The Measurement Goal

Assignment A2- part I
Software Metrics (PA1407)

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I. Abstract

This paper is a representation of the first phase of a three-phase practical assignment for measuring the usability of a given website. In this project, the authors measured the usability from a user's perspective of an online book store http://www.abebooks.co.uk. We have decided a measurement goal on the lines of the Goal-Question-Metric (GQM) framework measurement which acts as the base for the whole project. The primary objective of this document is to evaluate the usability of the website by assessing the website audit process. The document is presented based on the various reviews of the authors from user's perspective. A GQM tree is also presented which enables us to map the goal and questions with suitable metrics.

Keywords: Web usability, Software Metrics, Goal-Question-Metric Framework, GQM tree

II. Work Distribution Table

There was equal participation from the authors of this document in the project. The authors distributed the work to be performed in the project. The activities involved in the project and authors contribution are presented in the table 1 below.

Activity	Srikar Reddy Nadikattu	Aman Jain	Sharen Polavarapu	Prithvi Raj Sirigudi
Literature Study	**X**	**X**	**X**	**X**
Planning & Organizing	**X**			
Follow up & Review		**X**	**X**	
Corrections & Improvements	**X**			**X**
Documentation		**X**		

Table 1: Group Member's Participation

III. INTRODUCTION

The focus of this paper is to formulate a measurement goal which would help in evaluating the web audit process from the customer's perspective. The objective is to enhance the usability of website using Goal-Question-Metric (GQM) framework. The authors also present a GQM tree that helps in providing the relevant measures for evaluating the 'website auditing' process. Based on this aim, we started working on the background of usability by searching for relevant literature in scientific databases like *IEEE Xplore* and *Inspec*. Two referenced articles [1] [2], were provided that helped the authors to gain a better understanding regarding web usability, GQM framework and also how to evaluate the usability based on the GQM framework.

As the main objective of this paper is to enhance the usability of an online bookstore website, some criteria need to be considered based on which the website can be evaluated. The authors selected this criteria based on the literature studied regarding web usability. One such criteria involves the navigability of the website [1]. Navigability is one of the core usability elements, which needs specific metrics such as graphical models for measuring "structural complexity" of a website [6]. Another such criteria involves the consistency of the data and the layout being presented in the website [1]. Layout also includes the button styles, text format, images and graphics which also plays a key role to decide on the usability of a website.

About the website: After studying the background about usability, the authors analyzed the website and studied its behavior. It is presumed that http://www.abebooks.co.uk/ is an online book store which involves buying and selling of books. The site catalogue consists of various sections of books like literary fiction, history books, science fiction, cooking books etc. There is also a separate section for children which consists of story books, comic and graphic books. The website also provides a facility to buy back books from users but they are accepted solely based on the demand for the books in the website. The website provides its services for buying and selling books in several countries. The authors tried to cover most of the modules of the website but some modules may still be left out due to limitation over time. The views presented here are based on the modules of the website studied by the authors of this document. The website under evaluation may be subjected to change as per the user requirements by the developers of the website.

The remaining part of this document is structured as follows: section IV involves the measurement goal formulated by the authors for the project to evaluate the usability of the website, section V deals with the GQM tree which enables the authors to have a clear understanding of application of the GQM, section VI deals with discussion and section VII presents the summary of the work.

IV. THE MEASUREMENT GOAL

Nowadays, web developers tend to update the website as frequently as possible in order to enhance user satisfaction and to survive the competition from other websites of same domain. Though the developers follow rules while structuring the website, there are still some faults that tend to decrease the user satisfaction. This decrease in the user satisfaction is due to lack of estimating the requirements from the user's perspective. Thus in this section, we present a measurement goal that was designed based on the template provided in [emilia lecture].

➢ **Purpose:**

Evaluate the website audit process to measure usability in order to enhance user satisfaction.

➢ **Perspective:**

Examine the accessibility, navigability, consistency and content usefulness of the website from the viewpoint of the customer.

➢ **Environment and constraints:**

- ❑ The website is primarily an e-commerce website that deals with books and involves monetary transactions.
- ❑ The website being studied has been developed and is currently in the auditing phase.
- ❑ The website users are categorized into buyers and sellers who access it for a specific objective of either buying a book or to sell it online.
- ❑ The behaviour of both the buyers and sellers is studied and analyzed.
- ❑ There is a separate section dedicated only to buy-back books from the users.
- ❑ The website also operates and provides its services in various countries in their local language.
- ❑ The website is subject to changes while the authors analyse the website.
- ❑ The audit process was conducted in a limited time span i.e., from 2015-04-20 to 2015-05-17.

V. GQM TREE

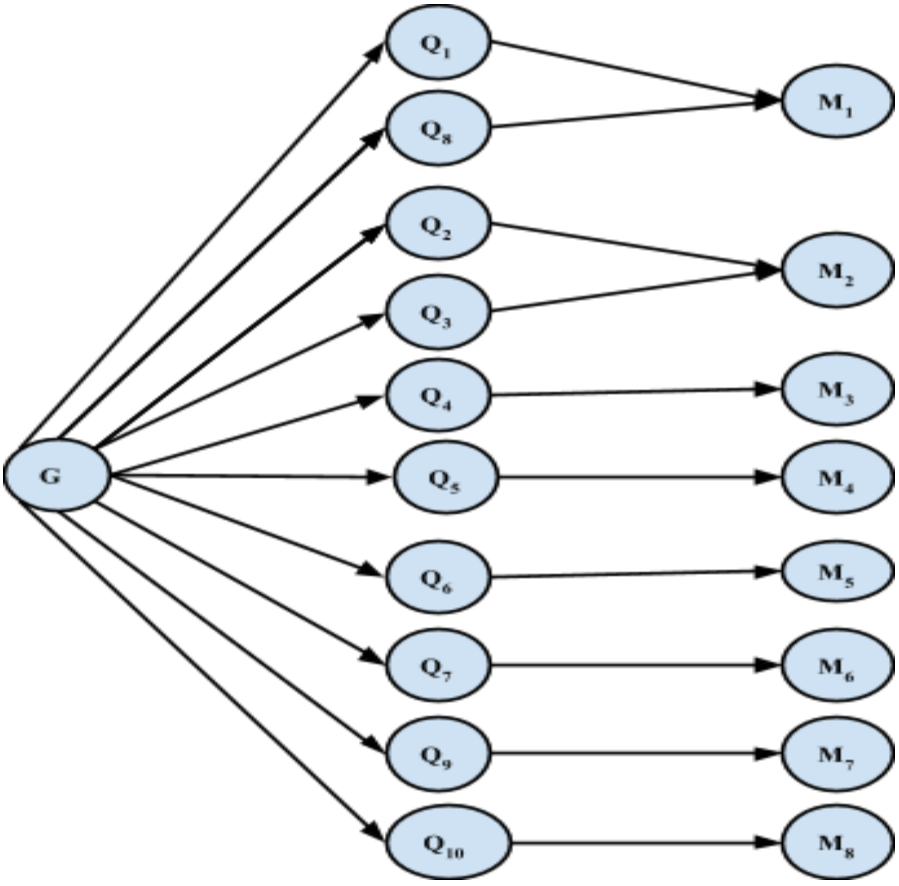

Figure 1: GQM Tree

Goal	
G	To evaluate the review process of a website to enhance user satisfaction
Questions	
$\mathbf{Q_1}$	Are all the pages navigable without any broken links in between?
$\mathbf{Q_2}$	What is the response time once a query is submitted by the user?
$\mathbf{Q_3}$	How long does it take for all the components of a webpage to load?
$\mathbf{Q_4}$	Is the website compatible across all browsers?
$\mathbf{Q_5}$	Are there sufficient user input options in the search facility of the website?
$\mathbf{Q_6}$	Are all the components of the website easy to operate?
$\mathbf{Q_7}$	Are all the items (books) categorised appropriately into different groups based on their properties?
$\mathbf{Q_8}$	Are all the page titles and topography consistent throughout the website?
$\mathbf{Q_9}$	Is the website content updated accordingly for each user action?
$\mathbf{Q_{10}}$	Is the page layout consistent when viewed with different displays/screen types?
Metrics	
$\mathbf{M_1}$	Number of webpages visited.
$\mathbf{M_2}$	Time elapsed.
$\mathbf{M_3}$	Type of browser.
$\mathbf{M_4}$	Search options in website.
$\mathbf{M_5}$	Ease of use.
$\mathbf{M_6}$	Book categories
$\mathbf{M_7}$	Number of user clicks.
$\mathbf{M_8}$	Device Displays.

Table 1: Description of Goal, Questions and Metrics

VI. DISCUSSION

In this section, we seek to justify the selection of the goal, questions and metrics that need to be measured, using relevant literature to support our statements. The metrics used for each of the questions have also been discussed broadly below:

- ➔ Q1 deals with the navigability aspect of a website. Q1 can be addressed using the metric of 'number of web-pages visited.' Navigation between web pages can be mapped using Bayesian networks[7], at both the page level and website level. This question has further been described in the reference paper [1].
- ➔ Q2 and Q3 are concerned with the accessibility feature of a website. These questions can be evaluated against the metric:'time consumed' while the task in question is being performed. Response time and load time are two important aspects from the user's perception. Both can be calculated based on a common time scale. Though, this is more of a performance issue dealing with web server efficiency [8], it is an important usability aspect.
- ➔ Q4 too deals with accessibility element of web. Cross-browser compatibility can vary from layout discrepancies to technical defects. Different browser types have different DOMs and webkits, which affect the elements of the website [6]. Thus, the browser type is chosen as the metric against which the respective question is evaluated.
- ➔ Q5 pertains to "content usefulness" feature of the website. This feature is briefly discussed in the reference papers [1] and [2]. The user must be satisfied with the the search facility provided, as it is an integral part of e-commerce websites like the one being studied. Search input has been aptly chosen as a metric for this question. Search input options include text boxes, submit buttons and other HTML elements.
- ➔ Q6 involves both accessibility and operability characteristics. It is a complex issue comprising of technical and psychological factors such as user perception and acceptance level. A website must be considerably easy to learn and operate and by all social groups. Thus, the standard metric 'ease of use' was chosen as the appropriate metric [1] [3].
- ➔ Q7 is concerned with 'content usefulness' of a website [1]. In B2C sites that involve buying/selling goods from consumers, it is vital to classify objects according to their genre. Data needs to be organised for hassle free browsing. Each object has its own id and class. Thus, objects need to be classified according to these elements. So, we have broadly chosen the metric: "book categories" to assess this question.
- ➔ Q8 deals with the consistency component. The format used for representation of data should be followed for the entirety of the website. Consistent text standards must be applied for every individual web page [2]. Web pages visited has been considered as an accurate metric for evaluating the question.
- ➔ Q9 also involves the 'consistency' component. This question is particularly necessary for e-commerce websites as every change must be reflected dynamically, when the user performs an action. This may include different functions such as cart updation. We have chosen 'user clicks' as the metric for this question as each click is the cause of an interaction with the website. Further, this metric has been explored in [4].
- ➔ Q10 is another 'consistency' related question. A website must maintain the same page layout when viewed across different browsers. This issue is linked to the display size of the devices or rather the screen resolution of the device in use [2]. Hence, the metric "device display" has been aptly chosen.

VII. SUMMARY AND CONCLUSION

The main aim of this part of the paper was to identify an applicable measurement goal for evaluating the usability of a website from a user's viewpoint. This process is based upon the standard Goal-based measurement framework. The goal, questions and metrics were decided after extensive discussion. Two reference papers were provided for identifying the goal and metrics. Apart from these, several other relevant

articles were chosen to justify our selection. Most of the metrics due to their importance from an e-commerce website's perspective. Our main focus was on key attributes such as navigability, consistency, content and accessibility, factors that are key to the success of any B2C website. The questions have been mapped to the corresponding metric.

In the successive parts, the entities and attributes and sub-attributes are decided and associated with the metrics chosen for measuring the goal. Further, the attributes are classified into internal and external and appropriate measuring scales are chosen.

VIII. REFERENCES

[1] J. J. Cappel and Zhenyu Huang, "A Usability Analysis of Company Websites," *J. Comput. Inf. Syst.*, vol. 48, no. 1, pp. 117–123, Fall 2007.

[2] S. Hassan and F. Li, "Evaluating the usability and content usefulness of web sites: A benchmarking approach," *J. Electron. Commer. Organ.*, vol. 3, no. 2, pp. 46 – 67, Apr. 2005.

[3] Laitenberger, O.; Dreyer, H.M., "Evaluating the usefulness and the ease of use of a Web-based inspection data collection tool," *Software Metrics Symposium, 1998. Metrics 1998. Proceedings. Fifth International* , vol., no., pp.122,132, 20-21 Nov 1998.

[4] K. Ali and M. Scarr, "Robust methodologies for modeling web click distributions," in 16th International World Wide Web Conference, WWW2007, May 8, 2007 - May 12, 2007, 2007, pp. 511–520.

[5] Menkus, B.,"Auditing The Effectiveness of The Design of A Web Page," *EDPACS*, vol. 27, no. 12, pp. 1–3, Jun. 2000.

[6] Yanlong Zhang; Hong Zhu; Greenwood, S., "Web site complexity metrics for measuring navigability," *Quality Software, 2004. QSIC 2004. Proceedings. Fourth International Conference on* , vol., no., pp.172,179, 8-9 Sept. 2004.

[7] Vaucher, S.; Sahraoui, H., "Multi-level evaluation of web site navigability," *Web Systems Evolution (WSE), 2010 12th IEEE International Symposium on* , vol., no., pp.93,100, 17-18 Sept. 2010.

[8] Ahmed, W.; Yongwei Wu; Weimin Zheng, "Response Time Based Optimal Web Service Selection," *Parallel and Distributed Systems, IEEE Transactions on* , vol.26, no.2, pp.551,561, Feb. 2015.

[9] Choudhary, S.R.; Versee, H.; Orso, A., "A cross-browser web application testing tool," *Software Maintenance (ICSM), 2010 IEEE International Conference on* , vol., no., pp.1,6, 12-18 Sept. 2010.

ENTITIES, ATTRIBUTES AND METRICS

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I. ABSTRACT

The usability measurement process is not only based on a good measurement goal but is also influenced by entities, attributes and the metrics being used to measure. This paper deals with the entities, attributes and the metrics being used in order to achieve the measurement goal. The main objective of this paper is to improve the online bookstore for the by measuring its usability. We have attempted to elucidate each entity and its equivalent attributes. We have selected acceptable scale types for each corresponding metric. This paper can also act as reference to many future works by practitioners and developers related to web usability measurement for websites of a similar domain.

Keywords: Web usability, Metrics, Scale types, Entities, Measurement, Attributes, and GQM.

II. PILOT STUDY OF THE PROJECT

INTRODUCTION:

In this section, the authors present a brief description of the second phase of this usability measurement project. Based on this goal, we identify the entities and their attributes. These attributes are then mapped with the metrics proposed according to the GQM framework in previous paper. The following section provides a description of the steps followed during the project as a flowchart. Further, we have sought to associate the metrics specified in the first phase with those given in the subsequent sections. The attributes of each metric in terms of rules to be observed and scale types considered is also explored in this phase.

BRIEF SUMMARY OF THE MEASUREMENT GOAL(PHASE 1):

The aim of this study was to analyze and measure the usability of the online bookstore website http://www.abebooks.co.uk based on the factors like navigability, accessibility from the user's perspective. This study helps the developers to ensure user satisfaction and the existence of the website against the competition from developers of same domain. The website under review is developed and is ready to be deployed to the users. Thus, by studying the behavior of the users with a website, the authors draw conclusions regarding accessibility, navigability, consistency and content usefulness. These conclusions serve as base for the developers and practitioners in measuring the usability of the website. A set of metrics have been designated in the previous phase and will be further inspected to derive the constraints and measurement scales types.

EVALUATION STUDY:

This diagrammatical representation depicts different phases of the measurement study. The graphical representation ensures that the sequence of steps are followed as planned during the planning phase of the study.

Figure 1: Flowchart of pilot study

Different levels involved are depicted in the above figure provide an overview of the various activities performed during the project starting from the defining of the measurement goal (described in the first part of the document) to the mapping of entities and attributes to the corresponding metrics identified presented in this paper. The intermediate phases involves the identification of metrics using GQM framework, identifying the entities and attributes required to measure the usability of the given website. Later, metrics are selected, scale types and points are selected which serve as a base to measure the usability. In the last phase, the entities and attributes are mapped to gain acceptable results. Based on this results, the authors presented a model which could help in estimating the trends in usability and also serve as a base to define a questionnaire which helps in selecting the appropriate method to perform empirical study.

METHOD USED FOR USABILITY INSPECTION:

The authors worked together to evaluate the usability of the website through coordinated meetings and brainstorming sessions. We utilised Nielsen's guidelines, specifically an informal version of "cognitive walkthrough" method for usability inspection of the website at various phases [10]. It is an iterative process wherein we considered different scenarios that could rise for the end user. All attributes were considered based on their importance from the user's viewpoint. At each meeting, we would discuss a new set of features. Each feature would then be associated with an entity and an attribute. The metrics and scale types were then decided in the discussion that followed. The authors split into two roles: buyers and sellers to inspect all primary attributes: navigability, consistency, content usefulness and accessibility.

This paper is organized as follows: section III provides an overview of entities, attributes and their types. Section IV discusses about the association between entities, attributes to the metrics defined in the previous paper. Section V discusses about the scale types and points used to measure the attributes specified. The summary of the work is discussed in Section VI.

III. SELECTED ATTRIBUTES

To measure the usability of a website, the primary entities and the attributes need to be defined correctly from the end-user's perspective and also the type of the attribute need to be identified. Entities are termed as the representation of real world objects []. Attributes are termed as the characteristic properties of entities which helps in distinguishing the entities. As the authors are auditing a website, the entities are divided into 2 categories i.e., Website and Web page. These entities are then related to the questions formulated in the earlier phase of the project. The attribute and the types corresponding to the entities and questions are illustrated in the table below.

Questions	Entity	Attribute	Sub-Attribute	Attribute type
Q1. Are all the pages navigable without any broken links in between?	Website	Navigability	Page-Linkage	External
Q2. What is the response time once a query is submitted by the user?	Web page	Accessibility	Response Time	Internal
Q3. How long does it take for all the components of a webpage to load?	Web page	Accessibility	Load Time	Internal
Q4. Is the website compatible across all browsers?	Website	Accessibility	Browser Compatibility	Internal
Q5. Are there sufficient user input options in the search facility of the website?	Web page	Content Usefulness	Search Options	External
Q6. Are all the components of the website easy to operate?	Website	Operability	Ease of use	External
Q7. Are all the items categorized appropriately into different groups based on their properties?	Website	Content Usefulness	Data Organisation	External
Q8. Are all the page titles and topography consistent throughout the website?	Website	Consistency	Data Consistency	External
Q9. Is the website content updated accordingly for each user action?	Website	Consistency	Responsiveness	Internal
Q10. Is the page layout consistent when viewed with different displays/screen types?	Web page	Consistency	Page Layout Consistency	Internal

Table 1: Classification of Entities and Attributes

From the data given above we can infer that most of the questions relate to the entity: website rather than to the entity: web page. A website can be considered as the parent entity of the web page. Nielsen who is considered as a pioneer in the field of usability, considers the attributes consistency, accessibility, content usefulness, operability and navigability as key elements of the bigger picture of usability. This seems to hold true, especially in the case of web design and development. A similar study was conducted to evaluate commercial web projects with those of library pages at universities. This study too highlighted the value of attributes such as navigation and search facilities [3]. A web page can be considered as both an entity and attribute but to further narrow down the audit process, we considered web page as an entity. The reference papers [1] [2] were pivotal in guiding our selection of attributes.The attributes were decided after iterative meetings among team members were held.

The chosen attributes can be classified into two categories:internal and external attributes. The following description provides a clear view of the identified attribute types. Internal attributes are the attributes which can be measured independently. Whereas external attributes are the attributes which are measured based on their behavior. Of the two entity classes, each attribute has been briefly described below:

INTERNAL ATTRIBUTES:

An internal attribute may be a product or process that can be measured taking into account just its internal properties without considering its behaviour in different contexts. Internal attributes can be measured directly based on its innate properties. For instance, page layout can be studied using the index of web pages as the measuring scale [4]. Some of the attributes chosen in this study such as response time and

responsiveness have been grouped as internal attributes as they can be measured directly using different measurement scales: time and number of hits experienced.

External Attributes:

An external attribute is one that needs to be measured based on its behaviour. The behaviour of the entity is more visible than the entity itself. External attributes need to be measured indirectly considering external perspectives such as that of end-users and developers. This includes attributes that are well dependent on their functional behaviour while being operated upon. External attributes rely on human factors for measuring aspects such as operability, learnability and ease of use. These attributes can only be measured through collective feedback from users. In general, usability can be considered as an external attribute as there is no standard scale for measuring user satisfaction. It can only be evaluated through surveys and rating approach [5].

IV. Mapping of Entities and Attributes to Metrics

Given below is a hierarchical mapping of entities and attributes with the metrics. The concept of domain and range was taken into account while mapping the entities and attributes. The domain here is the entity i.e., website and web page. The range is the attributes defined in the above section. The figure 2 depicts the mapping of attributes and entities. The authors also designed a model of rules to be followed to ensure the repeatability of the project in future. The table 2 given below describes the rules to be followed to ensure repeatability.

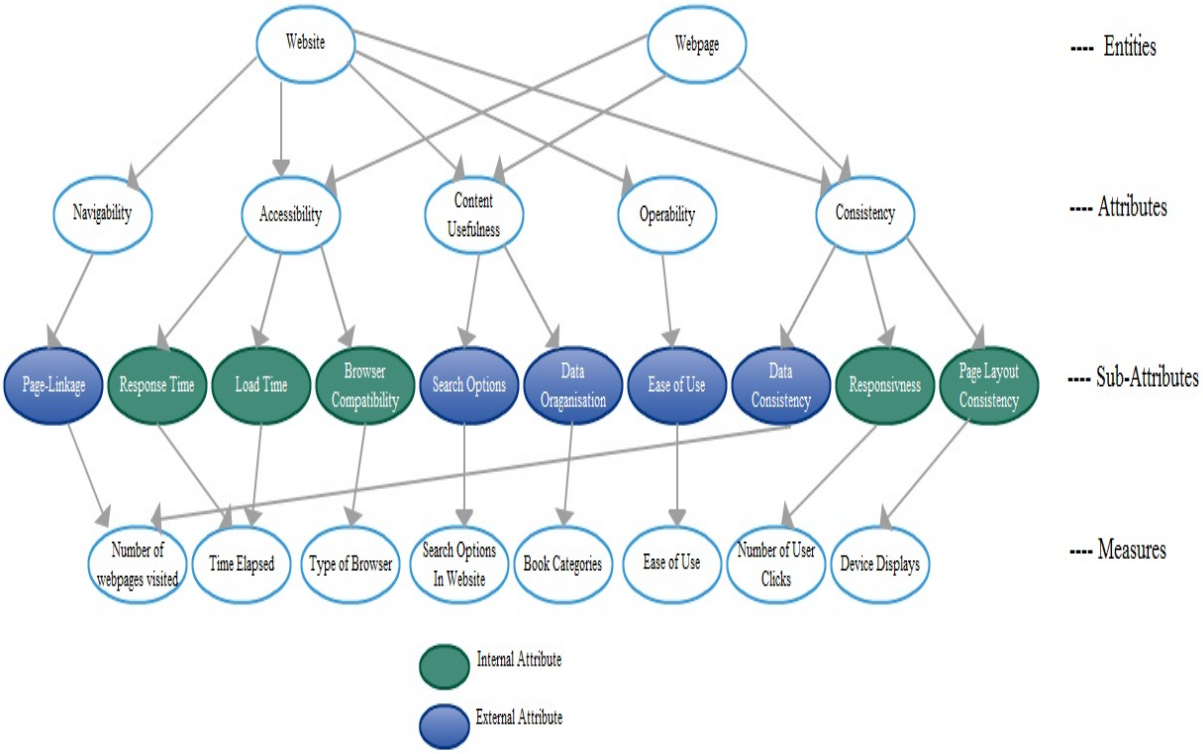

Figure 2. Mapping of attributes to measures

Sub-Attribute	Metric	Rules
Navigability: Page-Linkage	**Number of webpages visited**	- A specific page must be designated as the default page from which successive pages can be counted. - The page index can be observed to keep track of the sitemap.
Accessibility: Response Time	**Time Elapsed**	- The time count between the server request and server response is recorded. - The number of resultant objects must be recorded for each search iteration to get average time.
Accessibility: Load Time	**Time Elapsed**	- Time taken must be observed as the interval between accessing site url and loading of the entire web page. - Time lost due to unstable data transmission is neglected.
Accessibility: Browser Compatibility	**Cross-Browser Compatibility**	- Popular web browsing softwares that have been tested against time must be considered.
Content Usefulness: Search Options	**Number of User Input Options**	- The search options must be comparable to ones provided in other commerce websites. - The options must be available to buyers and sellers alike.
Operability	**Ease of Use**	- Several users must be involved in a usability survey to determine the average acceptance level.
Content Usefulness: Data Organisation	**Book Categories**	- All objects must be verified for valid identifiers. - Each object must be checked using their classes/ids to check whether they belong to the appropriate set.
Consistency: Data Consistency	**Web pages visited**	- All links and texts must comply with standard web design conventions. - The web page must exhibit resemblance at all levels.
Consistency: Responsiveness	**User Clicks**	- A record of all website activities must be maintained in an activity log. - The total number of user clicks must be compared with the action log of the website.
Consistency: Page Layout Consistency	**Screen Resolution**	- All standard resolutions such as 800*600 and 1366x768 are considered.

Table 2: Rules for measuring usability

V. Scale Types and Points

This section deals with the scale types and scale points defined for the metrics to measure the website's usability. The scale type corresponding to the metrics are presented in table 3 below.

Attribute	Metric	Scale Type	Scale Point
Page-Linkage	**Web pages visited**	Absolute	Number of Webpages
Response Time	**Time Elapsed**	Interval	Time(Seconds)
Load Time	**Time Elapsed**	Interval	Time(Seconds)
Browser Compatibility	**Cross-Browser Compatibility**	Nominal	None/Few/All
Search Options	**Input Options**	Nominal	Sufficient/Insufficient
Ease of Use	**Ease of Use**	Ordinal	Point-based Scale
Data Organisation	**Book Categories**	Nominal	Not Organised/Partially Organised/Fully Organised
Data Consistency	**Web pages visited**	Ordinal	Webpage Index
Responsiveness	**User Clicks**	Nominal	Acknowledged/Not Acknowledged
Page Layout Consistency	**Device Display**	Absolute	Screen Resolution

Table 3: Scale Types and Scale Points

From the above data, it is quite evident from the scale points that the users are allowed to submit their review regarding the various aspects related to the usability of the website.These reviews allows the developers to ensure that the website is developed to enhance user satisfaction. These measurement scales and points are designed as per the guidelines provided in [1].

Model for Predictions:

Website usability mainly involves the measurement of attributes based on the scale types and points. the attributes are defined for entities and these entities are defined based on the metrics. The usability measurement must be able to effect the changes in the website accordingly in the future. we present certain important attributes stated above which can have a considerable impact over the changes in the web usability.

- *Page Linkage:* It is one of the considerable factors that can have a significant influence on the usability of the website. The users must be able to get redirected to the home page if the objective of the user is not met, which is possible if the navigation between the pages is clearly stated and easily understood by the users [6].
- *Response Time:* The response time also plays a key role in affecting the usability of the website [6]. The response time refers to the time required to fetch the results based on the operation performed by the user. The lower is the response time the more is the user intended to revisit the website.
- *Search Options:* As the website under auditing is a E-commerce website, the search options provided to the user also plays a key role in affecting the usability of the website [6]. The more are the search options available to the user the more is the website interactive and the more is the user intended to revisit the website as they are able to fulfill their objectives with less effort.

the above attributes combined with the measurement rules can help the developers to enhance the user satisfaction and this serves a model of prediction regarding web usability.

Threats to Validity:

Though the usability measurement is controlled in many ways there are certain threats to the validation of the design as well as the measurement process. The threats to validity involved are provided below:

- Our study may involve internal validity threats such as maturation, mortality and selection of subjects [7][8].
- *Selection of subjects:* Selection of subjects plays a crucial role while determining the validity of the data being collected. The subjects need to be selected such that the sample represents the whole community of the subjects required for the experiment. Here the users can be categorised as technical and non-technical users [9]. So subjects need to be selected such that both the technical and non-technical users are involved during the data collection.
- *Maturation:* Maturation refers to the response of the users during the course of data collection [7][8]. the results can be greatly influenced based on factors that affect the user's performance during the data collection.
- *Mortality:* Mortality refers to the influence of the subjects who drop out during the data collection[8]. This threat can be mitigated by enabling the users to perform by motivating them and providing incentives if required.

VI. SUMMARY AND CONCLUSION

The previous report included the aspects of defining the measurement goal based on the Goal Question Metric (GQM) framework whereas this report presents aspects of identifying the entities, attributes and the corresponding metrics to measure the attributes. The authors also provided a recap of the measurement goal and defined the entities and attributes based on the literature to measure usability. The authors also presented a mapping of the entities to the attributes and the attributes to the defined metrics. The various scale types provided in the literature were also presented to measure the metrics and a model to predict the future trends in usability of websites of similar domain was also discussed. The authors presented a questionnaire and empirical research method to be followed by practitioners and developers in the latter part of the paper which would help them to develop more user satisfactory website.

VII. REFERENCES

[1] S. Hassan and F. Li, "Evaluating the usability and content usefulness of web sites: A benchmarking approach," *J. Electron. Commer. Organ.*, vol. 3, no. 2, pp. 46 – 67, Apr. 2005.

[2] J. J. Cappel and Zhenyu Huang, "A Usability Analysis of Company Websites," *J. Comput. Inf. Syst.*, vol. 48, no. 1, pp. 117–123, Fall 2007.

[3] Pamela Harpel-Burke, "Library homepage design at medium-sized universities: A comparison to commercial homepages via Nielsen and Tahir", OCLC Systems & Services: International digital library perspectives, Vol. 21 Iss: 3, pp.193 - 208, 2005.

[4] G. Kumar, N. Duhan, and A. K. Sharma, "Page ranking based on number of visits of links of Web page," in 2011 2nd International Conference on Computer and Communication Technology, 15-17 Sept. 2011, 2011, pp. 11–14.

[5] J. W. Palmer, “Web Site Usability, Design, and Performance Metrics,” Inf. Syst. Res., vol. 13, no. 2, pp. 151–167, Jun. 2002.

[6] T. Conte, J. Massollar, E. Mendes, and G. H. Travassos, “Usability Evaluation Based on Web Design Perspectives,” in *First International Symposium on Empirical Software Engineering and Measurement, 2007. ESEM 2007*, 2007, pp. 146–155.

[7] P. Lacherez, “The internal validity of web-based studies,” Jul. 2008.

[8] C. Wohlin, P. Runeson, M. Höst, M. C. Ohlsson, B. Regnell, and A. Wesslén, *Experimentation in software engineering*. Berlin: Springer, 2012.

[9] T. Ijaz and F. Andlib, “Impact of usability on non-technical users: Usability testing through websites,” in *Software Engineering Conference (NSEC), 2014 National*, 2014, pp. 37–42.

[10] J. Nielsen, “Usability Inspection Methods”, John Wiley and Sons, Inc, 1994.

PROPOSAL OF AN EMPIRICAL STUDY TO IMPROVE USABILITY OF WEBSITES

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I. ABSTRACT

This paper is a representation of partial fulfilment of the practical assignment for measuring the web usability. The success or failure depends on the user satisfaction and this user satisfaction can be determined by considering the usability of the product. The measure of usability enables the developers to learn about the user's viewpoint and increases the scope for enhancing the product in future. In this paper, the authors present a proposal to perform a survey regarding the user experience while using the website based on a questionnaire for acquiring the required data. The authors also suggested an empirical method i.e., survey to try to evaluate the usability of the website. This work serves as a reference to the developers while developing a usable website. The expected results serves the purpose of measuring the usability of the website http://www.abebooks.co.uk .

Keywords: web usability, survey, empirical study, user satisfaction

II. BACKGROUND

The authors defined the measurement goal based on the Goal-Question-Metric (GQM) framework. The authors also defined the entities, attributes and also defined the mapping of the attributes to the corresponding metric to measure the usability. A recap of the measurement goal is presented which was formulated based on the GQM framework template which is as presented below.

Purpose: *"To evaluate the website audit process to measure usability in order to enhance user satisfaction."*

By website audit [3], the authors mean the website review process which involves the analysis of the website from various perspectives. The user satisfaction plays a key role while determining the usability of a product before its deployment as it clears the developers point regarding the intention of the user to revisit the website again[3][4]. As the website under audit is already developed and deployed, the authors focus on the accessibility, screen appearance, navigability and content usefulness of the website [1][2]. So as a contribution towards enhancing the user satisfaction, the authors measured the usability and evaluated it using a questionnaire [5].

In this paper, the authors suggest an empirical research method to be implemented by a small firm i.e., http://www.abebooks.co.uk that is currently stationed at level 4 of CMM (Capability Maturity Model). The maturity level has a remarkable influence in defining the empirical studies method to make sure that the quality standards are not deviated [6]. Based on this motivation, the authors formulated a measurement goal, later defined the entities and attributes which are measured by defining the scale types and points in the previous parts of this paper. These entities and attributes enabled the authors to measure the usability of the website.

III. QUESTIONNAIRE

The authors presented a questionnaire which includes a series of questions that need to be answered by the users. This questionnaire forms a part of the empirical survey to be conducted in order to measure the usability of the website [5]. The authors before handing the questionnaire to the users provided them with the general questions about their name, age, mailing address and since how long have they been exposed and adapted to the website. Besides these queries, a series of questions pertaining to the measurement of usability in terms of content usefulness, accessibility, navigability and screen appearance were also presented. The table 1 below depicts the questions to be addressed and the motivation for addressing these questions.

S.No.	Question	Motivation
1.	Is any page of the website inaccessible i.e. did you receive any error message when looking for a certain page?	This question addresses our primary concern: Page-linkage. It is the basic checkpoint to ensure website navigability.
2.	How much time is take for the website to display the results of a book search operation?(1-Very less time, 2-Moderate Time, 3- Too much time)	Though we could use a an automated tool for measuring time. However, response time varies depending on user's input. Thus, we have used an nominal scale to get user feedback for different book searches.
3.	How much time does it take for the whole webpage to load?(1-Very less time, 2-Moderate Time, 3- Too much time)	Since it is difficult for end users to measure time in milliseconds, we were compelled to use a nominal scale to gather a large number of data points for different user scenarios.
4.	Does the website work properly for all the web browsers you tried out?	Each user has his/her own browser preferences. The purpose behind this question was to examine whether users were getting the same experience when using the site on different browsers.

5.	Are there sufficient search options provided for the basic and advanced search facilities?	Different users have different expectations from the search facility. This question is important to make necessary changes to it.
6.	On a five-point scale, how would easy is the website to use ideally?(1- Very Easy, 2-Easy, 3-Moderate, 4-Difficult, 5-Very Difficult)	We utilised a likert 5-point scale for measuring 'ease of use' an external attribute solely based on user acceptance levels.
7.	Did you find all your favourite book(s) listed under the correct categorie(s)?	This question is important as user perception may differ when it comes to content classification.
8.	Are all changes to your account detail(for e.g. cart status, previous transactions) being updated accordingly?	Website currency is an important factor of usability[1]. All changes made by the user must be reflected spontaneously.
9.	Did you find all the text consistent and visually attractive?	Consistency of text styling and formats is essential from the usability aspect [2]. This may enhance the overall user experience of the website.
10.	Do you use our website on different devices? If yes, Did you notice any anomalies regarding the screen display?	Users tend to access a website on several devices with different screen resolutions. Hence, it is important to know if difference in screen size may lead to any display inconsistencies.

Table 1: Motivation for Selected Questionnaire

IV. CHALLENGES DURING THE STUDY

The study can be highly influenced with the dynamic changes involved in the website under evaluation on which the authors may not have control [5]. The study is also influenced by the time constraint for the completion of the project. The authors have stated the challenges probable to occur and the solution to mitigate them in the previous paper. Though there are challenges encountered during the study, the prime focus remains unchanged i.e., collection of user reviews to enhance the user satisfaction regarding the website.

V. EMPIRICAL RESEARCH METHOD

In this section, the authors present the research method being used for empirical study and the motivation behind selecting the particular research method.

Objective*:*

The primary motive behind this project is to scale the usability of the online book store http://www.abebooks.co.uk with vital emphasis on website audit process. The website is developed and is at CMM (Capability Maturity Model) level 4. We decided that a survey study would be the most suitable for evaluating web studies. We performed a survey according to the guidelines presented in [5].

Research Method*:*

This study implicates scrutinizing the web audit process in order to enhance the user satisfaction. The study also includes the involvement of the user community to increase the usability of the website.

Our survey consists of 10 questions to carefully profile various aspects usability. The survey questions were inspired by similar web based studies[7] [8]. The questions were decided after rigorous discussion between all the authors. A case study was ruled out as it is a continuous process and needed a lot of time and resources than we could afford. Experiment could not be selected as it is performed in a controlled environment where the experimenter has the full control over the variables being used in the experiment [5]. Survey allows the authors to gather large amount of inputs from the user which in turn enables the developers to develop more usable websites [5].

Subjects of the Study*:*

It is important that the subjects are selected accordingly and the data acquired is properly validated. In this project, the users are categorized as buyers and sellers. So it is essential that the feedback from both type of users is collected and organized. The subjects need to be selected according to the guidelines in [1] [5]. The subjects are selected such that they represent the whole community of the users.

Data Collection*:*

To perform data collection using survey, the authors intend to publish the questionnaire online such that the data is collected from the visitors of the website [5]. Once the questionnaire is filled in by the users, the authors collect the data and record them for analysis. The authors also try to get the questionnaire filled by other users who are not actually using that website. By publishing online questionnaire it restricts the users using that website to fill it. So by getting the questionnaire filled in by non-frequent users we intend to collect more data regarding user satisfaction and needs.

Research Procedure*:*

The questionnaire is utilized in conducting the survey by following the sequence of steps described below. The steps are designed as per the guideline provided in [5].

1. The first step involves publishing the questionnaire in the website being inspected. The users are asked to fill in the questionnaire by motivating them with some incentives like discounts over the items they select and many more.
2. The first step being time consuming, the authors also plan to get these questionnaire filled in by a group of users representing the various users of a website.
3. The data is collected from the users and recorded. The authors then remove any invalid data obtained during the data collection.

4. The refined data is then analyzed by correlating them with the selected metrics and scale points so that some conclusions can be made regarding the usability.
5. Finally, based on the conclusions inferred from the data, the authors provide a set of guidelines to the developers that help them to develop more user satisfactory website.

VI. SUMMARY AND CONCLUSION

This section provides a summary of the work performed in this paper. the project's main aim was to measure the usability of the website http://www.abebooks.co.uk . The authors presented a measurement goal based on which the entities, attributes and metrics are selected. but identifying them does not complete the project. So the authors also proposed a questionnaire that would help in conducting a survey to find empirical results based on which the usability of the website can be validated. the authors also presented the research approach required and how the data is collected and the results are inferred about the usability of the website by the developers and the practitioners.

VII. REFERENCES

[1] S. Hassan and F. Li, "Evaluating the usability and content usefulness of web sites: A benchmarking approach," *J. Electron. Commer. Organ.*, vol. 3, no. 2, pp. 46 – 67, Apr. 2005.

[2] J. J. Cappel and Zhenyu Huang, "A Usability Analysis of Company Websites," *J. Comput. Inf. Syst.*, vol. 48, no. 1, pp. 117–123, Fall 2007.

[3] B. Menkus, "Auditing The Effectiveness of The Design of A Web Page," *EDPACS*, vol. 27, no. 12, pp. 1–3, Jun. 2000.

[4] T. Conte, J. Massollar, E. Mendes, and G. H. Travassos, "Usability Evaluation Based on Web Design Perspectives," in *First International Symposium on Empirical Software Engineering and Measurement, 2007. ESEM 2007*, pp. 146–155, 2007.

[5] C. Wohlin, P. Runeson, M. Höst, M. C. Ohlsson, B. Regnell, and A. Wesslén, *Experimentation in software engineering*. Berlin: Springer, 2012.

[6] M. C. Paulk, B. Curtis, M. B. Chrissis, and C. V. Weber, "Capability maturity model, version 1.1," *IEEE Softw.*, vol. 10, no. 4, pp. 18–27, Jul. 1993.

[7] Pei Yan; Jiao Guo, "The research of Web usability design," *Computer and Automation Engineering (ICCAE), 2010 The 2nd International Conference on* , vol.4, no., pp.480,483, 26-28 Feb. 2010.

[8] Ijaz, T.; Andlib, F., "Impact of usability on non-technical users: Usability testing through websites," *Software Engineering Conference (NSEC), 2014 National* , vol., no., pp.37,42, 11-12 Nov. 2014.