (AHP) approach" is a study prepared by Younghwa Lee and Kenneth Kozar, and published on 6 January 2006. Here, the data were analyzed using Expert Choice: an application implementing AHP. Expert Choice application provides results including local and global weights, priorities for the alternatives, and sensitivity analysis [10].

Adriano Bessa Albuquerque and Arnaldo Dias Belchior prepared a paper titled 'E-Commerce Websites: a Qualitative Evaluation, 2007'. In their paper, all factors obtained a good final evaluation, however, the factors of Security and Integrity obtained the best score of all in the consolidated evaluation. This result portrays the web context, wherein e-commerce is inserted. Because these applications are public, accessed by a vast population of users and it is not hard to find cases of security systems defrauded by hackers who begin to gain access to unauthorized data [11].
Ehsan Rasolinezhad prepared a study titled *Evaluating of the Chosen Electronic Shop Websites in Iran through the Combined AHP/DEA Model, 2006*. In order to avoid these problems (mentioned above), they use the AHP/DEA (Data Envelopment Analysis) approach. Here, at first they used DEA method to construct a pair wise comparison matrix and then to rank, they used AHP method. Their tested- units were 23 chosen electronic shop in Iran[12]. The data were analyzed using Expert Choice, an application implementing AHP. It provides results including local and global weights, priorities for the alternatives, and sensitivity analysis [12].

In 2006, Enrique Herrera-Viedma and Eduardo Peis conducted a study: "*A Fuzzy Linguistic Model to Evaluate the Quality of Websites that Store XML Documents Research*." The main benefits or advantages of the proposed model are:

- It can be easily adapted to different domains such as health, education, etc.
- It uses fuzzy linguistic techniques to model evaluation judgments and the quality ratings and, in such a way, the subjectivity typical of user-system interactions can be managed efficiently. Additionally, this fuzzy tool allows modeling the information in a linguistic way which is closer to the humans.
- It allows weighing the importance of the different quality criteria.
- Diverse application possibilities of the proposed model in the current Web technologies [7].

Gwo-Hshiung Tzeng, Cheng-Hsin Chiang and Chung-Wei Li in 2007, proposed "*the Evaluating Intertwined Effects in E-learning Programs: A Novel Hybrid MCDM Model Based on Factor Analysis and DEMATEL*". In this paper they outline a hybrid MCDM evaluation model for e-learning effectiveness[13]. Based on several aspects of e-learning effectiveness evaluation, the paper integrated several methods to make the proposed model: the hybrid MCDM (Multiple Criteria Decision Making) model, much closer to reality. According to the results of an empirical study, the hybrid MCDM model is a workable and useful model employed to evaluate e-learning effectiveness and to display the interrelations of intertwined criteria. The results show that if the effectiveness of an e-learning program is deficient, the problem will be found out based on AHP weights and interrelation based on the impact digraph-map of each factor [13].

Recently in 201, Xiaobing Yu, Shunsheng Guo, Jun Guo and Xiaorong Huang published their study "*Rank B2C(Business to Consumer) E-commerce Websites in E-alliance Based on AHP and Fuzzy TOPSIS*". They show that the e-alliance
performance is related to the quality of e-alliance, thus ranking e-alliance has significant impacts to the success and efficiency of e-alliance. Subjective or vague data must be considered during the process. Therefore, an effective ranking approach and model are essential to tackle the issue[14]. Here, they proposed a decision approach and model based on AHP and fuzzy TOPSIS. They used AHP to get weights of criteria, while fuzzy TOPSIS is utilized to rank e-commerce Websites. The weights obtained from AHP are included in decision-making process by using them in fuzzy TOPSIS computations and ranking order is determined based on these weights. Since the decisions will influence the efficiency and success of e-alliance, it is better to invite experts to operate. The accuracy of the decision could be improved. Besides, the difficulty in determining the parameters of most criteria forces them to utilize scientific methods. They concluded that the development of a decision approach for ranking e-commerce in e-alliance is very useful and important [14].

Mehrbakhsh Nilashi and Nasim Janahmadi have proposed a research for Assessing and Prioritizing Affecting Factors in E-Learning Websites Using AHP Method and Fuzzy Approach,2012. In their research, they developed a new method of assessment and ranking affecting factors on e-learning Websites through the use of fuzzy logic was presented. Fuzzy logic is the flexible tool for developing and evaluating a model with a simple framework and constructed with natural language. In their paper, they detected three major factors with related sub factors for e-learning Websites that can assist universities and instructors and web designer to evaluate e-learning Websites. Using AHP method, all factors in three groups was ranked and based on important sub factors and a second questionnaire was designed[15]. The findings of their research showed that Website quality, Website content, and Website design affect on e-learning Websites positively. An important finding of the research also showed that the Website quality has the most positive influence on online learners perceive of e-learning Website level[15].

Ramkrishna Lamichhane proposed a study titled: "A Usability Evaluation for Government Websites Of Nepal Using Fuzzy AHP,2011". Here, a multi-criteria, automatic evaluation model for web pages has been developed. It is simple and flexible to implement and makes it possible for measuring qualitative verbal inputs by Fuzzy AHP technique preserving the fuzziness of data inputs. User evaluations are computed to generalize judgments of webpage quality by fuzzy AHP. The proposed model is being compared with general AHP and Triangular AHP by the same set of data for
validation[16]. However, there are some limitations in this work. The cultural effect, age group effect, multilingual effects on usability are not included inside the process but they are other influencing subjective factors in usability. Another important thing is that, due to lack of time and resources during data collection, the adequacy of features and number of experts and users are compromised in the study. But it’s always possible to extend the experiment with a sufficient set of features and number of experts and users by the same technique [16].

Wei baolu, Dai Feng and Liu jingxu proposed "the C2C (Consumer-to-Consumer) E-commerce Risk Assessment Based on AHP and Fuzzy Comprehensive Evaluation, 2011". AHP and fuzzy comprehensive evaluation of the risk assessment C2C e-commerce transactions to resolve the assessment of quantitative assessment of qualitative indicators of the difficulty. By this method, one can calculate the relative risk factors and the C2C e-commerce transaction system's security risk level. By identifying the risk level of C2C e-commerce transactions to increase awareness of security risks; to determine the relative risk factor, one can control risk, reduce risk and transfer risk to make the right judgments. Example proves that the method has a strong scientific and effective tool, can be well applied to risk assessment of C2C e-commerce transactions [17].
3.1 Methodology

Many of the existing Website evaluation methods and criteria for evaluating Website quality are not able to sufficiently assess the performance and quality of a Website. This study aims at proposing new Website quality metrics and methods to measure Websites in terms of load time, response time, page size, image size and number of items.

3.2 Software Development Lifecycle (SDLC)

Application development refers to a software development process used by an application developer to build application systems. Figure 3.1 shows the process which is commonly known as the Software Development Lifecycle (SDLC) methodology and it encompasses all activities to develop an application system and put it into production, including analysis, planning, design, implementation and testing stages.

![Software Development Lifecycle (SDLC)](image)

Figure 3.1 The Software Development Life Cycle (SDLC)

The phases of SDLC are

3.2.1 Planning

Here, five universities Websites (University of Gezira, University of Khartoum, University of Omdurman, university of Sudan Science and Technology university, University of Bahri) are selected. The idea of this research is to apply an AHP model equations to check webpage quality depending on the following characteristics: load time,
response time, image size, page size and number of items. These characteristics have been chosen based on their importance.

3.2.2 Analysis Requirements

The research addressed to design an application with Visual Basic.net software and the use of the AHP model to calculate the weights of the components of Web pages to be assessed and determine the degree of quality. System requires a PC with Basic specifications to download the software. The data are represented by universities name and their webpage to assess their quality. The selection of weights of the university page components depend on the experience of the evaluator. AHP model is widely used as an analytical tool in various fields of studies. Broadly the technique considers the following steps during modeling of any system under consideration:

(a) Defining a site-specific hierarchic structure; as shown in Figure 3.2.

(b) Calculating weights.

(c) Comparing the ratios.

![Hierarchic Structure of the Websites Evaluation](image)

Figure 3.2 The Hierarchic Structure of the Websites Evaluation

At this stage, the system is designed and determined how it should work. First an application with Visual Basic.net software is created and interface is designed with several
components such as textbox to enter the user name and password to log in the application and also has buttons to calculate the weights of components. Each button provides an equation to calculate the weight of an AHP model.

3.3. Model Formulation

The AHP approach, as applied to the supplier selection problem, consists of the following five steps (Nydick and Hill, 1992):

i. Specify the set of criteria for evaluating the Websites.

ii. Obtain the pair wise comparisons of the relative importance of the criteria in achieving the goal, and choose the priorities or weights of the criteria based on this information.

iii. Obtain measures that describe the extent to which each Website achieves the criteria.

iv. Using the information in step iii, obtain the pair wise comparisons of the relative importance of the Websites with respect to the criteria, and compute the corresponding priorities.

v. Using the results of steps ii and iv, compute the priorities of each Website to achieve the required goal.

vi. There are 5 criteria that are being used to evaluate 5 selected university Websites.

vii. This will be applied by steps for the selected scale in the model of AHP:

The first step in the AHP is the estimation of the data in Table 3.1. This is described in the next sub section.
Table 3.1 Scale of Relative Importance (According to Saaty (1980))

<table>
<thead>
<tr>
<th>MEASUREMENT SCALE</th>
<th>Verbal Judgment of Preference</th>
<th>Numerical Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely Preferred</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Very Strongly Preferred</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Strongly Preferred</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Moderately Preferred</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Equally Preferred</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

In this step, a set of pair wise comparisons is set to define the relative importance of the criteria to complete the following matrix (Table 3.2).

Table 3.2 The Selection of Weights Depends on the Importance of Criteria

<table>
<thead>
<tr>
<th></th>
<th>Load time</th>
<th>Response time</th>
<th>Number of items</th>
<th>Image size</th>
<th>Page size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load time</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Response time</td>
<td>0.33</td>
<td>1</td>
<td>5</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Number of items</td>
<td>0.14</td>
<td>0.2</td>
<td>1</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Image size</td>
<td>0.11</td>
<td>0.11</td>
<td>0.2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Page size</td>
<td>0.11</td>
<td>0.11</td>
<td>0.14</td>
<td>0.33</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>1.69</td>
<td>4.42</td>
<td>13.34</td>
<td>24.33</td>
<td>29</td>
</tr>
</tbody>
</table>

The data in the matrix can be used to generate a good estimate of the criteria weights. The weights provide a measure of the relative importance of each criterion.

This process is summarized in the following three steps, and shown in the Table 3.3:

1. Sum the elements in each column.
2. Divide each value by its column sum.
3. Compute row averages
Next, the five Websites must be compared pair wise for each criterion. This process is virtually identical to the procedure that was used to develop the criteria comparison matrix. The only difference is that there is a Websites comparison matrix for each criterion. Therefore, the decision maker compares each pair of Websites with respect to the quality criterion, as shown in Table 3.5:

### Table 3.4 AHP Case Study: Load Time Matrix

<table>
<thead>
<tr>
<th></th>
<th>University of Khartoum</th>
<th>University of Gezira</th>
<th>University of Sudan</th>
<th>University of Omdurman</th>
<th>University of Bahri</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Khartoum</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>University of Gezira</td>
<td>0.3333</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>University of Sudan</td>
<td>1</td>
<td>0.3333</td>
<td>1</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>University of Omdurman</td>
<td>0.1</td>
<td>0.1428</td>
<td>0.1111</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>University of Bahri</td>
<td>0.3333</td>
<td>0.2</td>
<td>0.2</td>
<td>0.3333</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>2.87</td>
<td>4.68</td>
<td>2.31</td>
<td>22.33</td>
<td>17</td>
</tr>
</tbody>
</table>

### Table 3.5 AHP Case Study: Calculate the Weights of Load Time

<table>
<thead>
<tr>
<th></th>
<th>University of Khartoum</th>
<th>University of Gezira</th>
<th>University of Sudan</th>
<th>University of Omdurman</th>
<th>University of Bahri</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Khartoum</td>
<td>0.35</td>
<td>0.64</td>
<td>0.43</td>
<td>0.22</td>
<td>0.18</td>
<td>0.36</td>
</tr>
<tr>
<td>University of Gezira</td>
<td>0.12</td>
<td>0.21</td>
<td>1.30</td>
<td>0.31</td>
<td>0.29</td>
<td>0.45</td>
</tr>
<tr>
<td>University of Sudan</td>
<td>0.35</td>
<td>0.07</td>
<td>0.43</td>
<td>0.40</td>
<td>0.29</td>
<td>0.31</td>
</tr>
<tr>
<td>University of Omdurman</td>
<td>0.07</td>
<td>0.03</td>
<td>0.05</td>
<td>0.04</td>
<td>0.18</td>
<td>0.07</td>
</tr>
<tr>
<td>University of Bahri</td>
<td>0.12</td>
<td>0.04</td>
<td>0.09</td>
<td>0.01</td>
<td>0.06</td>
<td>0.06</td>
</tr>
</tbody>
</table>
Table 3.6 AHP Case Study: Response Time Matrix

<table>
<thead>
<tr>
<th></th>
<th>University of Khartoum</th>
<th>University of Gezira</th>
<th>University of Sudan</th>
<th>University of Omdurman</th>
<th>University of Bahri</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Khartoum</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>University of Gezira</td>
<td>0.2</td>
<td>1</td>
<td>7</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>University of Sudan</td>
<td>0.3333</td>
<td>0.1428</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>University of Omdurman</td>
<td>0.1111</td>
<td>0.2</td>
<td>0.3333</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>University of Bahri</td>
<td>0.3333</td>
<td>0.1428</td>
<td>0.2</td>
<td>18.11</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1.98</strong></td>
<td><strong>6.49</strong></td>
<td><strong>11.53</strong></td>
<td><strong>18.11</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>

Table 3.7 AHP Case Study: Calculate the Weights of Response Time

<table>
<thead>
<tr>
<th></th>
<th>University of Khartoum</th>
<th>University of Gezira</th>
<th>University of Sudan</th>
<th>University of Omdurman</th>
<th>University of Bahri</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Khartoum</td>
<td>0.51</td>
<td>0.77</td>
<td>0.26</td>
<td>0.50</td>
<td>0.12</td>
<td>10.53</td>
</tr>
<tr>
<td>University of Gezira</td>
<td>0.10</td>
<td>0.15</td>
<td>0.61</td>
<td>0.28</td>
<td>0.28</td>
<td>0.28</td>
</tr>
<tr>
<td>University of Sudan</td>
<td>0.17</td>
<td>0.02</td>
<td>0.09</td>
<td>0.17</td>
<td>0.50</td>
<td>0.19</td>
</tr>
<tr>
<td>University of Omdurman</td>
<td>0.06</td>
<td>1.40</td>
<td>0.03</td>
<td>0.06</td>
<td>0.36</td>
<td>0.38</td>
</tr>
<tr>
<td>University of Bahri</td>
<td>0.17</td>
<td>0.02</td>
<td>0.02</td>
<td>0.01</td>
<td>0.04</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Table 3.8 AHP Case Study: Number of Items Matrix

<table>
<thead>
<tr>
<th></th>
<th>University of Khartoum</th>
<th>University of Gezira</th>
<th>University of Sudan</th>
<th>University of Omdurman</th>
<th>University of Bahri</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Khartoum</td>
<td>1</td>
<td>5</td>
<td>9</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>University of Gezira</td>
<td>0.2</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>University of Sudan</td>
<td>0.1111</td>
<td>0.3333</td>
<td>1</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>University of Omdurman</td>
<td>0.1428</td>
<td>0.2</td>
<td>0.1428</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>University of Bahri</td>
<td>0.3333</td>
<td>1</td>
<td>0.2</td>
<td>0.3333</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1.79</strong></td>
<td><strong>7.53</strong></td>
<td><strong>13.34</strong></td>
<td><strong>20.33</strong></td>
<td><strong>13</strong></td>
</tr>
</tbody>
</table>
Table 3.9 AHP Case Study: Calculate the Weights of Number of Items Matrix

<table>
<thead>
<tr>
<th>University of Khartoum</th>
<th>University of Gezira</th>
<th>University of Sudan</th>
<th>University of Omdurman</th>
<th>University of Bahri</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Khartoum</td>
<td>0.56</td>
<td>0.66</td>
<td>0.67</td>
<td>0.34</td>
<td>0.23</td>
</tr>
<tr>
<td>University of Gezira</td>
<td>0.11</td>
<td>0.13</td>
<td>0.22</td>
<td>0.25</td>
<td>0.08</td>
</tr>
<tr>
<td>University of Sudan</td>
<td>0.06</td>
<td>0.04</td>
<td>0.07</td>
<td>0.34</td>
<td>0.38</td>
</tr>
<tr>
<td>University of Omdurman</td>
<td>0.08</td>
<td>0.03</td>
<td>0.01</td>
<td>0.05</td>
<td>0.23</td>
</tr>
<tr>
<td>University of Bahri</td>
<td>0.19</td>
<td>0.13</td>
<td>0.01</td>
<td>0.02</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Table 3.10 AHP Example: Image Size Matrix

<table>
<thead>
<tr>
<th>University of Khartoum</th>
<th>University of Gezira</th>
<th>University of Sudan</th>
<th>University of Omdurman</th>
<th>University of Bahri</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Khartoum</td>
<td>1</td>
<td>9</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>University of Gezira</td>
<td>0.1111</td>
<td>1</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>University of Sudan</td>
<td>0.3333</td>
<td>0.1428</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>University of Omdurman</td>
<td>0.3333</td>
<td>0.1111</td>
<td>0.3333</td>
<td>1</td>
</tr>
<tr>
<td>University of Bahri</td>
<td>1</td>
<td>0.2</td>
<td>0.2</td>
<td>0.1428</td>
</tr>
<tr>
<td>Total</td>
<td>2.78</td>
<td>10.45</td>
<td>11.53</td>
<td>16.14</td>
</tr>
</tbody>
</table>

Table 3.11 AHP Case Study: Calculate the Weights of Image Size

<table>
<thead>
<tr>
<th>University of Khartoum</th>
<th>University of Gezira</th>
<th>University of Sudan</th>
<th>University of Omdurman</th>
<th>University of Bahri</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Khartoum</td>
<td>0.36</td>
<td>0.86</td>
<td>0.26</td>
<td>0.19</td>
<td>0.05</td>
</tr>
<tr>
<td>University of Gezira</td>
<td>0.04</td>
<td>0.10</td>
<td>0.61</td>
<td>0.56</td>
<td>0.26</td>
</tr>
<tr>
<td>University of Sudan</td>
<td>0.12</td>
<td>0.01</td>
<td>0.09</td>
<td>0.19</td>
<td>0.26</td>
</tr>
<tr>
<td>University of Omdurman</td>
<td>0.12</td>
<td>0.01</td>
<td>0.03</td>
<td>0.06</td>
<td>0.37</td>
</tr>
<tr>
<td>University of Bahri</td>
<td>0.36</td>
<td>0.02</td>
<td>0.02</td>
<td>0.01</td>
<td>0.05</td>
</tr>
</tbody>
</table>
### Table 3.12 AHP Case Study: Page Size Matrix

<table>
<thead>
<tr>
<th></th>
<th>University of Khartoum</th>
<th>University of Gezira</th>
<th>University of Sudan</th>
<th>University of Omdurman</th>
<th>University of Bahri</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Khartoum</td>
<td>1</td>
<td>9</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>University of Gezira</td>
<td>0.1111</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>University of Sudan</td>
<td>0.2</td>
<td>0.1428</td>
<td>1</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>University of Omdurman</td>
<td>0.3333</td>
<td>1</td>
<td>0.1428</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>University of Bahri</td>
<td>0.3333</td>
<td>0.2</td>
<td>1</td>
<td>0.1428</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>1.98</td>
<td>11.34</td>
<td>14.14</td>
<td>12.14</td>
<td>17</td>
</tr>
</tbody>
</table>

### Table 3.13 AHP Case Study: Calculate the Weights of Page Size

<table>
<thead>
<tr>
<th></th>
<th>University of Khartoum</th>
<th>University of Gezira</th>
<th>University of Sudan</th>
<th>University of Omdurman</th>
<th>University of Bahri</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Khartoum</td>
<td>0.51</td>
<td>0.79</td>
<td>0.35</td>
<td>0.25</td>
<td>0.18</td>
<td>0.42</td>
</tr>
<tr>
<td>University of Gezira</td>
<td>0.06</td>
<td>0.09</td>
<td>0.50</td>
<td>0.08</td>
<td>0.29</td>
<td>0.20</td>
</tr>
<tr>
<td>University of Sudan</td>
<td>0.10</td>
<td>0.01</td>
<td>0.07</td>
<td>0.58</td>
<td>0.06</td>
<td>0.16</td>
</tr>
<tr>
<td>University of Omdurman</td>
<td>0.17</td>
<td>0.09</td>
<td>0.01</td>
<td>0.08</td>
<td>0.41</td>
<td>0.15</td>
</tr>
<tr>
<td>University of Bahri</td>
<td>0.17</td>
<td>0.02</td>
<td>0.07</td>
<td>0.01</td>
<td>0.06</td>
<td>0.07</td>
</tr>
</tbody>
</table>

### Table 3.14: Criteria Weights and Alternative (Websites) weights:

<table>
<thead>
<tr>
<th></th>
<th>Weights</th>
<th>University of Khartoum</th>
<th>University of Gezira</th>
<th>University of Sudan</th>
<th>University of Omdurman</th>
<th>University of Bahri</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load time</td>
<td>0.4950</td>
<td>0.36</td>
<td>0.45</td>
<td>0.31</td>
<td>0.07</td>
<td>0.06</td>
</tr>
<tr>
<td>Response time</td>
<td>0.2953</td>
<td>10.53</td>
<td>0.28</td>
<td>0.19</td>
<td>0.38</td>
<td>0.02</td>
</tr>
<tr>
<td>Number of items</td>
<td>0.1299</td>
<td>0.49</td>
<td>0.16</td>
<td>0.18</td>
<td>0.04</td>
<td>0.09</td>
</tr>
<tr>
<td>Image size</td>
<td>0.0499</td>
<td>0.34</td>
<td>0.31</td>
<td>0.13</td>
<td>0.12</td>
<td>0.09</td>
</tr>
<tr>
<td>Page size</td>
<td>0.0297</td>
<td>0.42</td>
<td>0.20</td>
<td>0.16</td>
<td>0.15</td>
<td>0.07</td>
</tr>
</tbody>
</table>
Table 3.15: The Final Matrix of University Websites (calculate the degree of quality)

<table>
<thead>
<tr>
<th>University of Khartoum</th>
<th>Load time</th>
<th>Response time</th>
<th>Number of items</th>
<th>Image size</th>
<th>Page size</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Gezira</td>
<td>0.22</td>
<td>0.08</td>
<td>0.02</td>
<td>0.01</td>
<td>0.01</td>
<td>0.35</td>
</tr>
<tr>
<td>University of Sudan</td>
<td>0.15</td>
<td>0.06</td>
<td>0.02</td>
<td>0.05</td>
<td>0.04</td>
<td>0.29</td>
</tr>
<tr>
<td>University of Omdurman</td>
<td>0.03</td>
<td>0.11</td>
<td>0.01</td>
<td>0.04</td>
<td>0.02</td>
<td>0.07</td>
</tr>
<tr>
<td>University of Bahri</td>
<td>0.03</td>
<td>0.01</td>
<td>0.01</td>
<td>0.00</td>
<td>0.02</td>
<td></td>
</tr>
</tbody>
</table>

According to the previous results, the highest weight goes to University of Khartoum, and is judged to be the best of all. After University of Khartoum comes University of Gezira, but University of Sudan of Science and Technology and Omdurman Islamic University has the same quality in the last rank comes University of Bahri.

3.2.3 Design

At this stage the system is designed and determined how it should work. First an application is created using Visual Basic.net software and design an interface with several components such as textbox to enter the user name and password to log in the application, and also with buttons to calculate the weights of components. Page each button is provided with an equation to calculate the weight of a given model using an algorithm. Finally, through the total weight one can locate the page quality rank compared to other pages.

3.2.4 Implementation

\[
\begin{bmatrix}
1 & \cdots & a_{1n} \\
\vdots & \ddots & \vdots \\
a_{1n} & \cdots & 1
\end{bmatrix} 
\]

……………… (1) (Saaty : 2002:218 )

Where \( a_{ij} \) are elements in AHP model

In the implementation phase, the equations that have been applied in the previous tables will be clarified.
a) Preparation of A norm natural matrix by a process of division of each element in the matrix A in column i to the sum of all elements in the same column as follows:

$$ R_{ij} = \frac{a_{ij}}{\sum_{i=1}^{N} a_{ij}} \quad \ldots \ldots \ldots \ldots \ldots (2) \quad \text{(Saaty : 2002:219 )} $$

Where \( i=1, 2\ldots \ldots N \)

Where \( R_{ij} \) Natural element of the matrix Anorm

We apply this equation to the previous tables of matrixes

b) Calculate weights matrix "W", if one represents these weights vectors preference among alternatives according to the criteria, for example, calculate the weight of the row (i), which represents a variant of the matrix "W" grade average of the elements of the matrix A also comes:

$$ W_i = \left( \frac{1}{N} \right) \sum_{j=1}^{N} r_{ij} \quad \ldots \ldots \ldots \ldots \ldots (3) $$

Where \( W_i \) : Represents the preference vector Or What called Priority vector.

Where \( i=1, 2\ldots \ldots N \)

This equation is applied to the previous tables of Normalized.

In the next chapter the results will be shown after the design of a program and associate it with these equations.

In this phase, the system is applied to the organization that need assessment and then determine the degree of quality. To improve the design of the front and improve the degree of quality.

**3.2.5 Testing**

During the test stage, the and test data are migrated from the development environment to a separate test environment. At this point, all test cases are run to verify the correctness and completeness of the software. Successful execution of the test suite confirms a robust and complete migration capability.
4.1 Results of Evaluation Selected Websites

According to the results shown in Table (3.11), the Khartoum University has highest weight (3.38), and is judged to be the best of all. After University of Khartoum comes University of Gezira (0.35) followed by both University of Sudan of Science and Technology and the Omdurman Islamic University (0.29) which have the same quality and finally University of Bahri (0.07) comes last.

Table 4.1 The Details of Collected Data

<table>
<thead>
<tr>
<th>University Name</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Khartoum</td>
<td><a href="http://www.uofk.edu">www.uofk.edu</a></td>
</tr>
<tr>
<td>University of Gezira</td>
<td><a href="http://www.uofg.edu.sd">www.uofg.edu.sd</a></td>
</tr>
<tr>
<td>University of Sudan of Science and Technology</td>
<td><a href="http://www.sustech.edu.sd">www.sustech.edu.sd</a></td>
</tr>
<tr>
<td>Omdurman Islamic University</td>
<td><a href="http://www.oiu.edu.sd">www.oiu.edu.sd</a></td>
</tr>
<tr>
<td>University of Bahri</td>
<td><a href="http://www.Bahri.edu.sd">www.Bahri.edu.sd</a></td>
</tr>
</tbody>
</table>

In the end, we have designed the application for domain experts to help them to determine the appropriate weights easily, this application depend on an algorithm to calculate the final values which determine the highest value to be in the first level, and other levels for other value.

In the following we will explain the system’s screens and show how it works:

Figure: 4.1. Evaluator Name and Password Interface

The first steps in this application: the user name and password are entered to login.
Welcome screen and the definition of the name of the application appear next.

In this screen, there are dropdown lists to determine what the evaluators want, they can evaluate. Also there are two lists: file list and help list.
Either choose the evaluation and go to evaluation screen or choose the second option for the report to see the latest report of assessment or choose the final option to exit from the application.

In this list there is only one option that shows what is the AHP model.
Figure: 4.6 The Evaluation of the University Interface

After selecting the evaluation from the File menu, the screen shown above appears, which contains a number of components the beginning of a list containing the universities to be assessed and it also shows the characteristics of the Universities pages (load time, response time, number of items, page size, image size), shown with weights and then the calculate button shows the values for each of the above characteristics depending on the algorithm.
Figure: 4.7 Selecting Universities and Weights of the Characteristics in the Evaluation Universities Interface

In this screen, the evaluator chooses the universities to be assessed and the characteristics weights of the universities pages, after that the evaluator clicks the calculate button of the load time.
Figure: 4.8 Selecting Gezira and Khartoum Universities and the Weights of the Characteristics

In this step the evaluator selects two universities beginning with Gezira and press on the add university button and then appear on the list box and repeats same operation is related with the University of Khartoum then we can press on the radio button of the weight of the load time and choose any weight i.e. (1,3,5,7,9) based on the experience of evaluator after that press calculate button of the load time and then select the new weight for the response time and then we press on the calculate button of the response time.
Figure: 4.9 Selection of Weights for the Other Characteristics

In this step the evaluator selects the weight of the number of items, page size, image size and after that calculates their values.
Figure: 4.10 Go to Criteria Interface

After the evaluator calculates all of the characteristics weights for the universities’ Websites, he or she presses on the criteria button to go to criteria screen.
Figure: 4.11 Criteria Interface

In this step the evaluator evaluates the characteristics of web pages, also selecting the weights of any two characteristics.
Figure: 4.12 Final Results

In this step the evaluator calculates the values of final array and then presses on result button to see the final score of universities. As it shown the University of Gezira takes 0.013 less than University of Khartoum which takes 0.027 this means that University of Khartoum is better than University of Gezira in terms of the comparative characteristics.
This screen shows the final score of the universities in the form of a report. This screen can be opened from the main screen and then go to file list and then select report option.

Figure: 4.13 Report Interface

This figure shows the differentiation between universities sites.

Figure: 4.14 Graph Interface
5.1 Conclusion

This research identifies the application of the AHP method in the process of selection of an optimal university webpage using specific criteria. This method is used in decision-making when there is no perceptible information about preference alternatives. It is based on selecting weights of the alternatives depending on the specific characteristics, and weights of the characteristics depending on preference alternatives. The Selection of weights for sites based on expert.

5.2 Recommendation

We recommend developing an application to a Web page through which the analysis of university page components to be assessed and give the final score according to the result of analysis the characteristics of pages that comparing.
Reference


Appendix A

Public Class Form3

    Private Sub Button1_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button1.Click
        If TextBox1.Text = "noon" And TextBox2.Text = "123" Then
            'Form1.Show()
            wel.Show()
            Me.Hide()
        Else
            MsgBox("خطأ المستخدم اسم أو السر كلمة")
        End If
    End Sub

End Class

Public Class main

    Private Sub AboutToolStripMenuItem_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles AboutToolStripMenuItem.Click
        frmAHP.Show()
    End Sub

    Private Sub ExitToolStripMenuItem_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles ExitToolStripMenuItem.Click
    End
    End Sub

    Private Sub ReportToolStripMenuItem_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles ReportToolStripMenuItem.Click
        frmReport.Show()
    End Sub

    Private Sub EvaluationToolStripMenuItem_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles EvaluationToolStripMenuItem.Click
        Form1.Show()
    End Sub

End Class
Module Module1
    Public sumev(10) As Double
    Public sumcra(10) As Double
    Public sumload(10) As Double
    Public sumresponse(10) As Double
    Public sumnumber(10) As Double
    Public sumpage(10) As Double
    Public sumimage(10) As Double
    Public n, i, j As Integer
    Public lr, sr, mr, hr, nr, cr, kr, ar, dr, gr As Integer
    Public aa As New List(Of String)
End Module

Public Class Form1
    Private Sub Button1_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button1.Click
        If n1.Checked = True Then
            ' ListBox1.length
            n = 2
        ElseIf n2.Checked = True Then
            n = 3
        ElseIf n3.Checked = True Then
            n = 4
        ElseIf n4.Checked = True Then
            n = 5
        End If
        ListBox1.Items.Add(Combouniv.SelectedItem)
    End Sub

    Private Sub GroupBox1_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles GroupBox1.Click
        GroupBox2.Visible = True
    End Sub

    Private Sub Form1_Load(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles MyBase.Load
        Dim i As Integer
        Dim y() As String = {"0", "Equal preference", "2", "Moderately preference", "4", "Strong preference", "6", "Very strong preference", "8", "Absolute preference"}
        For i = 1 To 9

i += 1
Next i
GroupBox13.Visible = False
GroupBox12.Visible = False
GroupBox14.Visible = False
GroupBox15.Visible = False
GroupBox13.Visible = False
GroupBox12.Visible = False
GroupBox14.Visible = False
GroupBox15.Visible = False
GroupBox8.Visible = False
GroupBox9.Visible = False
GroupBox11.Visible = False
GroupBox16.Visible = False
GroupBox18.Visible = False
GroupBox19.Visible = False
End Sub

Private Sub RadioButton21_CheckedChanged(ByVal sender As System.Object, ByVal e As System.EventArgs)

End Sub

Private Sub Button2_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button2.Click

If un11.Checked = True Then
    sr = 1
ElseIf un12.Checked = True Then
    sr = 3
ElseIf un13.Checked = True Then
    sr = 5
ElseIf un14.Checked = True Then
    sr = 7
ElseIf un15.Checked = True Then
    sr = 9
End If
'--------------------------------------
If un21.Checked = True Then
    mr = 1
ElseIf un22.Checked = True Then

endif
mr = 3
ElseIf un23.Checked = True Then
    mr = 5
ElseIf un24.Checked = True Then
    mr = 7
ElseIf un25.Checked = True Then
    mr = 9
End If
'..............................................

If un31.Checked = True Then
    lr = 1
ElseIf un32.Checked = True Then
    lr = 3
ElseIf un33.Checked = True Then
    lr = 5
ElseIf un34.Checked = True Then
    lr = 7
ElseIf un35.Checked = True Then
    lr = 9
End If
'..............................................

If un41.Checked = True Then
    hr = 1
ElseIf un42.Checked = True Then
    hr = 3
ElseIf un43.Checked = True Then
    hr = 5
ElseIf un44.Checked = True Then
    hr = 7
ElseIf un45.Checked = True Then
    hr = 9
End If
'..............................................

If un51.Checked = True Then
    nr = 1
ElseIf un52.Checked = True Then
    nr = 3
ElseIf un53.Checked = True Then
    nr = 5
ElseIf un54.Checked = True Then
    nr = 7
ElseIf un55.Checked = True Then
nr = 9
End If
'''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
dr = 3
ElseIf un93.Checked = True Then
dr = 5
ElseIf un94.Checked = True Then
dr = 7
ElseIf un95.Checked = True Then
dr = 9
End If

If un101.Checked = True Then
gr = 1
ElseIf un102.Checked = True Then
gr = 3
ElseIf un103.Checked = True Then
gr = 5
ElseIf un104.Checked = True Then
gr = 7
ElseIf un105.Checked = True Then
gr = 9
End If

Dim y(10, 10) As Double
For i = 1 To n
    For j = 1 To n
        If (i = j) Then
            y(i, j) = 1
        ElseIf (i = 1 And i + 1 = j) Then
            y(i, j) = sr
        ElseIf (i = 1 And i + 2 = j) Then
            y(i, j) = mr
        ElseIf (i = 2 And i = j + 1) Then
            y(i, j) = 1 / sr
        ElseIf (i = 2 And i = j - 1) Then
            y(i, j) = lr
        ElseIf (i = 3 And i = j + 2) Then
            y(i, j) = 1 / mr
        ElseIf (i = 3 And i = j + 1) Then
            y(i, j) = 1 / lr
        ElseIf (i = 1 And i + 3 = j) Then
            y(i, j) = hr
    End If
End For
End For
ElseIf (i = 4 And i = j + 3) Then
    y(i, j) = 1 / hr
ElseIf (i = 2 And i + 2 = j) Then
    y(i, j) = nr
ElseIf (i = 4 And i = j + 2) Then
    y(i, j) = 1 / nr
ElseIf (i = 3 And i + 1 = j) Then
    y(i, j) = cr
ElseIf (i = 4 And i = j + 1) Then
    y(i, j) = 1 / cr
ElseIf (i = 1 And i + 4 = j) Then
    y(i, j) = kr
ElseIf (i = 5 And i = j + 4) Then
    y(i, j) = 1 / kr
ElseIf (i = 2 And i + 3 = j) Then
    y(i, j) = ar
ElseIf (i = 5 And i = j + 3) Then
    y(i, j) = 1 / ar
ElseIf (i = 3 And i + 2 = j) Then
    y(i, j) = dr
ElseIf (i = 5 And i = j + 2) Then
    y(i, j) = 1 / dr
ElseIf (i = 4 And i + 1 = j) Then
    y(i, j) = gr
ElseIf (i = 5 And i = j + 1) Then
    y(i, j) = 1 / gr
End If
Next j
Next i

' Dim sumload(10) As Double
For i = 1 To n
    For j = 1 To n
        'ComboBox1.Items.Add(y(i, j))
        ListBox2.Items.Add(Math.Round(y(i, j), 3))
    Next j
Next i

'-----------------------------------------
For j = 1 To n
    For i = 1 To n
        sumload(j) = sumload(j) + y(i, j)
    Next i
Next j

For j = 1 To n
    ComboBox2.Items.Add(sumload(j))
    ListBox3.Items.Add(Math.Round(sumload(j), 3))
Next j

Dim ldiv(10, 10) As Double
For j = 1 To n
    For i = 1 To n
        ldiv(i, j) = y(i, j) / sumload(j)
    Next i
Next j

For i = 1 To n
    For j = 1 To n
        ComboBox3.Items.Add(ldiv(i, j))
        ListBox4.Items.Add(Math.Round(ldiv(i, j), 3))
    Next j
Next i

For i = 1 To n
    For j = 1 To n
        sumload(i) = sumload(i) + ldiv(i, j)
    Next j
Next i

For i = 1 To n
    For j = 1 To n
        sumload(i) = sumload(i) / n
    Next j
Next i

For i = 1 To n
    ComboBox4.Items.Add(sumload(i))
    ListBox5.Items.Add(Math.Round(sumload(i), 3))
Next i

End Sub
Private Sub Button5_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button5.Click

    If un11.Checked = True Then
        sr = 1
    ElseIf un12.Checked = True Then
        sr = 3
    ElseIf un13.Checked = True Then
        sr = 5
    ElseIf un14.Checked = True Then
        sr = 7
    ElseIf un15.Checked = True Then
        sr = 9
    End If
    '--------------------------------------
    If un21.Checked = True Then
        mr = 1
    ElseIf un22.Checked = True Then
        mr = 3
    ElseIf un23.Checked = True Then
        mr = 5
    ElseIf un24.Checked = True Then
        mr = 7
    ElseIf un25.Checked = True Then
        mr = 9
    End If
    '----------------------------------------
    If un31.Checked = True Then
        lr = 1
    ElseIf un32.Checked = True Then
        lr = 3
    ElseIf un33.Checked = True Then
        lr = 5
    ElseIf un34.Checked = True Then
        lr = 7
    ElseIf un35.Checked = True Then
        lr = 9
    End If
    '-------------------------------------------
    If un41.Checked = True Then
        hr = 1
    End If

End Sub
ElseIf un42.Checked = True Then
  hr = 3
ElseIf un43.Checked = True Then
  hr = 5
ElseIf un44.Checked = True Then
  hr = 7
ElseIf un45.Checked = True Then
  hr = 9
End If

ElseIf un51.Checked = True Then
  nr = 1
ElseIf un52.Checked = True Then
  nr = 3
ElseIf un53.Checked = True Then
  nr = 5
ElseIf un54.Checked = True Then
  nr = 7
ElseIf un55.Checked = True Then
  nr = 9
End If

ElseIf un61.Checked = True Then
  cr = 1
ElseIf un62.Checked = True Then
  cr = 3
ElseIf un63.Checked = True Then
  cr = 5
ElseIf un64.Checked = True Then
  cr = 7
ElseIf un65.Checked = True Then
  cr = 9
End If

ElseIf un71.Checked = True Then
  kr = 1
ElseIf un72.Checked = True Then
  kr = 3
ElseIf un73.Checked = True Then
  kr = 5
ElseIf un74.Checked = True Then
  kr = 7
End If
ElseIf un75.Checked = True Then
    kr = 9
End If

ElseIf un81.Checked = True Then
    ar = 1
ElseIf un82.Checked = True Then
    ar = 3
ElseIf un83.Checked = True Then
    ar = 5
ElseIf un84.Checked = True Then
    ar = 7
ElseIf un85.Checked = True Then
    ar = 9
End If

ElseIf un91.Checked = True Then
    dr = 1
ElseIf un92.Checked = True Then
    dr = 3
ElseIf un93.Checked = True Then
    dr = 5
ElseIf un94.Checked = True Then
    dr = 7
ElseIf un95.Checked = True Then
    dr = 9
End If

ElseIf un101.Checked = True Then
    gr = 1
ElseIf un102.Checked = True Then
    gr = 3
ElseIf un103.Checked = True Then
    gr = 5
ElseIf un104.Checked = True Then
    gr = 7
ElseIf un105.Checked = True Then
    gr = 9
End If

' MsgBox(lr)
' MsgBox(n)
Dim y(10, 10) As Double
For i = 1 To n
    For j = 1 To n
        If (i = j) Then
            y(i, j) = 1
        ElseIf (i = 1 And i + 1 = j) Then
            y(i, j) = sr
        ElseIf (i = 1 And i + 2 = j) Then
            y(i, j) = mr
        ElseIf (i = 2 And i = j + 1) Then
            y(i, j) = 1 / sr
        ElseIf (i = 2 And i = j - 1) Then
            y(i, j) = lr
        ElseIf (i = 3 And i = j + 2) Then
            y(i, j) = 1 / mr
        ElseIf (i = 3 And i = j + 1) Then
            y(i, j) = 1 / lr
        ElseIf (i = 1 And i + 3 = j) Then
            y(i, j) = hr
        ElseIf (i = 4 And i = j + 3) Then
            y(i, j) = 1 / hr
        ElseIf (i = 2 And i + 2 = j) Then
            y(i, j) = nr
        ElseIf (i = 4 And i = j + 2) Then
            y(i, j) = 1 / nr
        ElseIf (i = 3 And i + 1 = j) Then
            y(i, j) = cr
        ElseIf (i = 4 And i = j + 1) Then
            y(i, j) = 1 / cr
        ElseIf (i = 1 And i + 4 = j) Then
            y(i, j) = kr
        ElseIf (i = 5 And i = j + 4) Then
            y(i, j) = 1 / kr
        ElseIf (i = 2 And i + 3 = j) Then
            y(i, j) = ar
        ElseIf (i = 5 And i = j + 3) Then
            y(i, j) = 1 / ar
        ElseIf (i = 3 And i + 2 = j) Then
            y(i, j) = dr
        ElseIf (i = 5 And i = j + 2) Then
            y(i, j) = 1 / dr
    Next j
Next i
ElseIf (i = 4 And i + 1 = j) Then
    y(i, j) = gr
ElseIf (i = 5 And i = j + 1) Then
    y(i, j) = 1 / gr
End If
Next j
Next i

' Dim sumnumber(10) As Double
For i = 1 To n
    For j = 1 To n
        'ComboBox9.Items.Add(y(i, j))
        ListBox10.Items.Add(Math.Round(y(i, j), 3))
    Next j
Next i

'-----------------------------------------
For j = 1 To n
    For i = 1 To n
        sumnumber(j) = sumnumber(j) + y(i, j)
    Next i
Next j
'------------------------------------------
For j = 1 To n
    'ComboBox10.Items.Add(sumnumber(j))
    ListBox11.Items.Add(Math.Round(sumnumber(j), 3))
Next j
'-------------------------------
Dim ldiv(10, 10) As Double
For j = 1 To n
    For i = 1 To n
        ldiv(i, j) = y(i, j) / sumnumber(j)
    Next i
Next j
'-------------------------------
For i = 1 To n
    For j = 1 To n
        'ComboBox11.Items.Add(ldiv(i, j))
        ListBox12.Items.Add(Math.Round(ldiv(i, j), 3))
    Next j
Next i
'-------------------------------
For j = 1 To n
    sumnumber(i) = sumnumber(i) + ldiv(i, j)
Next j
Next i

'-------------------------------------------
For i = 1 To n
    For j = 1 To n
        sumnumber(i) = sumnumber(i) / n
    Next j
Next i
'--------------------------------------------
For i = 1 To n
    ComboBox12.Items.Add(sumnumber(i))
    ListBox13.Items.Add(Math.Round(sumnumber(i), 3))
Next i
End Sub

Private Sub n3_CheckedChanged(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles n3.CheckedChanged
    GroupBox13.Visible = True
    GroupBox12.Visible = True
    GroupBox14.Visible = True
    GroupBox15.Visible = True
    GroupBox8.Visible = True
    GroupBox9.Visible = True
    GroupBox11.Visible = False
    GroupBox16.Visible = False
    GroupBox18.Visible = False
    GroupBox19.Visible = False
End Sub

Private Sub n2_CheckedChanged(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles n2.CheckedChanged
    GroupBox13.Visible = True
    GroupBox12.Visible = False
    GroupBox14.Visible = True
    GroupBox15.Visible = True
    GroupBox8.Visible = False
    GroupBox9.Visible = False
    GroupBox11.Visible = False
    GroupBox16.Visible = False
    GroupBox18.Visible = False
End Sub
GroupBox18.Visible = False
GroupBox19.Visible = False
End Sub

Private Sub Button4_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button4.Click

If un11.Checked = True Then
    sr = 1
ElseIf un12.Checked = True Then
    sr = 3
ElseIf un13.Checked = True Then
    sr = 5
ElseIf un14.Checked = True Then
    sr = 7
ElseIf un15.Checked = True Then
    sr = 9
End If

If un21.Checked = True Then
    mr = 1
ElseIf un22.Checked = True Then
    mr = 3
ElseIf un23.Checked = True Then
    mr = 5
ElseIf un24.Checked = True Then
    mr = 7
ElseIf un25.Checked = True Then
    mr = 9
End If

If un31.Checked = True Then
    lr = 1
ElseIf un32.Checked = True Then
    lr = 3
ElseIf un33.Checked = True Then
    lr = 5
ElseIf un34.Checked = True Then
    lr = 7
ElseIf un35.Checked = True Then
    lr = 9
End If
lr = 9
End If

If un41.Checked = True Then
    hr = 1
ElseIf un42.Checked = True Then
    hr = 3
ElseIf un43.Checked = True Then
    hr = 5
ElseIf un44.Checked = True Then
    hr = 7
ElseIf un45.Checked = True Then
    hr = 9
End If

If un51.Checked = True Then
    nr = 1
ElseIf un52.Checked = True Then
    nr = 3
ElseIf un53.Checked = True Then
    nr = 5
ElseIf un54.Checked = True Then
    nr = 7
ElseIf un55.Checked = True Then
    nr = 9
End If

If un61.Checked = True Then
    cr = 1
ElseIf un62.Checked = True Then
    cr = 3
ElseIf un63.Checked = True Then
    cr = 5
ElseIf un64.Checked = True Then
    cr = 7
ElseIf un65.Checked = True Then
    cr = 9
End If

If un71.Checked = True Then
    kr = 1
ElseIf un72.Checked = True Then
kr = 3
ElseIf un73.Checked = True Then
    kr = 5
ElseIf un74.Checked = True Then
    kr = 7
ElseIf un75.Checked = True Then
    kr = 9
End If

If un81.Checked = True Then
    ar = 1
ElseIf un82.Checked = True Then
    ar = 3
ElseIf un83.Checked = True Then
    ar = 5
ElseIf un84.Checked = True Then
    ar = 7
ElseIf un85.Checked = True Then
    ar = 9
End If

If un91.Checked = True Then
    dr = 1
ElseIf un92.Checked = True Then
    dr = 3
ElseIf un93.Checked = True Then
    dr = 5
ElseIf un94.Checked = True Then
    dr = 7
ElseIf un95.Checked = True Then
    dr = 9
End If

If un101.Checked = True Then
    gr = 1
ElseIf un102.Checked = True Then
    gr = 3
ElseIf un103.Checked = True Then
    gr = 5
ElseIf un104.Checked = True Then
    gr = 7
ElseIf un105.Checked = True Then
gr = 9
End If
'....................................................
'MsgBox(sr)
'MsgBox(n)
Dim y(10, 10) As Double
For i = 1 To n
    For j = 1 To n
        If (i = j) Then
            y(i, j) = 1
        ElseIf (i = 1 And i + 1 = j) Then
            y(i, j) = sr
        ElseIf (i = 1 And i + 2 = j) Then
            y(i, j) = mr
        ElseIf (i = 2 And i = j + 1) Then
            y(i, j) = 1 / sr
        ElseIf (i = 2 And i = j - 1) Then
            y(i, j) = lr
        ElseIf (i = 3 And i = j + 2) Then
            y(i, j) = 1 / mr
        ElseIf (i = 3 And i = j + 1) Then
            y(i, j) = 1 / lr
        ElseIf (i = 1 And i + 3 = j) Then
            y(i, j) = hr
        ElseIf (i = 4 And i = j + 3) Then
            y(i, j) = 1 / hr
        ElseIf (i = 2 And i + 2 = j) Then
            y(i, j) = nr
        ElseIf (i = 4 And i = j + 2) Then
            y(i, j) = 1 / nr
        ElseIf (i = 3 And i + 1 = j) Then
            y(i, j) = cr
        ElseIf (i = 4 And i = j + 1) Then
            y(i, j) = 1 / cr
        ElseIf (i = 1 And i + 4 = j) Then
            y(i, j) = kr
        ElseIf (i = 5 And i = j + 4) Then
            y(i, j) = 1 / kr
        ElseIf (i = 2 And i + 3 = j) Then
            y(i, j) = ar
        ElseIf (i = 5 And i = j + 3) Then
            y(i, j) = ar
y(i, j) = 1 / ar
ElseIf (i = 3 And i + 2 = j) Then
y(i, j) = dr
ElseIf (i = 5 And i = j + 2) Then
y(i, j) = 1 / dr
ElseIf (i = 4 And i + 1 = j) Then
y(i, j) = gr
ElseIf (i = 5 And i = j + 1) Then
y(i, j) = 1 / gr
End If
Next j
Next i
' Dim sumresponse(10) As Double
For i = 1 To n
    For j = 1 To n
        'ComboBox5.Items.Add(Math.Round(y(i, j),3))
        ListBox6.Items.Add(y(i, j))
    Next j
Next i
'-----------------------------------------
For j = 1 To n
    For i = 1 To n
        sumresponse(j) = sumresponse(j) + y(i, j)
    Next i
Next j
'-----------------------------------------
For j = 1 To n
    'ComboBox6.Items.Add(sumresponse(j))
    ListBox7.Items.Add(Math.Round(sumresponse(j), 3))
Next j
'-----------------------------------------
Dim ldiv(10, 10) As Double
For j = 1 To n
    For i = 1 To n
        ldiv(i, j) = y(i, j) / sumresponse(j)
    Next i
Next j
'-------------------------------
For i = 1 To n
    For j = 1 To n
        'ComboBox7.Items.Add(ldiv(i, j))
        ListBox8.Items.Add(Math.Round(ldiv(i, j), 3))
    Next j
Next i
For $i = 1$ To $n$
    For $j = 1$ To $n$
        sumresponse($i$) = sumresponse($i$) + ldiv($i$, $j$)
    Next $j$
Next $i$

For $i = 1$ To $n$
    For $j = 1$ To $n$
        sumresponse($i$) = sumresponse($i$) / $n$
    Next $j$
Next $i$

For $i = 1$ To $n$
    'ComboBox8.Items.Add(sumresponse($i$))
    ListBox9.Items.Add(Math.Round(sumresponse($i$), 3))
Next $i$
End Sub

Private Sub Button8_Click(ByVal sender As System.Object, ByVal e As System.EventArgs)
    Form2.Show()
End Sub

Private Sub Button6_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button6.Click
If un11.Checked = True Then
    sr = 1
ElseIf un12.Checked = True Then
    sr = 3
ElseIf un13.Checked = True Then
    sr = 5
ElseIf un14.Checked = True Then

End If
A •
sr = 7
ElseIf un15.Checked = True Then
    sr = 9
End If

If un21.Checked = True Then
    mr = 1
ElseIf un22.Checked = True Then
    mr = 3
ElseIf un23.Checked = True Then
    mr = 5
ElseIf un24.Checked = True Then
    mr = 7
ElseIf un25.Checked = True Then
    mr = 9
End If

If un31.Checked = True Then
    lr = 1
ElseIf un32.Checked = True Then
    lr = 3
ElseIf un33.Checked = True Then
    lr = 5
ElseIf un34.Checked = True Then
    lr = 7
ElseIf un35.Checked = True Then
    lr = 9
End If

If un41.Checked = True Then
    hr = 1
ElseIf un42.Checked = True Then
    hr = 3
ElseIf un43.Checked = True Then
    hr = 5
ElseIf un44.Checked = True Then
    hr = 7
ElseIf un45.Checked = True Then
    hr = 9
End If

If un51.Checked = True Then
nr = 1
ElseIf un52.Checked = True Then
    nr = 3
ElseIf un53.Checked = True Then
    nr = 5
ElseIf un54.Checked = True Then
    nr = 7
ElseIf un55.Checked = True Then
    nr = 9
End If

If un61.Checked = True Then
    cr = 1
ElseIf un62.Checked = True Then
    cr = 3
ElseIf un63.Checked = True Then
    cr = 5
ElseIf un64.Checked = True Then
    cr = 7
ElseIf un65.Checked = True Then
    cr = 9
End If

If un71.Checked = True Then
    kr = 1
ElseIf un72.Checked = True Then
    kr = 3
ElseIf un73.Checked = True Then
    kr = 5
ElseIf un74.Checked = True Then
    kr = 7
ElseIf un75.Checked = True Then
    kr = 9
End If

If un81.Checked = True Then
    ar = 1
ElseIf un82.Checked = True Then
    ar = 3
ElseIf un83.Checked = True Then
    ar = 5
ElseIf un84.Checked = True Then
ar = 7
ElseIf un85.Checked = True Then
    ar = 9
End If

If un91.Checked = True Then
dr = 1
ElseIf un92.Checked = True Then
dr = 3
ElseIf un93.Checked = True Then
dr = 5
ElseIf un94.Checked = True Then
dr = 7
ElseIf un95.Checked = True Then
dr = 9
End If

If un101.Checked = True Then
gr = 1
ElseIf un102.Checked = True Then
gr = 3
ElseIf un103.Checked = True Then
gr = 5
ElseIf un104.Checked = True Then
gr = 7
ElseIf un105.Checked = True Then
gr = 9
End If

' MsgBox(lr)
' MsgBox(n)
Dim y(10, 10) As Double
For i = 1 To n
    For j = 1 To n
        If (i = j) Then
            y(i, j) = 1
        ElseIf (i = 1 And i + 1 = j) Then
            y(i, j) = sr
        ElseIf (i = 1 And i + 2 = j) Then
            y(i, j) = mr
        ElseIf (i = 2 And i = j + 1) Then
            y(i, j) = 1 / sr
        End If
    Next j
Next i
ElseIf (i = 2 And i = j - 1) Then
    y(i, j) = lr
ElseIf (i = 3 And i = j + 2) Then
    y(i, j) = 1 / mr
ElseIf (i = 3 And i = j + 1) Then
    y(i, j) = 1 / lr
ElseIf (i = 1 And i + 3 = j) Then
    y(i, j) = hr
ElseIf (i = 4 And i = j + 3) Then
    y(i, j) = 1 / hr
ElseIf (i = 2 And i + 2 = j) Then
    y(i, j) = nr
ElseIf (i = 4 And i = j + 2) Then
    y(i, j) = 1 / nr
ElseIf (i = 3 And i + 1 = j) Then
    y(i, j) = cr
ElseIf (i = 4 And i = j + 1) Then
    y(i, j) = 1 / cr
ElseIf (i = 1 And i + 4 = j) Then
    y(i, j) = kr
ElseIf (i = 5 And i = j + 4) Then
    y(i, j) = 1 / kr
ElseIf (i = 2 And i + 3 = j) Then
    y(i, j) = ar
ElseIf (i = 5 And i = j + 3) Then
    y(i, j) = 1 / ar
ElseIf (i = 3 And i + 2 = j) Then
    y(i, j) = dr
ElseIf (i = 5 And i = j + 2) Then
    y(i, j) = 1 / dr
ElseIf (i = 4 And i + 1 = j) Then
    y(i, j) = gr
ElseIf (i = 5 And i = j + 1) Then
    y(i, j) = 1 / gr
End If
Next j
Next i
' Dim sumpage(10) As Double
For i = 1 To n
    For j = 1 To n
        ' ComboBox13.Items.Add(y(i, j))
ListBox14.Items.Add(Math.Round(y(i, j), 3))

Next j
Next i

' -----------------------------------------
For j = 1 To n
    For i = 1 To n
        sumpage(j) = sumpage(j) + y(i, j)
    Next i
Next j

' ------------------------------------------
For j = 1 To n
    'ComboBox14.Items.Add(sumpage(j))
    ListBox15.Items.Add(Math.Round(sumpage(j), 3))
Next j

'-------------------------------
Dim ldiv(10, 10) As Double
For j = 1 To n
    For i = 1 To n
        ldiv(i, j) = y(i, j) / sumpage(j)
    Next i
Next j

'-------------------------------
For i = 1 To n
    For j = 1 To n
        'ComboBox15.Items.Add(ldiv(i, j))
        ListBox16.Items.Add(Math.Round(ldiv(i, j), 3))
    Next j
Next i

'------------------------------------------
For i = 1 To n
    For j = 1 To n
        sumpage(i) = sumpage(i) + ldiv(i, j)
    Next j
Next i

'-------------------------------------------
For i = 1 To n
    For j = 1 To n
        sumpage(i) = sumpage(i) / n
    Next j
Next i

'--------------------------------------------
For i = 1 To n
    ComboBox16.Items.Add(sumpage(i))
    ListBox17.Items.Add(Math.Round(sumpage(i), 3))
Next i
End Sub

Private Sub Button7_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button7.Click

    If un11.Checked = True Then
        sr = 1
    ElseIf un12.Checked = True Then
        sr = 3
    ElseIf un13.Checked = True Then
        sr = 5
    ElseIf un14.Checked = True Then
        sr = 7
    ElseIf un15.Checked = True Then
        sr = 9
    End If

    If un21.Checked = True Then
        mr = 1
    ElseIf un22.Checked = True Then
        mr = 3
    ElseIf un23.Checked = True Then
        mr = 5
    ElseIf un24.Checked = True Then
        mr = 7
    ElseIf un25.Checked = True Then
        mr = 9
    End If

    If un31.Checked = True Then
        lr = 1
    ElseIf un32.Checked = True Then
        lr = 3
    ElseIf un33.Checked = True Then
        lr = 5
    ElseIf un34.Checked = True Then
        lr = 7
    ElseIf un35.Checked = True Then

lr = 9
End If

If un41.Checked = True Then
  hr = 1
ElseIf un42.Checked = True Then
  hr = 3
ElseIf un43.Checked = True Then
  hr = 5
ElseIf un44.Checked = True Then
  hr = 7
ElseIf un45.Checked = True Then
  hr = 9
End If
'..........................................

If un51.Checked = True Then
  nr = 1
ElseIf un52.Checked = True Then
  nr = 3
ElseIf un53.Checked = True Then
  nr = 5
ElseIf un54.Checked = True Then
  nr = 7
ElseIf un55.Checked = True Then
  nr = 9
End If
'.................................................

If un61.Checked = True Then
  cr = 1
ElseIf un62.Checked = True Then
  cr = 3
ElseIf un63.Checked = True Then
  cr = 5
ElseIf un64.Checked = True Then
  cr = 7
ElseIf un65.Checked = True Then
  cr = 9
End If
'...................................................

If un71.Checked = True Then
  kr = 1
ElseIf un72.Checked = True Then
kr = 3
ElseIf un73.Checked = True Then
    kr = 5
ElseIf un74.Checked = True Then
    kr = 7
ElseIf un75.Checked = True Then
    kr = 9
End If

If un81.Checked = True Then
    ar = 1
ElseIf un82.Checked = True Then
    ar = 3
ElseIf un83.Checked = True Then
    ar = 5
ElseIf un84.Checked = True Then
    ar = 7
ElseIf un85.Checked = True Then
    ar = 9
End If

If un91.Checked = True Then
    dr = 1
ElseIf un92.Checked = True Then
    dr = 3
ElseIf un93.Checked = True Then
    dr = 5
ElseIf un94.Checked = True Then
    dr = 7
ElseIf un95.Checked = True Then
    dr = 9
End If

If un101.Checked = True Then
    gr = 1
ElseIf un102.Checked = True Then
    gr = 3
ElseIf un103.Checked = True Then
    gr = 5
ElseIf un104.Checked = True Then
    gr = 7
ElseIf un105.Checked = True Then

gr = 9
End If
'
MsgBox(lr)
MsgBox(n)
Dim y(10, 10) As Double
For i = 1 To n
    For j = 1 To n
        If (i = j) Then
            y(i, j) = 1
        ElseIf (i = 1 And i + 1 = j) Then
            y(i, j) = sr
        ElseIf (i = 1 And i + 2 = j) Then
            y(i, j) = mr
        ElseIf (i = 2 And i = j + 1) Then
            y(i, j) = 1 / sr
        ElseIf (i = 2 And i = j - 1) Then
            y(i, j) = lr
        ElseIf (i = 3 And i = j + 2) Then
            y(i, j) = 1 / mr
        ElseIf (i = 3 And i = j + 1) Then
            y(i, j) = 1 / lr
        ElseIf (i = 1 And i + 3 = j) Then
            y(i, j) = hr
        ElseIf (i = 4 And i = j + 3) Then
            y(i, j) = 1 / hr
        ElseIf (i = 2 And i + 2 = j) Then
            y(i, j) = nr
        ElseIf (i = 4 And i = j + 2) Then
            y(i, j) = 1 / nr
        ElseIf (i = 3 And i + 1 = j) Then
            y(i, j) = cr
        ElseIf (i = 4 And i = j + 1) Then
            y(i, j) = 1 / cr
        ElseIf (i = 1 And i + 4 = j) Then
            y(i, j) = kr
        ElseIf (i = 5 And i = j + 4) Then
            y(i, j) = 1 / kr
        ElseIf (i = 2 And i + 3 = j) Then
            y(i, j) = ar
        ElseIf (i = 5 And i = j + 3) Then
            y(i, j) = 1 / ar
ElseIf (i = 3 And i + 2 = j) Then
    y(i, j) = dr
ElseIf (i = 5 And i = j + 2) Then
    y(i, j) = 1 / dr
ElseIf (i = 4 And i + 1 = j) Then
    y(i, j) = gr
ElseIf (i = 5 And i = j + 1) Then
    y(i, j) = 1 / gr
End If
Next j
Next i

' Dim sumimage(10) As Double
For i = 1 To n
For j = 1 To n
    'ComboBox17.Items.Add(y(i, j))
    ListBox18.Items.Add(Math.Round(y(i, j), 3))
Next j
Next i

'-----------------------------------------
For j = 1 To n
For i = 1 To n
    sumimage(j) = sumimage(j) + y(i, j)
Next i
Next j

'-------------------------
'-----------------------------------------
For j = 1 To n
    'ComboBox18.Items.Add(sumimage(j))
    ListBox19.Items.Add(Math.Round(sumimage(j), 3))
Next j

'----------------------------
Dim ldiv(10, 10) As Double
For j = 1 To n
For i = 1 To n
    ldiv(i, j) = y(i, j) / sumimage(j)
Next i
Next j

'----------------------------
For i = 1 To n
For j = 1 To n
    'ComboBox19.Items.Add(ldiv(i, j))
    ListBox20.Items.Add(Math.Round(ldiv(i, j), 3))
Next j
Next i

'-----------------------------
For i = 1 To n
    For j = 1 To n
        sumimage(i) = sumimage(i) + ldiv(i, j)
    Next j
Next i
' ...................................
For i = 1 To n
    For j = 1 To n
        sumimage(i) = sumimage(i) / n
    Next j
Next i
' ...................................
For i = 1 To n
    ComboBox20.Items.Add(sumimage(i))
    ListBox21.Items.Add(Math.Round(sumimage(i), 3))
Next i
End Sub

Private Sub n4_CheckedChanged(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles n4.CheckedChanged
    GroupBox13.Visible = True
    GroupBox12.Visible = True
    GroupBox14.Visible = True
    GroupBox15.Visible = True
    GroupBox16.Visible = True
    GroupBox17.Visible = True
    GroupBox18.Visible = True
    GroupBox19.Visible = True
End Sub

Private Sub n1_CheckedChanged(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles n1.CheckedChanged
    GroupBox13.Visible = False
    GroupBox12.Visible = False
    GroupBox14.Visible = False
    GroupBox15.Visible = True
    GroupBox16.Visible = True
    GroupBox17.Visible = True
    GroupBox18.Visible = False
    GroupBox19.Visible = False
GroupBox9.Visible = False
GroupBox11.Visible = False
GroupBox16.Visible = False
GroupBox18.Visible = False
GroupBox19.Visible = False
End Sub

Private Sub Button9_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button9.Click
    Form2.Show()
End Sub

Private Sub ListBox1_MouseDoubleClick(ByVal sender As Object, ByVal e As System.Windows.Forms.MouseEventArgs) Handles ListBox1.MouseDoubleClick
    ListBox1.Items.Remove(ListBox1.SelectedItem)
End Sub

Private Sub ListBox1_SelectedIndexChanged(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles ListBox1.SelectedIndexChanged
    'GroupBox15.Text = ListBox1.SelectedItem & ListBox1.SelectedItem
End Sub

Private Sub Button10_Click(ByVal sender As System.Object, ByVal e As System.EventArgs)
    Form3.Show()
End Sub

Private Sub ComboBox1_SelectedIndexChanged(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles ComboBox1.SelectedIndexChanged
    Select Case (ComboBox1.SelectedIndex)
        Case 0
            GroupBox13.Visible = False
            GroupBox12.Visible = False
            GroupBox14.Visible = False
            GroupBox15.Visible = True
            GroupBox8.Visible = False
            GroupBox9.Visible = False
            GroupBox11.Visible = False
            GroupBox16.Visible = False
GroupBox18.Visible = False
GroupBox19.Visible = False
n1.Checked = True

Case 1
GroupBox13.Visible = True
GroupBox12.Visible = False
GroupBox14.Visible = True
GroupBox15.Visible = True
GroupBox8.Visible = False
GroupBox9.Visible = False
GroupBox11.Visible = False
GroupBox16.Visible = False
GroupBox18.Visible = False
GroupBox19.Visible = False
n2.Checked = True

Case 2
GroupBox13.Visible = True
GroupBox12.Visible = True
GroupBox14.Visible = True
GroupBox15.Visible = True
GroupBox8.Visible = True
GroupBox9.Visible = True
GroupBox11.Visible = False
GroupBox16.Visible = False
GroupBox18.Visible = False
GroupBox19.Visible = False
n3.Checked = True

Case 3
GroupBox13.Visible = True
GroupBox12.Visible = True
GroupBox14.Visible = True
GroupBox15.Visible = True
GroupBox8.Visible = True
GroupBox9.Visible = True
GroupBox11.Visible = True
GroupBox16.Visible = True
GroupBox18.Visible = True
GroupBox19.Visible = True
n4.Checked = True

End Select
If n1.Checked = True Then
' ListBox1.Length
n = 2
ElseIf n2.Checked = True Then
n = 3
ElseIf n3.Checked = True Then
n = 4
ElseIf n4.Checked = True Then
n = 5
End If
End Sub

Private Sub Button3_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button3.Click
    ListBox1.Items.Add(TextBox1.Text)
End Sub
End Class

Public Class Form2

    Dim lor, low, loni, lois, rw, rn, ri, wn, wi, ni, i, j As Integer

    Private Sub GroupBox15_Enter(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles GroupBox15.Enter
        End Sub
    End Sub

    Private Sub GroupBox3_Enter(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles GroupBox3.Enter
        End Sub
    End Sub

    Private Sub RadioButton34_CheckedChanged(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles wn2.CheckedChanged
        End Sub
    End Sub

    Private Sub Button1_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button1.Click
        If lor1.Checked = True Then

§
lor = 1
ElseIf lor2.Checked = True Then
    lor = 3
ElseIf lor3.Checked = True Then
    lor = 5
ElseIf lor4.Checked = True Then
    lor = 7
ElseIf lor5.Checked = True Then
    lor = 9
End If

If low1.Checked = True Then
    low = 1
ElseIf low2.Checked = True Then
    low = 3
ElseIf low3.Checked = True Then
    low = 5
ElseIf low4.Checked = True Then
    low = 7
ElseIf low5.Checked = True Then
    low = 9
End If

If loni1.Checked = True Then
    loni = 1
ElseIf loni2.Checked = True Then
    loni = 3
ElseIf loni3.Checked = True Then
    loni = 5
ElseIf loni4.Checked = True Then
    loni = 7
ElseIf loni5.Checked = True Then
    loni = 9
End If

If lois1.Checked = True Then
    lois = 1
ElseIf lois2.Checked = True Then
    lois = 3
ElseIf lois3.Checked = True Then
    lois = 5
ElseIf lois4.Checked = True Then
    lois = 7
ElseIf lois5.Checked = True Then
    lois = 9
End If
lois = 7
ElseIf lois5.Checked = True Then
    lois = 9
End If

'..................................................
If rw1.Checked = True Then
    rw = 1
ElseIf rw2.Checked = True Then
    rw = 3
ElseIf rw3.Checked = True Then
    rw = 5
ElseIf rw4.Checked = True Then
    rw = 7
ElseIf rw5.Checked = True Then
    rw = 9
End If

'..................................................
If rn1.Checked = True Then
    rn = 1
ElseIf rn2.Checked = True Then
    rn = 3
ElseIf rn3.Checked = True Then
    rn = 5
ElseIf rn4.Checked = True Then
    rn = 7
ElseIf rn5.Checked = True Then
    rn = 9
End If

'..................................................
If ri1.Checked = True Then
    ri = 1
ElseIf ri2.Checked = True Then
    ri = 3
ElseIf ri3.Checked = True Then
    ri = 5
ElseIf ri4.Checked = True Then
    ri = 7
ElseIf ri5.Checked = True Then
    ri = 9
End If
If wn1.Checked = True Then
    wn = 1
ElseIf wn2.Checked = True Then
    wn = 3
ElseIf wn3.Checked = True Then
    wn = 5
ElseIf wn4.Checked = True Then
    wn = 7
ElseIf wn5.Checked = True Then
    wn = 9
End If

If wi1.Checked = True Then
    wi = 1
ElseIf wn2.Checked = True Then
    wi = 3
ElseIf wn3_Checked = True Then
    wi = 5
ElseIf wn4_Checked = True Then
    wi = 7
ElseIf wn5_Checked = True Then
    wi = 9
End If

If ni1_Checked = True Then
    ni = 1
ElseIf ni2_Checked = True Then
    ni = 3
ElseIf ni3_Checked = True Then
    ni = 5
ElseIf ni4_Checked = True Then
    ni = 7
ElseIf ni5_Checked = True Then
    ni = 9
End If
ElseIf loni4.Checked = True Then
  loni = 7
ElseIf loni5.Checked = True Then
  loni = 9
End If

Dim y(10, 10) As Double
For i = 1 To 5
  For j = 1 To 5
    If (i = j) Then
      y(i, j) = 1
    ElseIf (i = 1 And i + 1 = j) Then
      y(i, j) = lor
    ElseIf (i = 1 And i + 2 = j) Then
      y(i, j) = low
    ElseIf (i = 1 And i + 3 = j) Then
      y(i, j) = loni
    ElseIf (i = 1 And i + 4 = j) Then
      y(i, j) = lois
    ElseIf (i = 2 And i = j + 1) Then
      y(i, j) = 1 / lor
    ElseIf (i = 2 And i = j - 1) Then
      y(i, j) = rw
    ElseIf (i = 2 And i = j - 2) Then
      y(i, j) = rn
    ElseIf (i = 2 And i = j - 3) Then
      y(i, j) = ri
    ElseIf (i = 3 And i = j + 2) Then
      y(i, j) = 1 / low
    ElseIf (i = 3 And i = j + 1) Then
      y(i, j) = 1 / rw
    ElseIf (i = 3 And i = j - 1) Then
      y(i, j) = wn
    ElseIf (i = 3 And i = j - 2) Then
      y(i, j) = wi
    ElseIf (i = 4 And i = j + 3) Then
      y(i, j) = 1 / loni
    ElseIf (i = 4 And i = j + 2) Then
      y(i, j) = 1 / rn
  Next j
Next i
ElseIf (i = 4 And i = j + 1) Then
    y(i, j) = 1 / wn
ElseIf (i = 4 And i = j - 1) Then
    y(i, j) = ni
ElseIf (i = 5 And i = j + 4) Then
    y(i, j) = 1 / lois
ElseIf (i = 5 And i = j + 3) Then
    y(i, j) = 1 / ri
ElseIf (i = 5 And i = j + 2) Then
    y(i, j) = 1 / wi
ElseIf (i = 5 And i = j + 1) Then
    y(i, j) = 1 / ni
End If
Next j
Next i
' Dim sumcra(10) As Double
For i = 1 To 5
    For j = 1 To 5
        ' ComboBox1.Items.Add(y(i, j))
        ListBox4.Items.Add(Math.Round(y(i, j), 3))
    Next j
Next i
'-------------------------------------
For j = 1 To 5
    For i = 1 To 5
        sumcra(j) = sumcra(j) + y(i, j)
    Next i
Next j
'------------------------------------------
For j = 1 To 5
    'ComboBox2.Items.Add(sumcra(j))
    ListBox5.Items.Add(Math.Round(sumcra(j), 3))
Next j
'-------------------------------
Dim ldiv(10, 10) As Double
For j = 1 To 5
    For i = 1 To 5
        '...
ldiv(i, j) = y(i, j) / sumcra(j)
Next i
Next j
'-----------------------------
For i = 1 To 5
    For j = 1 To 5
        ' ComboBox3.Items.Add(ldiv(i, j))
        ListBox6.Items.Add(Math.Round(ldiv(i, j), 3))
    Next j
Next i
'-----------------------------
For i = 1 To 5
    For j = 1 To 5
        sumcra(i) = sumcra(i) + ldiv(i, j)
    Next j
Next i
'-----------------------------
For i = 1 To 5
    For j = 1 To 5
        sumcra(i) = sumcra(i) / 5
    Next j
Next i
'-----------------------------
For i = 1 To 5
    ' ComboBox4.Items.Add(sumcra(i))
    ListBox7.Items.Add(Math.Round(sumcra(i), 3))
Next i
End Sub

Private Sub Form2_Load(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles MyBase.Load
End Sub

Private Sub Button2_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles Button2.Click
Dim arrayload(10) As Double
Dim arrayresponse(10) As Double
Dim arraynumber(10) As Double
Dim arraypage(10) As Double

\ *
Dim arrayimage(10) As Double

For j = 1 To n
    arrayload(j) = sumcra(1) * sumload(j)
    arrayresponse(j) = sumcra(2) * sumresponse(j)
    arraynumber(j) = sumcra(3) * sumnumber(j)
    arraypage(j) = sumcra(4) * sumpage(j)
    arrayimage(j) = sumcra(5) * sumimage(j)
Next j

For j = 1 To n
    sumev(j) = arrayload(j) + arrayresponse(j) + arraynumber(j) + arraypage(j) + arrayimage(j)
Next j

aa.Add(New String("-----------------------"))

For i = 1 To n
    'ComboBox5.Items.Add(sumev(i))
    ListBox3.Items.Add(Form1.ListBox1.Items(i - 1).ToString & " " & Math.Round(sumev(i), 3).ToString)
    aa.Add(New String(Form1.ListBox1.Items(i - 1).ToString & " " & Math.Round(sumev(i), 3).ToString))
Next i

End Sub

End Class