Effects of Information Architecture on Agriculture Website Usability: A Comparative Study between CGIAR Research Map and Kenya Agriculture Information Network (KAINet)

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DECLARATION

I, Evelyn Katingi, declare that this is my original work and has not been presented for a degree or award in any other university.

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This thesis has been submitted with our approval as supervisors

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ACKNOWLEDGMENTS

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CGIAR – Global research partnership for a food secure future

KAINet – Kenya Agriculture Information Network

KARI – Kenya Agricultural Research Institute

ILRI – International Livestock Research Institute (ILRI)

IARCs - International Agricultural Research Centers

NARs - National Agricultural Research System

ABSTRACT

Websites are an important link in the exchange of agricultural information between the providers and users of the information. The high growth rate of information and communication technology (ICT) has seen a surge not only in the number of websites being designed but also in the design style and standards being applied by web developers when designing and building websites. This study compared two websites, the CGIAR Research Map, designed using the matrix information architecture and the Kenya Agriculture Information Network (KAINet) website designed using the hierarchical information architecture and the effects of these designs on various usability criteria.

Two integrated test methods, testing with end users and inspection methods were applied in order to collect usability information from the websites so as to realize the objectives of the study. Websites usability information was obtained from a random sample on 126 websites end users and the study's websites developer's provided information on the website administration. In the second method, four evaluators reviewed the websites by checking against a set of usability criteria.

The design and graphic features in the matrix design is a feature that was seen to attract more users to share information. The cost of maintaining information in the matrix designed website in terms of the number people responsible for updating information and the frequency of checking information in the back end by the administrators was found to be higher than that of the hierarchical designed website. Further, the search function design of the websites was important to the clicks on target when users carried out a search, with the matrix design listing more hits on targets. Overall, the findings revealed that users prefer different usability features in different architectures with the CGIAR Research Map exhibiting more robustness.

CHAPTER 1: INTRODUCTION

1.1   Background

Information is the basic element of any technological innovation and a key component of all innovation and research processes (Rivas et al, 2007). In the recent years, there has been an exponential increase in the amount of information generated by the various stakeholders including farmers, scientists, agribusiness dealers and students that is potentially important for agricultural production (ibid). Information and communication technologies (ICT) have become very important tools with transforming impact on how we exchange information.

ICT has contributed to the harvest of results in terms of diffusion of innovation, market access information, technology releases in various sectors including the agriculture (Sánchez-Tarragó, 2009). Websites have become essential tools in the dissemination of content in digital format, especially in organizations where the generation, management and distribution of information and knowledge are among the major activities. The same is true in agricultural institutions, where information and knowledge are the major byproducts of agricultural research (Chisenga et al, 2004). Times have passed when research institutions had to produce brochures to reach their communities. Today, even the smallest institution is able to generate and distribute information in a simple way by using digital media. Additionally, it is not only easy to create adequate digital instruments for information sharing, it is also inexpensive (Weber, 2009).

The world wide web contains a large and exponentially increasing number of websites, ranging from a single personal homepages, to large corporate sites containing thousands of individual pages (Cunliffe, 2000). The extraordinary growth in internet usage offers researchers significant

new opportunities to identify and test ways for delivering information based on the structure of the websites. The information architecture (IA)—the structure of website information—is an important but often overlooked factor to consider when designing and analyzing websites for sharing agriculture information (Danaher et al, 2005).

IA has been defined as the "process of structuring and organizing information so that it is easier for users to find and for owners to maintain" (Rosenfeld, 2000) and is an important dimension in a website worthy of greater scrutiny and research. IA designs include: a) the free-form matrix design that offers little information structure; b) hierarchical design that provides the user with information arranged in an organized fashion; c) tunnel design that defines a narrow path with a predefined series of steps; and, d) hybrid design composed of a combination of modules that have their own IA design (Danaher et al, 2000). Hierarchical designed websites like the Kenya Agriculture Information Network (KAINet) have been extensively used by agricultural research institutions to share information while new architecture design websites like the matrix designed CGIAR Research Map which uses a combination of graphic features to display information are gaining popularity.

Another critical dimension of scrutiny heavily related to the website IA is its usability in order to determine how well the different designed websites meet user needs. Usability includes consistency and the ease of getting the website to do what the user intends it to do, clarity of interaction, ease of reading, arrangement of information, speed and layout. Appropriate design of user interfaces includes organization, presentation and interactivity (Shneuderman, 1998). How information in the matrix, hierarchical and other architectural designs in websites are categorized, labeled and presented; and how navigation and access are facilitated determines not

only whether users will and can find what they need, but also affect user satisfaction and does influence return visits. The design of IA also affects users' sense of orientation (knowing where they are in the hierarchy) (Zaphiris et al, 2003).

1.2   Problem statement

While the potential of the internet has been illustrated, most of the websites do not meet their potential (Baggio, 2003). User's evaluations and mapping of contents and services offered attain a generally low quality index, mainly in the area of usability functionalities (ibid). Developing appropriate user interface architecture for supporting a system's tasks is critical to the system's overall usability (Ramsay, 2008). Typical information architectures were commonly designed by conventional systems analysis methodologies, but they lack the flexibility to cope with the increasing pace of information technology and constantly fluctuating business environment (Pai and Lee, 2005).

Efficient utility of agricultural websites will depend on how flexible organizations are willing to respond to the changes in information technology and website design standards. Billie and Curto (2011) stated that getting traffic to your website is important, but equally important is keeping visitors on your website once they have found it. They further reported that, the appearance of your website is critical to retaining visitors. Taylor (2010) found that the use of Maps in websites design have emerged as an important asset in publicly revealing data and information needed for development efforts at the community, national, regional and international level. This website design technique is increasing in popularity and has become a useful way of providing and finding information on what exists and where. While there are principles to guide architectural

design, confirming that the correct decisions that will enhance the transfer of information between agricultural information providers and users are made can involve the collection and analysis of lots of test data (Ramsay, 2008).

Hohl (2009) investigated the concept of information visualization such as diagrams, maps, graphs and charts and found that while they can achieve their purpose in making complex information accessible and clear, there are an increasing number of events, where it may be useful to present that information in a logical way. The study did not attempt to compare these two information presentation methods explicitly displayed through the matrix and hierarchical information architectures to tell how they affect different websites usability criteria.

Morosan and Fesenmaier (2007) on their study on persuasive architecture of tourism websites found that consumers do more than process information to carry out their desired action in the websites but engage also in emotional appreciation of the website features through various graphic information architectures features. This has also been reported by other destination marketing and consumer studies based websites.

The literature quoted does not attempt to show if this is true for the agriculture industry websites. Whereas several website usability studies have been done, none have attempted to collect test data in agricultural websites to determine whether correct decisions are being made by institutions in designing websites that enhance and improve the transfer and use of agricultural information through comparing different information architectures.

Designing appropriate agricultural websites that meet user needs is critical to the success of the agricultural industry (Ramsay, 2008). The studies quoted above do not attempt to show which features in the matrix and hierarchical information architectures would hugely contribute to how

information is exchanged and which features would result to ineffective information exchange in agricultural websites.

1.3   Purpose and Objectives

1.3.1 Purpose

The purpose of this study was to compare two different information architecture designs, the matrix and hierarchical designs, in the CGIAR Research Map and the KAINet website respectively, built for sharing agricultural information and the effects of each of these information architecture on various usability criteria that can be inspected and evaluated.

1.3.2 Specific objectives

The specific objectives were:

1. to assess how information architecture influences the speed at which information is retrieved in a website

2. to determine the effect of information architecture on information sharing

3. to compare the human resource needed in information maintenance and website administration in relation to the architecture of the website

1.4   Study questions

The following research questions were addressed in the study:

1. does the website's information architecture influence the time spent in a website and the amount of browsing one would carry out?

2. to what extent does the website information architecture influence contribution of information by information providers?

3. to what extent does the human resource needed in developing and maintaining a website influence the information architecture design?

1.5   Significance of the study

The impact of a website's design on the ability of a user to navigate the website is very often overlooked by many website designers (Zaphiris et al, 2003). Addressing information architecture issues in the area of agriculture information communication and management is important to enable effective and efficient flow of information from the information generators to the user of such information. Through examining the identified IA, the study aims to make important contributions to the way agriculture websites are currently being designed so as to enhance usability of such information.

The study will inform agriculture research institutions on the importance and effects of good information architecture design on information dissemination by providing insights on factors that institution should take into place when designing their websites to achieve maximum utility of this communication tool. It will target website developers, agricultural scientists, academician, communication professionals and curious agriculture information users.

The study will give insight on the human resource needed in designing websites with the different information architecture in terms of how much skill, expertise and time is required to design each websites by analyzing feedback from the web designers and web administrators. In addition, it will give insight into the maintenance of the site and the amount of user support needed in each of the websites. This information will be useful to institutions when they are identifying and choosing appropriate information architecture for developing their websites. Collected study information will also be important in contributing to future related studies.

CHAPTER 2: LITERATURE REVIEW

2.0   Introduction

This chapter provides a review on previous work pertaining to the study. Prior work on the role of information management in agriculture, the different information architectures used to build websites and the websites architectural features that support website usability are reviewed. Further, the various methods for evaluating websites and the features investigated during evaluation are also reviewed.

2.1   Agriculture information management

Technical information is a key element of any innovation or research process undertaken in the agricultural sector. Institutions that promote such processes are currently facing a number of challenges in relation to information management (IM) (Rivas et al, 2007). Processes must be carried out in a changing environment characterized by an exponential increase in the amount of potentially important information available, the continuing development of information and communication technologies (ICT) including websites, as well as other factors (ibid). The challenges include the need to incorporate information explicitly into the planning and execution of all institutional processes and to make maximum use of the tools offered by ICT, which will generate support for knowledge management processes. Information is one of the fields that continue to be mostly affected by major, rapid ICT changes in recent years (ibid).

It is a useful metaphor to think of information, knowledge and communication as essential elements that 'fertilize' research and innovation for agricultural growth and development (Ballantyne, 2009). In recent years, there has been an exponential increase in the amount of information available that is potentially important for agricultural production. Furthermore, changes in ICT have impacted the way in which organizations devoted to agricultural research

and innovation work and have opened up a wide variety of new opportunities, while at the same time posing new and complex challenges (Rivas et al, 2007). Maru et al. (2009) argue that the processes by which knowledge, information and data are generated and shared are being transformed and reinvented – especially enabled by ongoing developments in the area of information and communication technologies (ICTs) – and that these transformations provide massive opportunities for the entire Agricultural Research for Development (ARD) community to truly mobilize and apply global scientific knowledge, in ways that are hardly yet appreciated.

More than ever, the developing world needs reliable information and knowledge on agricultural issues. It needs this knowledge to be accessible and well communicated (Ballantyne, 2009). On its own, more information is not enough: access is needed to additional, different knowledge, from different people across the full spectrum of producers, scientists, educators, advisors and policy makers. Beyond access to information and knowledge, people and institutions in agriculture seek more and better opportunities to interact, to converse, to engage with and question multiple views and perspectives from the peripheries to the centers. New and innovative ways are needed to mobilize and communicate the evidence and insights that decision makers require to take difficult decisions (ibid).

2.2   Information architecture

Information architecture (IA) can be described as the organization of a website's structure and content by labeling and categorizing information; designing navigation and search systems; identifying and using language and vocabulary schemata; and designing the website layout in order to enable user task execution in finding information efficiently and effectively (WoVG, 2010: 2). Princeton University guide (2008) defines it as the structure or organization of a

websites describing the way different pages are organized in a consistent and predictable way one each page. They further state that it involves various steps such as assessing existing and needed content, organizing the pages, providing clues to help use the site efficiently and developing navigational structure. Information architecture is the structure of information space to facilitate intuitive access to content and task completion, it is considered as a potential foundation for building structured, interactive and coordinated information systems (Danaher et al, 2000).

In their 2006 report, Danaher et al. describe four IA website designs and their rationale for use. A free-form matrix design that offers little information structure; 2) a hierarchical design that provides the user with information arranged in an organized fashion; 3) a tunnel design that defines a narrow path with a predefined series of steps; and 4) a hybrid design composed of a combination of modules that have their own IA design.

Websites with a matrix IA design embody the principles of the originators of hypertext, HyperText Markup Language (HTML), and they take fullest advantage of HTML's hyperlink capabilities to allow users to review all website content. In the matrix IA design, users are free to pursue their idiosyncratic interests by using their own path through the available content. When properly created, this design can expedite a user's search of the content (Danaher et al, 2006).

In hierarchical structures the information is categorized in a parent-child manner where the parent contains the broader content items and the information reduces in the child category. Hierarchical IA designs help users find desired content by locating a broad theme and then drilling down into more detailed information, it is relatively easy to find your way back through content already viewed because it simply involves moving back up the hierarchical structure (Danaher et al, 2006; Zimmerman, 2005).

The tunnel information architecture design also referred to as a flat pattern is a linear model that that follows a step-by-step approach with only a few standard topics such as home, contacts, products and about us (Zimmerman, 2005). Almost all e-learning courses adhere to a tunnel design. These typically have a series of lessons that present the content, test for comprehension, and provide remedial loops and other conditional branching. (Danaher et al, 2006).

Hybrid designs are composed of multiple IA modules, each of which can be described along the continuum from matrix and tunnel designs. The hybrid designs also allow the user to break free from the lock-step sequence of pages found in a tunnel design offering alternative ways of interacting with websites, initiating users own learning as opposed to users falling into a mode of a passive page turner (Danaher et al, 2006).

2.3   Information architecture and website usability

A successful website architecture needs to support the ways which users look for information and interact with the system (Hourican, 2002). Measuring the 3Us (usage, usability and usefulness) of your website is key to making sure that you are meeting the objectives and impact you set out to achieve when you built your website. Knowing how many people visit your site, who they are and what they do while they are there (usage) will help you tailor your site to deliver, share or pull in the information or messages your audiences most need, in the way audiences want to receive and contribute to it (Buonaiuto et al, 2007). Knowing how easily visitors find what they are looking for and their perception of your site (usability) will help you improve its functionality and the user-experience—encouraging more use of your site. And knowing how well your site meets your visitors' information needs (usefulness) will help you improve both your content and its organization to meet those needs (ibid).

Website design can be seen as a blend of three elements: content; visual appearance; and usability. Usability itself must be evaluated at two often interrelated levels, site-level usability and page-level usability (Nielsen 1998a). The relative importance of these three elements can be site and user specific, though it has been suggested (Nielsen, 1996) that the visual appearance of Web interfaces (and interfaces generally) is becoming increasingly significant (Cunliffe, 2000).

Further, results suggest that website success is a first-order construct. Moreover, website success is significantly associated with website download delay (speed of access and display rate within the Website), navigation (organization, arrangement, layout, and sequencing), content (amount and variety of product information), interactivity (customization and interactivity), and responsiveness (feedback options and FAQs) (Palmer, 2002). A website that has a poor or confused visual appearance is much less likely to retain visitors than a site that has been carefully designed to use the appearance as a way to convince users that your site is the site they have been looking for (Cuto, 2011). Smith (2000) observed that the influence of website quality on brand building and loyalty has been assessed in a number of empirical and theoretical works and many stress the critical role of the first impression created by a website as well as its ease of use.

2.4   Approaches to website evaluation

In their study of usability testing, Arh and Blazic (2008) report that usability testing is of key importance in the human-computer interaction. It is one of the basic elements used to verify the user interface quality. They further divided usability methods into inspection methods (without

end users) and test methods (with end users). Inspection methods are methods for identifying usability problems and improving the usability of an interface design by checking it against

established standards. These methods include heuristic evaluation, cognitive walkthroughs, and action analysis (ibid). Heuristic evaluation (HE) is a commonly used informal method where a few evaluators judge different elements in the websites by checking against some usability principles (Cunliffe, 2000). A cognitive walkthrough (CW) is a task-oriented method by which the analyst explores the system's functionalities; that is, CW simulates step-by-step user behaviour for a given task (Arh et al, 2008). Walk-throughs are used to determine whether a user might fare with a product by envisioning the users paths of browsing (Rubin and Chisnell, 2008).

Testing with end users is the most fundamental usability method and is in some sense indispensable (Arh et al, 2008). It provides direct information about how people use systems and their exact problems with a specific interface. This method, also referred to as inquiry usability testing requests information from the users and included use of focus groups, interviews, questionnaires, surveys and thinking aloud (Whitehead, 2006). In the thinking aloud (THA) method, one of the most valuable usability testing method, the participant explaining certain actions within the website while the observer records these (McMullen, 2001). Field observation is the simplest of all methods. It involves visiting one or more users in their workplaces. Notes must be taken as unobtrusively as possible to avoid interfering with their work. Many aspects of usability can best be studied by querying the users. Questionnaires are useful for studying how end users use the system and their preferred features, but need some experience to design (Arh et al, 2008).

2.5   Website evaluation features

Websites evaluation categories can be broadly consolidated into, functionality, which refers to how effectively a site is designed, authority, referring to the truth worthiness of the information

in the site, validity, an indication of the extent that others consider the website useful, obtainability, referring to the ease with which as site may be recalled and displayed, relevance, referring to the information requirement of the user and substance assesses, referring to the significance of a site for producing reliable information (Middleton, 2007)

Baggio et al. (2003) assessed the websites of major European and a number of Mediterranean tourism destinations using heuristic evaluation of the user perception of the website and a mapping of contents and services offered by the presenting organization. They defined a list of items that can be inspected and evaluated by an appropriate sample of users of a specific website by combining various principles and a number of features that might characterize a successful e-tourism website. These include: First impact: the general feeling during a first scan, before an accurate visit of the site; Design and graphics (DG): the quality of graphical elements (pictures, symbols, photographs etc) and the balance between text and images; Information content (IC): the thoroughness and usefulness of information, the clarity of language; Interactivity and services (IS): the number and quality of interactive services and the tested user-friendliness of the functions; Structure and navigation (SN): the rationality of the website structure and navigation aids; Technical management (TM): the updating of contents, the response times and the absence of errors or missing links.

When website evaluation is qualitative, the sample visitors express their appreciation of the various website usability features by means of a score. Evaluators award from a range of scores from the minimum to the maximum set values to each of the inspection items (Covini & Baggio in Baggio 2003).

CHAPTER 3: METHODOLOGY

3.0   Introduction

This chapter provides the description of the research methodology applied in the study. It begins by providing the delimitations of the study followed by an examination of the existing theories guiding the study defined in the theoretical framework and the study's conceptual framework that shows the various study variables. The detailed description of the sampling and data analysis techniques are provided.

3.1   Study scope

The comparative study was carried out on two agriculture information websites built on different information architecture. The CGIAR Research Map designed using the matrix information architecture and the Kenya Agriculture Information Network (KAINet) designed using the hierarchical information architecture.

The CGIAR Research Map is a website that has information on the research projects being carried out in Africa by the 15 International Agricultural Centers of the Consultative Group of Agricultural Research (CGIAR). The Research Map facilitates project information and knowledge sharing among the CGIAR Centers, its partners and other users of agriculture information so as to promote synergy, enhance information accessibility and sharing by availing information from a single source. The information in the Research Map has been geo-referenced and the entry level navigation is through a Map where various countries are used to show areas where there is information.

Kenya Agricultural Information Network (KAINet) is an information network set up to promote information exchange among stakeholders in the agricultural sector in order to support decision

making, promote innovation in agriculture and subsequently improve livelihoods. It aims to modernise and increase productivity of the agricultural sector. The KAINet e-respository access to a large collection of world literature covering all aspects of agricultural sciences and technology, including grey literature which is not available through normal publication and distribution channels (KAINet.org).

These websites were selected based on the following characteristic: a) Both provide information on agriculture research; b) They both have specific target groups for their information and; c) CGIAR Research Map is built using the matrix IA while KAINet is built using hierarchical IA.

3.2 Theoretical framework

This study was informed on two theories: 1) information theory and 2) social cognitive theory. These theories provided the logic in understanding how the design of the website facilitates the transmission of information between the providers and users of information.

As described by Griffin (2000: 48), the theory of information was first developed by Claude Shannon in the 1940s as a mathematical theory of signal transmission that discovered the transmission of messages from the sender to the receiver. This theory was then translated by Warren Weaver to describe human communication into what can be seen in the source-channel-receiver diagram shown in Figure 3.1. The source-channel-receiver model describes the various paths that a message follows with the overall aim of maximizing the amount of information that can be passed from the receiver to the sender over a given channel (ibid).
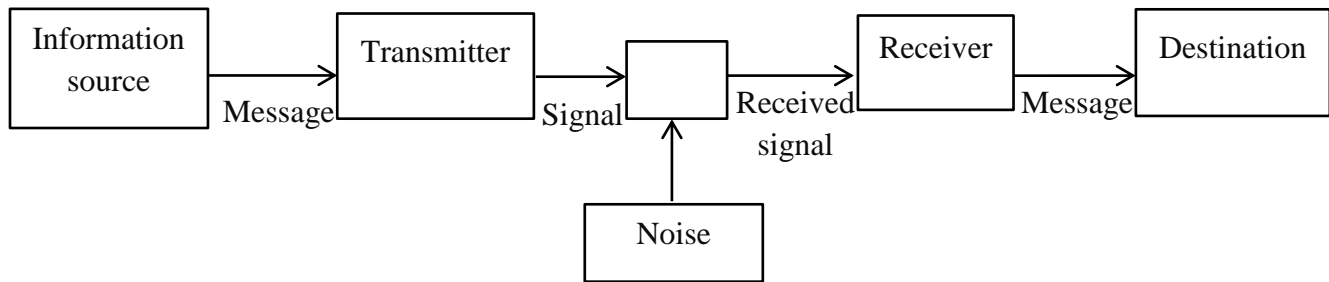
Figure 3.1 Shannon and Weaver model of communication (Adapted from Shannon and Weaver, *The Mathematical Theory of Communication*.)

Among the barriers to efficient communication flow as described in the model is noise. In real life scenarios noise could be anything that hinders how a message is transmitted from the sender to the receiver. As applied in this study, there are various usability features that make up the architecture of a website which affect how information is transmitted between the information providers and the information users just like noise, the effects of these features on the transmission of information in websites were investigated.

Wood and Bandura (1989) defines the social-cognitive theory as 'explains the psychosocial functioning in terms of triadic reciprocal causation'. The theory explains the behavior of people resulting from the interactions of the environment, people and behaviour. In modern communication, the theory can be applied to internet usage whereas encountering informative and well-designed webpages can increase usage and expected negative encounters such as non-desired search outcomes, outdated information could discourage use (LaRose, 2001).

As applied in this study, the various features that make up a good website such as design and graphics, information content, structure and navigation and technical management are factors that can enhance or discourage website use. According to the social-cognitive theory this is true as environmental events, in this study website features, personal factors and behaviours influence

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each other. This theory aided in understanding how the different information architecture features affect usability.

3.3   Conceptual framework

The enormous growth of the ICT sector together with the increasing demand to make research information widely accessible and available to end users has seen many institutions and individuals investing a lot of resources in developing appropriate online communication channels for sharing their information (Pai et al, 2005). The internet is a technology with the potential to bring about major contributions to the agriculture sector by closing the gap between information provider and seekers, developed and emerging economies like Africa where agriculture greatly contributes to the gross domestic product, by enabling access to and the sharing of useful information, and by connecting virtual communities of interest (Parent, 2009).

Information exchange between agricultural information providers and users is derived from the intersection of the demand and supply of information with websites providing a balance on this intersection, this has led to the development of many different websites which seek to bridge the gap between information providers and users (Winter and Strauch, 2003). Information architecture (IA) is increasing being considered an important blueprint for implementing successful agricultural information communication systems. Different information architecture designs have been proposed in recent years by researchers with the overall aim of enhancing the flow of information between the producers and users of information (Pai et al, 2005).

Websites are designed to facilitated information discovery and exchange between information users and providers. Effective web communication is a consequences of the 3 elements a communication triad namely, the users of information, the information providers and websites architectures in the middle (Morosan, 2007). The framework in Figure 1 puts agricultural

information providers and users on the different ends of the communication divide and the agricultural website serving as a bridge to the two. How effective this communication channel is, largely depends on the IA of the website. The study investigated the different elements of a website that contributes to its IA which included the consistency of information arrangement, clarity of interaction, ease of reading, search tasks speed and layout by comparing two websites build using different IA designs. A good IA plays an important role in how information is exchanged between the providers and users of the information.
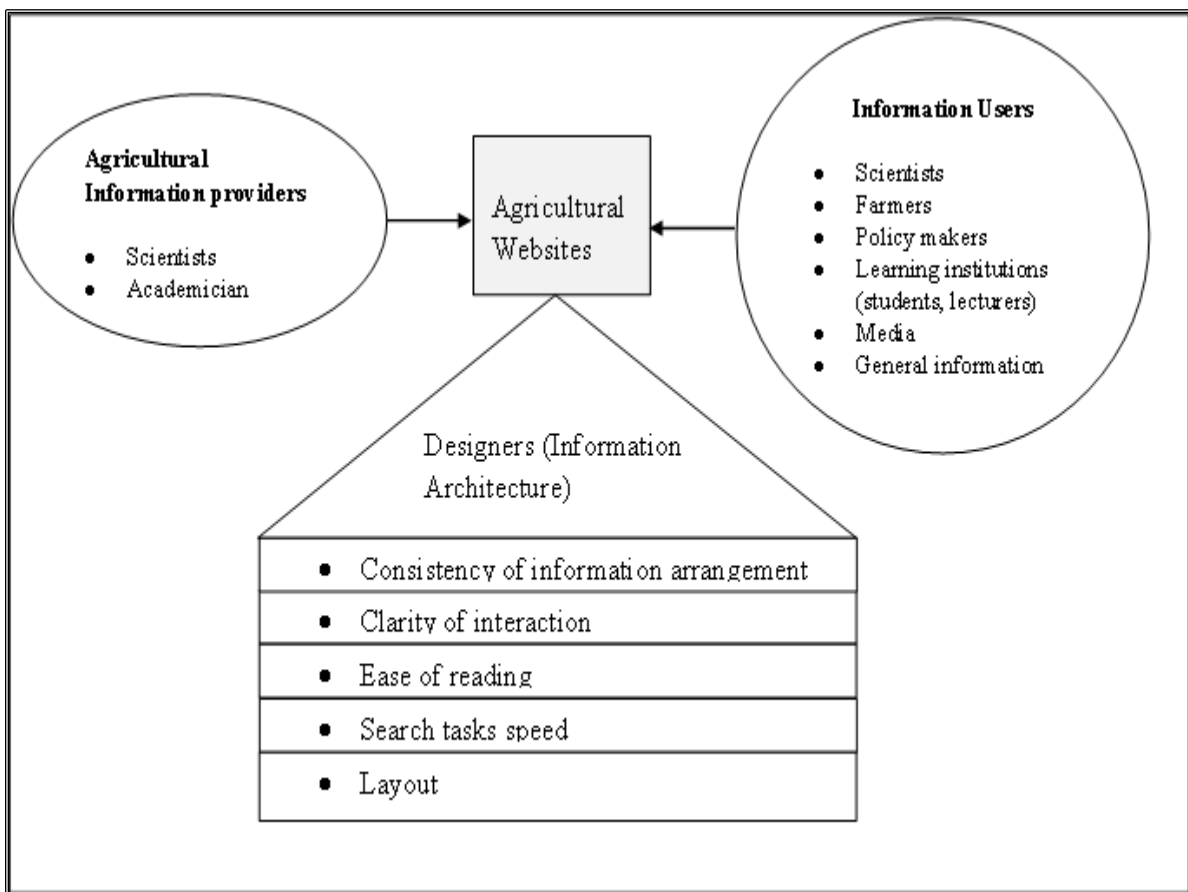
Figure 3.2: Conceptual framework on the relationship between agricultural information architecture and information exchange, Source: Author's synthesis (2012)

The framework shows the information architecture components necessary to make a good website and how that influences the balance on effectiveness of the exchange of information between information providers and information users.

3.4   Sampling and data collection

The sampling frame was divided into two clusters of internet users, who provided primary data for the study. The first cluster was made up of the end-users of the information in the two websites who included agricultural scientists, academician and general information users. The second cluster was made up of web developers and web administrators who provided information about the technical development and overall administration of their websites. Participants comprised academic and research community in the different agriculture research institutions that contribute and use the agricultural information in the two comparative study websites. Two organizations, the International Livestock Research Institute (ILRI), selected as a representative of the host organization for the CGIAR Research Map and the Kenya Agricultural Research Institute (KARI) which is where the KAINet website is hosted were used to compute the sample size.

3.5   Sample size

Primary data was collected using two integrated website data collection approaches that helped in reaching conclusions. A description of these methods and their sample size determination is described in section 3.5.1 and 3.5.2 below:

3.5.1 Sampling end users

This method involved designing questionnaires for websites end users that described key website usability information and for the website system administrators that described the maintenance and management of the websites. The population for International Livestock Research Institute

(ILRI) was 700 staff, while that of the scientific staff of the Kenya Agricultural Research Institute was 500 bringing the total population to 1200. The sample size for the research was calculated using the formula below for finite population according to Rea & Parker (1997).

$$n = \left(\frac{Z\alpha\sqrt{p(1-p)}}{Cp} * \sqrt{\frac{(N-n)}{(N-1)}} \right)^2$$

Introducing *n* on each side of the equation and solving for n the equation becomes

$$n = \frac{\left[z_\alpha^2 p(1-p)N \right]}{\left[z_\alpha^2 p(1-p)N + (N-1)C_p^2 \right]} \tag{2}$$

where *n* = the desired sample size; N = total population; C_p = margin of error; Zα = Z score for various levels of confidence (α). Taking a 99 percent confidence (Z = 2.575) at the ± 10 percent margin of error, the following sample size required was 146.

3.5.2   Inspection method sample size

Websites inspection methods are evaluation techniques where a team of investigators review the interface of the websites against usability criteria. The study employed heuristic evaluation as its website inspection technique (Arh et al, 2008).

For the inspection method, Nielsen (1994) recommends three to five website evaluators stating that one does not gain that much additional information by using large numbers. The study thus enlisted four evaluators who inspected and evaluated each of the study websites against the established usability criteria.

3.6   Sampling Procedure

Website users of the two comparative websites who mainly included researchers and the academic community that had access to a computer and internet connection were identified from ILRI, KARI and other IARC and NARs centers who share information in the study websites. Participants who had not interacted with the websites in the recent future and those who were not sure of any prior interaction with the websites were allowed time to browse the websites and a set of basic navigation tasks which reflected the context in which the websites are used for was administered. The structured questionnaires were mainly made up of closed ended questions which investigated various elements of websites usability. These factors, broadly categorized by Shneuderman (1998) included; consistency of information arrangement, ease of getting the web site to do what the user intends it to do, clarity of interaction, ease of reading, arrangement of information, search tasks speed and layout. Additional variables investigated included the ease of updating information in the website and experience in sharing information.

A second set of questionnaire was administered to the web developers in each of the study websites where information on website development and maintenance was captured so as to establish the human resource needed in managing the websites.

Heuristic evaluation was administered by website evaluators in order to analyse the websites. Four evaluators who were equipped with an internet connected computer were asked to conduct several browsing tasks in the websites and record their actions. The experiment was designed in such a way that those participants who had no previous experience of the websites, were given additional time for them to browse and familiarize themselves with the websites before carrying out the evaluation. The evaluators inspected and rated the two websites, KAINet and CGIAR Research Map, against a set of established usability criteria so as to check on the websites

usability standards. The information was used to reveal key usability features and test against the test methods results of the study.

3.7   Data analysis

After data collection, the data were coded and entered in Microsoft excel and later exported to Statistical Package for Social Sciences (SPSS) where data frequencies and statistical analyses were performed to reach quantitative conclusion on the results. The statistical tests performed were to examine the differences between the factors of analysis in the two websites, the tests included the, Chi-square test and the Mann-Whitney non-parametric test used to show comparisons on the ranked responses in the two websites.

CHAPTER 4: RESULTS AND DISCUSSION

The analysis of the data from the websites end user's questionnaires where key usability information was obtained and the websites information maintenance and management information obtained from the system administrators questionnaires are presented in this section. Key usability features from the integrated website inspection method carried out are also described. The overall usability, speed of information retrieval, user information sharing experiences and the websites information maintenance and administration in the two websites are compared.

4.1   Participants and website uses description

The description of the study participants is given in section 4.1.1. Whereas there are various reasons that websites designers hope to meet when defining their websites, the various uses that the participants use the websites for are presented in Table 4.2.

4.1.1   Participants description

A total of 126 questionnaires were analysed (86 % response rate) from the users of the CGIAR Research Map and KAINet website. Among those 65 (41 male and 24 female) were users of the CGIAR Research Map users and 61 (38 male and 23 female) were KAINet users.The occupation of the respondents was composed of research officers at 27 %, students 23.8%, general website users 19%, academic staff at 18.3% and scientists at 11.9%. The distribution of the respondents occupation in the two websites is shown in Table 4.1.

Table 4.1: Occupation of the study website users

Occupation	CGIAR Research Map		KAINet		Total	
	n	(%)	n	(%)	n	(%)
Research officers	18	27.7	16	26.2	34	27.0
Students	12	18.5	18	29.5	30	23.8
General users	12	18.5	12	19.7	24	19.0
Academic staff	13	20.0	10	16.4	23	18.3
Scientists	10	15.4	5	8.2	15	11.9
Total	65	100.0	61		126	100.0

The age of the sampled website users ranged from under 25 years to 54 years, with the age of most (54%) of the users ranging from 35-44 years, 27.8% ranged from 25-34 years, 10.3% under 25 years while 7.9 % ranged from 45-54 years. A Chi-square test (Ch.sq.=3.644, p = 0.300) on the age shows the age categories was not significantly different across the study websites.
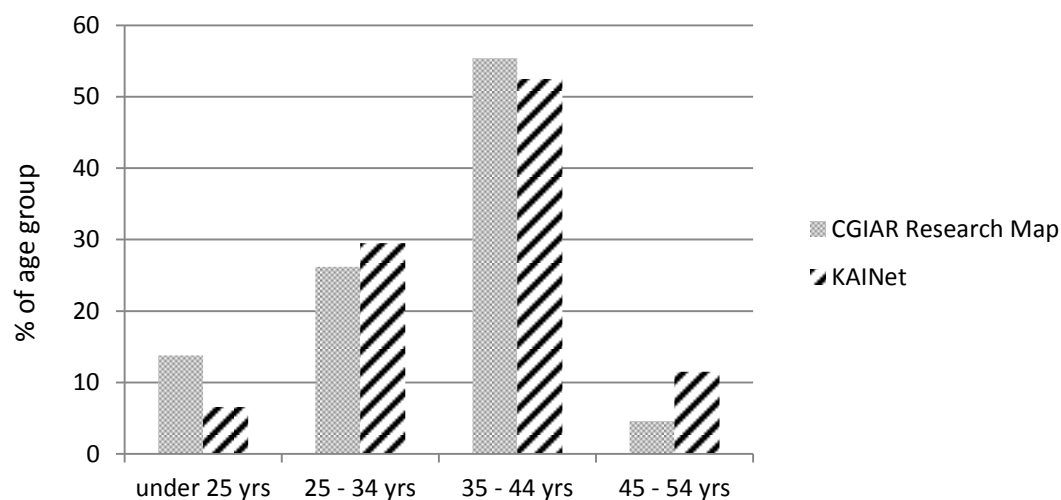
Figure 4.1: Age group of the study websites respondents

(Source: *Data computations with SPSS, November 2012*)

4.1.2 Measure of overall usability

In line with other previous studies that have shown that websites are increasing in use and also the purposes in which they are being used, across the two websites, users gave similar key reasons for using the websites with the search for research information details and reading agriculture related news dominating other functions as shown table 4.2 below.

Table 4.2: Reasons for using the websites

Purpose for using websites	KAINet		CGIAR Research Map		Total	
	n	%	n	%	n	%
Look for research information details	23	16.5	25	18	48	34.5
Read agriculture related news	22	15.8	16	11.5	38	27.3
Access research papers, journals, reports etc	10	7.2	11	7.9	21	15.1
Find out what research is being carried out where	3	2.2	8	5.8	11.0	7.9
Look projects to collaborate with	2	1.4	5	3.6	7	5
Share information	3	2.2	4	2.9	7	5
Look for scientists contacts	1	0.7	2	1.4	3	2.2
Look for internship opportunities	0	0	2	1.4	2	1.4
Find links to other websites and portals	1	0.7	1	0.7	2	1.4
Total	65	46.8	74	53.2	139	100

Source: *Data computations with SPSS, November 2012*

4.2 Speed of information retrieval

To assess how information architecture would influence the speed of information retrieval, participants rated the websites design and features that would influence users search experience.

Information layout and the appearance of the websites play an important role in how users browse the site and results are presented.

4.2.1   Score of key website usability functions

In the evaluation of the overall website design, users were first asked to indicate whether they found the homepage of the website they were evaluating descriptive. Ninety four percent (94%) of the CGIAR Research Map respondents found the homepage descriptive while 6 % did not find the homepage descriptive. Ninety percent (90%) of the KAINet respondents found the website descriptive while 10% said the home was not descriptive. Respondents were then asked to rate the appearance, information layout and style design of the website as excellent, good and fair below are the responses. The ratings are shown in Table 4.3 below.

Table 4.3: Rating of the overall websites appearance, information layout and style design

Website	CGIAR Research Map				KAINet			
	Excellent	Good	Fair	Total	Excellent	Good	Fair	Total
Information layout	28 (43.1%)	3 (52.3%)	3 (4.6%)	65 (100%)	9 (14.7%)	52 (85.2%)	0	61 (100%)
Style design of website	28 (43.1%)	35 (53.8%))	2 (3.1%)	65 (100%)	4 (6.5%)	53 (86.8%)	4(6.5 %)	61 (100%)
Overall appearance	37 (56.9%)	25 (38.4%)	3 (4.6%)	65 (100%)	27 (44.2%)	32 (52.4%)	2 (3.3%)	61 (100%)

Source: *Data computations with SPSS, November 2012*

A Mann-Whitney non-parametric test was performed on the data which was ranked from 1 (excellent) to 4 (poor) in order to determine whether there was any relation between the design measures and the websites. The results show that the website and information layout was significant (U=-2.913, p=0.004), website and style design of website was also important (U=-4.511, p=0.000), while website and appearance were not significant. The mean rank and the Mann-Whitney results are show in Table 4.4 and Table 4.5.

Table 4.4: Mean of the overall websites design measures rankings

	CGIAR Research Map		KAINet	
	n	Mean Rank	n	Mean Rank
Information layout	65	56.1	61	71.4
Style design of website	65	52.1	61	75.7
Overall appearance	65	60.0	61	67.3

Source: *Data computations with SPSS, November 2012*

Table 4.5: Test statistics for the overall websites design

	Information layout	Style design of website	Overall appearance
Mann-Whitney U	1499	1242	1754
U	-2.913	-4.511	-1.263
Asymptotic significance (2-tailed)	0.004	0	0.207

Source: *Data computations with SPSS, November 2012*

Navigation systems are among the essential elements of websites information architecture that facilitate the delivery and access of information (WoVG, 2010: 2). The layout and information organization of the website contributes to how a user and thereby influencing how users search for information in the websites. The results indicate that users of the CGIAR Research Map would more likely spend a lesser time retrieving information due to the layout and style design of the website as compared to the KAINet users.

4.2.2 Website content and search function

A good designed websites will reduce the loss of time in searching for content and eliminate the frustrations and confusions that users face in a poorly designed website when searching for information, by presenting relevant and targeted search results. Users can search for contents through item searching, subject searching or free-text searching. On the search functionality, 58.5% of the CGIAR Research Map respondents were satisfied with the search and 70.5% of the

KAINet respondents were satisfied with the search. On the search results, 50.8 % of the of the CGIAR Research Map respondents reported that frequently the search gave desired outcomes and 27.9% of the KAINet respondents reported that frequently a search gave the desired outcomes. The search function results are shown in Table 4.6 below.

Table 4.6: Rating of the website search function and search function target of the outputs

	CGIAR Research Map		KAINet	
	n	%	N	%
	search function satisfaction			
very satisfied	26	40	10	16.4
satisfied	38	58.5	43	70.5
unsatisfied	1	1.5	8	13.1
Total	65	100	61	100
	search desired outcome			
frequently	33	50.8	17	27.9
occasionally	31	47.7	42	68.8
rarely	1	1.5	2	3.3
Total	65	100.0	61	100.0

Source: *Data computations with SPSS, November 2012*

A Mann-Whitney non-parametric test was performed on the data which was ranked from 1 (very satisfied), 2 (satisfied) and 3 (unsatisfied) for search function and 1 (frequently), 2 (occasionally) and 3 (rarely) for the search outcomes. The results indicated that website and search functionality was significant (U= -3.466, p=0.001) and also website and search results effect was significant (U= -2.628, p=0.009). The mean rank and tests statistics are from the data is show in Table 4.7 and 4.8.

Table 4.7: Mean of the search functionality and search outcomes rankings

	CGIAR Research Map		KAINet	
	n	Mean Rank	n	Mean Rank
search satisfaction	65	54.3	61	73.3
search outcomes	65	56.4	61	71.1

Source: *Data computations with SPSS, November 2012*

Table 4.8: Test statistics for the websites functionality and search outcomes

	search satisfaction	search outcomes
Mann-Whitney U	1384	1518.5
U	-3.466	-2.623
Asymptotic significance (2-tailed)	0.001	0.009

Source: *Data computations with SPSS, November 2012*

The most significant step in developing effective information architecture is the analysis of user characteristics and the tasks and the interactions they want to undertake when visiting the website (WoVG, 2010: 2). The search functionality results show that the information architecture of the two websites affect the speed of information retrieval with the CGIAR Research Map generating better search results than the KAINet website.

4.3 Information sharing

The results in the part of the study sought to reveal the websites search navigation functions and browsing effectiveness and how these influence the information sharing in the websites. Content is the main reasons why users visit a websites and the need to keep accurate and up-to-date cannot be overstated. Users ranked the appropriateness of the content in order to determine how up-to-date the information in the websites was as well as reported on their experiences in the event that they also had a chance to share their research information in the websites.

4.3.1   Content appropriateness

The results of content appropriateness in terms of, date when the information was updated and hierarchy of information arrangement are presented in Table 4.9. About 50.8% of the respondents of the CGIAR Research Map found the website content very appropriate while 11.5% of the KAINet respondents found the content very appropriate.

Table 4.9: Rating of the website content relevance

	CGIAR Research Map		KAINet	
	n	%	N	%
	Appropriateness of content			
very appropriate	33	50.8	7	11.5
appropriate	32	49.2	25	41.0
not appropriate	0	0	29	47.5
Total	65	100	61	100

Source: *Data computations with SPSS, November 2012*

A Mann-Whitney non-parametric test was performed for content appropriateness where the data was ranked 1 (very appropriately), 2 (appropriate) and 3 (not appropriate). The results indicated that website and content appropriateness are important ($U = -6.295$, p less than 0.01), this result could further be explained as being caused by the number of content managers available in the systems discussed later in this section. There were 20 people responsible for updating content in the CGIAR Research Map and 4 people in the KAINet website. The mean rank and tests statistics are from the test is show in Table 4.10 and 4.11.

Table 4.10: Mean of the websites content relevance

	Content relevance	
	n	Mean Rank
CGIAR Research Map	65	45.0
KAINet	61	83.2

Source: *Data computations with SPSS, November 2012*

Table 4.11: Test statistics for websites content relevance

	Content relevance
Mann-Whitney U	781
U	-6.295
Asymptotic signifance (2-tailed)	0

Source: *Data computations with SPSS, November 2012*

The results indicate that content appropriateness that is related to how and also the frequency of updating information in the websites. The information in CGIAR Research Map was found to be more appropriate than that of the KAINet website.

4.3.2   User information sharing

Results on user information sharing revealed that 5% of the KAINet users and 10.8% of the CGIAR Research Map users had shared their information on the website. In terms of uploading content, all the CGIAR Research Map users reported that it was easy but time consuming at 71.4% while 66.7% of KAINet users reported that the experience was easy and fast. Searching for the uploaded content was easy and fast at 71.4% for the CGIAR Research Map users and time consuming at 66.7% for the KAINet users. Table 4.12, shows the mean and standard deviations of the experiences in information sharing experiences while uploading and searching for the uploaded and their experiences in terms of speed.

Table 4.12 Experiences in sharing and searching for content of users who had shared information in the websites

Website		n	Mean	Std. Deviation
KAINet	uploading content experience	3	3.0	1.7
	uploading content speed	3	4.3	1.2
	searching content experience	3	2.3	1.5
	searching content speed	3	3.7	1.2
	Total	12	3.3	1.4
CGIAR Research Map	uploading content experience	7	4.0	0.0
	uploading content speed	7	4.4	1.0
	searching content experience	7	3.3	1.3
	searching content speed	7	4.4	1.0
	Total	28	4	1.0

Source: *Data computations with SPSS, November 2012*

Results of the independent sample t-test on information sharing information are shown on Table 4.13 below. The results revealed that in overall information sharing and websites is important (t-1.781, p = 0.083). The differences in the variable categories could not be conclusively indicated due to the few categories for analysis.

Table 4.13 Test statistics for the experiences in sharing and searching for websites content

	F	t	df	Sig. (2-tailed)
Information sharing experience	3.642377819	-1.7813	38.0000	0.0829

Source: *Data computations with SPSS, November 2012*

Further the results indicated a willingness to share information among the users who had not had any previous experience with sharing information on the websites at 90.8% for CGIAR Research Map users and 78.6% for the KAINet users as shown in figure 4.2.
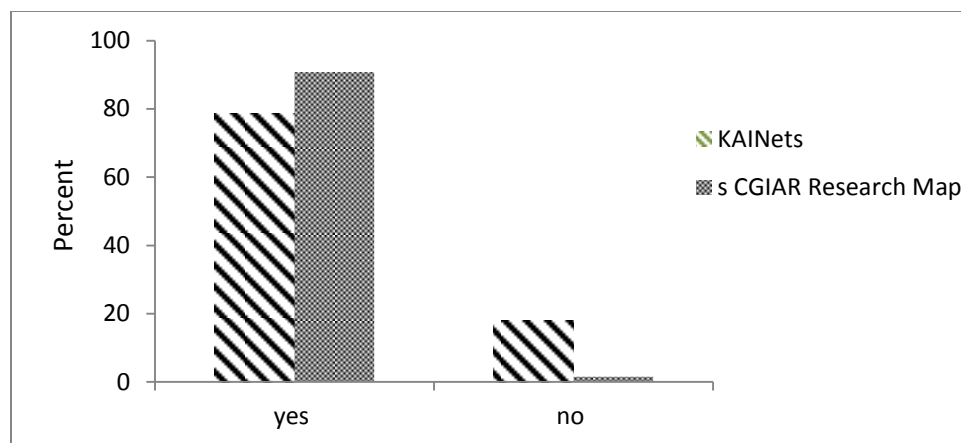
Figure 4.2: Respondents willing to share their information in the websites, Source: *Data computations with SPSS, November 2012*

The reasons given for willingness to share information are shown in Table 4.14. This reveals that display of information in CGIAR Research Map is what would attract most users to share their information at 58.8%, while clarity in the way information is arranged is ranked highest at 44.8% in the KAINet website as the reason that would attract more users to share their information. Speed at which information is accessed is rated as the least attractive feature. The main consideration from this result is that the design and graphic in the CGIAR Research Map and information content in the KAINet website are attractive features to users in the two architectures that web designer need to continuously improve to enhance information sharing.

Table 4.14: Reasons why respondents would share information in the websites

	CGIAR Research Map		KAINet	
Reason	n	(%)	n	(%)
Display of information on the website	50	58.8	19	32.8
Clarity in the way information is arranged	14	16.5	26	44.8
The organization of information on the website	10	11.8	4	6.9
Interactivity and website engagement	6	7.1	5	8.6
Speed at which information is accessed	5	5.9	4	6.9

Source: *Author (2012)*

4. 4   Information maintenance and Website administration

4.4.1   Website software design

Marus 2010, states that information technology managers are presented with the whole range of information management solutions and therefore the ability for the web developers to critically select a good software design that would enhance usability of the sites is critical to website usability. Results on the technology used to build the websites revealed that the software used to design both the CGIAR Research Map and the KAINet website was open source. While the technology used to build the application side of the website that resides on the server side was similar, the technology used to build the application side of the website that resides on the client side was different for the two website. This findings showed the different software's in the architecture of the websites, with the use of Extensible Hyper Text Markup Language (XHTML) that is more flexible and allowed for better review of website content in the matrix design for the CGIAR Research Map and the Extensible Markup Language (XML) that allowed users to review details as they browse deeper in the website used for the hierarchical architecture on the KAINet website. Choosing an appropriate software to use in the development of the site is important to enhancing the usability of the websites and web designers need to be well conversant with these software. The software used is shown in Table 4.15.

Table 4.15: Website design and development

	Software	Technology used to build application side of the website that resides on the client side	Technology used to build the application side of the website that resides on the server side
CGIAR Research Map	Open source software development	- Extensible Hyper Text Markup Language (XHTML) - JavaScript- Object based scripting language with strong support for proper software engineering techniques	- Web servers - Databases - PHP- open source server side "scripting language" for developing internet based applications.
KAINet	Open source software development	- Dreamweaver and Extensible Markup Language (XML) - Other: Content Management System – Drupal, Web agris (GIS and XML), Fireworks	- Web servers - Databases - PHP- a popular open source server side "scripting language" for developing internet based applications.

Source: *Data computations with SPSS, November 2012*

4.4.2   Website design principles

The results of the website designs principles in designing the websites revealed that the two websites used different user design principles. The CGIAR Research Map design process combined a number of design methods. These include: a) user-centered design i.e. requirements and limitations of the end user were given attention at each stage of the design process; b) contextual design i.e. designer collects data from users own environment by observation with some level of involvement; c) learner-centered i.e. the site was constructed by reviewing user needs; d) participatory design i.e. users were co-designers, contributors, owners; and e) Agile i.e. developing small pieces and upgrades throughout the cycle of the website. The KAINet design user involvement involved, contextual design i.e. designer collects data from users own environment by observation with as some level of involvement.

Previous studies have shown that some of the problems facing information architectures were the convention system development techniques that were not flexible to cope with the fluctuating business environment (Pai et al, 2005). The CGIAR Research Map applied the agile

development method that allows for upgrade of the system by testing the systems usability with the users throughout the cycle of the website. This technique would need constant upgrading and therefore a more involving website design technique as compared to the KAINet design principles.

4.4.3 Website administration and content management

The various people who carry out different design and administration work related to the websites are shown in Table 4.16. It was found that updating of information in the website is carried out by content managers who require basic website and browsing skills and go through informal training in order to update information for the CGIAR Research Map whereas in the KAINet website it is carried out by the web administrator who requires basic website and browsing skills to perform the task. The consistency and accuracy of information in the back end was reported to be checked frequently for the CGIAR Research Map and occasionally for the KAINet website. This results show that the administration and content management for the CGIAR Research Map is more expensive in terms of the number of people required for the task and the supported training given to people who carry out content management than that of the KAINet website. In addition, the availability of the graphic designer in the CGIAR Research Map whom the KAINet website reported not to have could be used to explain the differences in design, graphics and first impact (display of information) that were listed as reasons that would attract more users to share information.

Table 4.16: System and content managers of the websites

	CGIAR Research Map		KAINet	
	Available	n	available	n
Information architecture	Yes	1	yes	1
Graphic designer	Yes	1	no	
Web administrator	Yes	1	yes	1
Content managers	Yes	20	yes	4

Source: *Data computations with SPSS, November 2012*

4.5 Website usability review

In this part of the study, heuristic evaluation, a website inspection method for examining website's interface, was used to investigate the interface of the two websites by four evaluators. The evaluators had different knowledge on agriculture research websites, with half (2 people) having experience in information systems design, one person was experienced in information communication and the other with basic experience in browsing. The evaluators inspected and rated the two websites, KAINet and CGIAR Research Map, against a set of established usability criteria so as to check on the websites usability standards. The information was used to reveal key usability features and test against the test methods results of the study.

The mean ratings for the areas that evaluators reviewed and their standard deviations are shown in Table 4.17. From the mean scores, the results gave a general view on some of the usability attributes ranked highest and lowest across the websites. An independent sample test on the evaluation criteria showed that the CGIAR Research Map had a higher mean rank of 3.93 than KAINet whose mean rank was 3.31 and a statistically significant criteria and website effect (t= -3.111, p= 0.003). Studies have shown various usability features that can tested in guiding the assessment of information architecture on websites usability of, the results confirm that all the five usability criteria combined are important in the both the matrix and hierarchical information architectures although the test did not reveal any particular differences in individual criteria.

Table 4.17: Mean and standard deviation of the usability review criteria

Criteria	Website	Mean	n	Std. Deviation
Homepage	CGIAR Research Map	3.67	3	0.72
	KAINet	3.17	3	0.14
	Total	3.42	6	0.54
Navigation	CGIAR Research Map	4.25	8	0.5
	KAINet	3.5	8	0.61
	Total	3.89	16	0.66
Search	CGIAR Research Map	4.44	4	0.314
	KAINet	3.25	4	0.54
	Total	3.84	8	0.76
Content	CGIAR Research Map	3.5	4	0.89
	KAINet	3.38	4	0.59
	Total	3.44	8	0.70
Help	CGIAR Research Map	2.89	2	0.18
	KAINet	2.75	2	0.71
	Total	2.81	4	0.43
Total	CGIAR Research Map	3.93	21	0.73
	KAINet	3.31	21	0.55
	Total	3.62	42	0.71

Ratings: 1 = very poor 2 = poor 3 = good 4 = very good 5 = Excellent

Source: *Data computations with SPSS, November 2012*

CHAPTER 5: SUMMARY, CONCLUSIONS RECOMMENDATIONS AND LIMITATIONS

5.1 Summary and conclusions

The aim of this study was to compare two websites, the CGIAR Research Map, designed using matrix information architecture and KAINet, designed using hierarchical information architecture and the effects of these designs on various usability criteria. Websites are increasingly being used to share agricultural information and their architecture has the potential to increase and enhance the uptake of this information through the design of websites that are meeting user needs.

Among the usability features studied, as well as what other studies have shown, the results confirmed that design and graphic, structure and navigation, technical management and information content are important usability features in websites. This study revealed that design and graphics, and structure and navigation are key usability features that users prefer in the matrix designed CGIAR Research Map over the hierarchical designed KAINet website. While information content is a key features that users were attracted to in the hierarchical design, the results revealed that the KAINet website did not fully meet user needs where this feature is concerned. The websites have the same potential of attracting users where the user first impact is concerned.

The results showed that the search function design which has an effect on the time spent on a website is important. Although both the matrix and hierarchical designs have a good search functions, search results that were on target were more frequent in the matrix designs than in hierarchical design, in addition the results showed that a user of the hierarchical designed website would use more clicks to carry out a search than a user of the matrix design. The designers of such websites should examine how results are displayed to ensure that users are able

to get the desired outcomes in the shortest time and least effort. However the speed of both these websites can be improved for better user experience.

Users of the matrix and hierarchical designed websites generally expressed their willingness to share information. Differences were seen on the features that would attract most users to share information with display of information seen to attract users of the matrix designed website and information arrangement in the hierarchical designed website. The matrix design is an interactive information architecture that more easily allows for content managers to update information. To ensure that information seekers find relevant content the designers of these websites should enhance the design of the various features that attract users to share content in the websites, on regular intervals, they should investigate and improve potential areas that would pose challenges to users who would like to share information.

Information content appropriateness was also seen as an important factor in the study, in the matrix designed website, the content was found to be more relevant. This is in line with the results that also indicated that a lot more content managers are required to maintain information in the matrix designed website as compared to the hierarchical website design. Informal training of content managers so as to ensure the accuracy of information being shared as well as the relevance of the existing information was also reported in the matrix designed website. The results also showed that checking for consistency of the information in the backend is carried out frequently in the matrix designed website and occasionally in the hierarchical website. This suggests that it would cost more to maintain a matrix designed website than a hierarchical designed website. In general, the findings indicated that the matrix design offers a better user experiences than the hierarchical designed website.

5.2   Recommendations

The growth of web based sources of information implies that web designers need to critically think through the design process of the websites if they are to meet the user needs. Information managers and web developers need to involve all the key people responsible for the success of a good website during the life cycle of developing a website, these are, information architects, graphic designers, website administrators and content managers, required so as to ensure that all usability factors are taken into account in the design process. Information architectures should be conversant and flexible to cope with the growth of technology available for building websites. Organisations should also support and embrace new technology when they are looking at how their websites are evolving through design.

 User involvement in the design process of the website plays an important role to the success of a website's objectives. A combination of user focused design methods, ranging from user centered design, participatory design, agile user-centered method, among other methods which have been shown to be useful in the development process should be carefully thought through and adopted in the design process. These methods would provide designers with various inputs from the target users and ensure that there is participation and feedback from target users throughout the design process. The study revealed that users are attracted to different usability feature in different architectures, web designers need to investigate and find out which attributes in their websites are most attractive for users to improve on those and which ones are not in order to come up with better alternatives.

Information architecture focus on the content with an organization, how an organization can organize its internal content determines how it will deal with the external content (Hourican, 2002). Learning from one another and extending good website design principles across organizations is an area that national and institutional stakeholders should encourage.

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Organisations should put in place measures that would ensure that key people responsible for the development of websites are constantly documenting the various processes and experiences in the different development stages. In addition, they should also see to it that this information is publicly shared so that other interested stakeholders can access.

Research has shown that audience-oriented communication strategies play an important role in providing relevant information. An assessment of the design of major agricultural websites and their effects on usability is an area that policy stakeholders should look into and encourage future studies on this research area. Websites play an important role in linking information generators with target audience, such studies and assessments would not only help organisations when designing appropriate websites that meet user needs, but would greatly contribute to the uptake and exchange of agriculture information particularly in regions where agriculture is critical to growth of such economies.

5.3   Limitations

It was assumed that the selected sample represented the characteristic of the actual population and that the selected data collections instruments were able to capture most of the usability issues affecting the websites. In addition to this, limited research funds for data collection limited the scope of the study.

The study focus was on two types of information architecture, comparison on other forms of architectural designs and their effects on usability would provide a more complete overview on websites design and their usability. As indicated by Baggio (2003) in the websites analysis of European tourism organizations study, such studies face a limitation in the lack of common and general accepted assessment principle, this was also a restraint in this study. Few studies on how information architecture affects usability have been conducted and particularly in the field of

agriculture communication, the study faced a challenge in reviewing appropriate literature on the

design of websites for sharing agricultural information

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APPENDICES

Appendix 1: Screen shot of study websites

Figure 1.screen shot of the CGIAR Research Map, source: http://ongoing-research.cgiar.org/

Figure 2.screen shot of the Kenya Agriculture Information Network, KAINet, source:
http://www.kainet.or.ke/

Appendix 2: End user Questionnaire

My name is Evelyn Namvua, I am carrying out my thesis in partial fulfillment of a Masters degree in Agricultural Information Communication Management (AICM) at University of Nairobi. This questionnaire intends to determine 'The effects of Information Architecture on Website Usability: A Comparative Study between CGIAR Research Map and Kenya Agriculture Information Network, KAINet'. The information sought is for academic purposes and will be kept confidential.

This questionnaire should take roughly 20 minutes to complete. Please tick or mark with an '**X**' the correct response.

All completed questionnaires and/or queries should be returned or channelled to the enumerator or emailed to Evelyn Namvua (ekating@cgiar.org or namvua@gmail.com). Thank you.

For official use   *Questionnaire id. No. _____*

Name of enumerator_____

Date _____

Instructions

Respondents should take a few minutes and interact with the website being evaluated if they have not done so in the recent past. Below are the websites url:

CGIAR Research Map (http://ongoing-research.cgiar.org/)

KAINet (http://www.kainet.or.ke/)

QUESTIONNAIRE A: TO BE COMPLETED BY END USERS

PART 1: RESPONDENT'S CONTACT INFORMATION

First Name	Last Name	Email

Name of institution	Location	Occupation

Gender   ( ) male   ( ) female

Age   ( ) under 25 yrs   ( ) 25-34 yrs   ( ) 35-44 yrs   ( ) 45-54 yrs   ( ) 55 yrs and above

PART 2: MEASURE OF OVERALL USABILITY

1. Website being evaluated   ( ) CGIAR Research Map   ( ) KAINet

2. What are the main purposes that you use the website for?

 ( ) Find out what research is being carried out where
 ( ) Look for research information details
 ( ) Look projects to collaborate with
 ( ) Look for scientists contacts
 ( ) Look for internship opportunities
 ( ) Share information
 ( ) Read agriculture related news
 ( ) Find links to other websites and portals
 ( ) Access research papers, journals, reports etc.

Other_____
_____

3. Is the home page descriptive or does it provide a description link of what the website does?

     ( ) yes   ( ) no

4. How do you rate the overall appearance of the website?

      ( ) excellent   ( ) good   ( ) fair   ( ) poor

4. How do you rate the layout/arrangement of information of the website? (usefulness of information, page layers, linking of pages etc.)

      ( ) excellent   ( ) good   ( ) fair   ( ) poor

6. How do you rate the style design of the site? (fontcolour, text style and spacing used etc.)

      ( ) excellent   ( ) good   ( ) fair   ( ) poor

PART 3: USER INTERACTION

7. How do you rate the appropriateness/relevance of the content? (e.g. is there a date indicating when the information was last updated etc.)

( ) very appropriate   ( ) appropriate   ( ) not appropriate

8. How satisfied are you when using a particular search?

( ) very satisfied   ( ) satisfied   ( ) unsatisfied

9. How often does a particular search give you the desired outcome?

( ) frequently   ( ) occasionally   ( ) rarely

10. Are you able to retrace your last 2 steps in a particular search? i.e. can you go 2 steps back to the page where you were at?

( ) yes   ( ) no

11. Does the navigation have enough buttons for navigation?

( ) yes   ( ) no

12. Does the system provide all the functions you expect of it?

( ) yes   ( ) no

13. On average how many minutes do you spend browsing the website?

( ) 1 minute or less   ( ) 2– 5 minutes   ( ) 5 – 8 minutes   ( ) 9 and above minutes

PART 4: KNOWLEDGE SHARING

14. Have you ever shared information in the website?

( ) yes   ( ) no

If yes proceed to question 15, if no question 16

15a. How was your experience?

( ) easy   ( ) complicated   ( ) difficult

15b. In terms of speed how was your experience in sharing content?

( ) fast   ( ) time consuming

15c. How was your experience in searching for your uploaded content in the front end?

( ) easy   ( ) complicated   ( ) difficult

15d. In terms of speed how was your experience in searching for the uploaded content?

(   ) fast   (   ) time consuming

16. Would you share your information in the website?

( ) yes   ( ) no

16a. Give reasons for your answer, you can tick more than one response

( ) The organization of information on the website

( ) Display of information on the website

( ) Clarity in the way information is arranged

( ) Interactivity and website engagement

( ) Speed at which information is accessed

Any other reasons _____

_____

17. Any other usability review comments about the system

_____

_____

_____

Appendix 3: Web Developer Questionnaire

QUESTIONNAIRE B: TO BE COMPLETED BY WEB DEVELOPER AND WEB ADMINISTRATORS

PART 1: RESPONDENT'S CONTACT INFORMATION

First Name	Last Name	Email

Name of institution	Location	Occupation

Level of education

( ) Bachelors   ( ) Masters

Other specialized IT skills

_____

_____

PART 1: TECHNICAL MANAGEMENT OF THE WEBSITE

Section A: Web Design and Development

1. Website being evaluated   ( ) CGIAR Research Map   ( ) KAINet

2. What is the technology used to build the application side of the website that resides on the client side?

    ( ) a. Extensible Hyper Text Markup Language (XHTML),
    ( ) b. JavaScript- Object based scripting language with strong support for proper soft ware engineering techniques
    ( ) c. Adobe Flash
    ( ) d. Adobe Flex

( ) e. Dreamweaver and Extensible Markup Language (XML)

( ) f. Other, please list_____

3. What is the technology used to build the application side of the website that resides on the server side?

   (   ) a. web servers

   (   ) b. databases

   (   ) c. ASP.NET

   ( ) d. PHP- A popular open source server side "scripting language" for developing internet based applications.

   (   ) e. Ruby on Rails- An open source, web application development scripting language and frameworkthat increases the speed at which you can create database-driven web application.

   (   ) f. JavaServer Faces

   (   ) g. Other, please list_____

4. What kind of software is required to build the website?

   (   ) a. Agile Software Development

   (   ) b. Refactoring

   (   ) c. Design patterns

   (   ) d. Open source software development

   (   ) e. Other, please list_____

5. In terms of user involvement in designing the website, what was the design method used?

   (   ) a. User-centered design i.e. users had little or no involvement in the design

   (   ) b. Contextual design i.e. designer collects data from users own environment by observation with was some level of involvement

   (   ) c. Learner-centered i.e. the site was constructed by reviewing user needs

   (   ) d. Participatory design i.e. users were co-designers, contributors, owners

   (   ) e. Bonded i.e. the design team comprised of both designers and users

   (   ) f. Agile i.e. developing small pieces and upgrades throughout the cycle of the website

6. Please rate the below in order of importance of information architecture to the website?

   Scale 6 = most important, 1 = least important

   [ ] cost of finding information

   [ ] value of education users

   [ ] cost of construction

   [ ] cost of maintenance

[ ] cost of training
[ ] value of brand

7. How much does it cost to host the website per year?

   _____

8. How long did it take to build the current version of the website?

   _____

9. When was the current version of website launched?

   _____

Section B: Web Administration and Content Management

1. Indicate whether the system has the below people and how many in each case

   a. Information architecture / web designer ( ) yes   ( ) no   how many _____

   b. Graphic designer   ( ) yes   ( ) no   how many _____

   c. Web administrator   ( ) yes   ( ) no   how many _____

   d. Content managers   ( ) yes   ( ) no   how many _____

   e. Others _____

2. Who is responsible for updating information in the website?

   ( ) Web designer

   ( ) Web administrator

   ( ) Content managers

   ( ) Others, please list them _____

3. What are the skills required to maintain information the website?

   ( ) Basic website and browsing skills

   ( ) Specialized IT skills

   If specialized, please list the skills?

_____

4. How is information updated in the system?

    a. Through the website administration   ( ) yes   ( ) no

    b. Through the website content managers ( ) yes   ( ) no

       bi. If yes, is training required ( ) yes   ( ) no

          bii. if yes, what level of training?

          ( ) formal training ( ) informal training   ( ) online tutorials

    c. Through end users who have rights to the systems ( ) yes   ( ) no

       ci. If yes is training required ( ) yes   ( ) no

          cii. If yes what level of training?

          ( ) formal training ( ) informal training   ( ) online tutorials

    d. Other ways _____

5. How frequently do you check the consistency and accuracy of information in the back end?

  ( ) frequently   ( ) occasionally ( ) rarely

6. Any other comments

_____

_____

_____

_____

Appendix 4: Usability Review Questions

Homepage / starting page

1   The Homepage / starting page provides a clear snapshot and overview of the content, features and functionality available.

2   The home page / starting page is effective in orienting and directing users to their desired information and tasks.

3   The homepage / starting page layout is clear and uncluttered with sufficient 'white space'.

Navigation

4   The navigational scheme (e.g. menu) is easy to find, intuitive and consistent.

5   The navigation has sufficient flexibility to allow users to navigate by their desired means (e.g. searching, browse by type, browse by name, most recent etc…).

6   The site or application structure is clear, easily understood and addresses common user goals.

7   Links are clear, descriptive and and well labelled.

8   Browser standard functions (e.g. 'back', 'forward', 'bookmark') are supported.

9   The current location is clearly indicated (e.g. highlighted menu item).

10   Users can easily get back to the homepage or a relevant start point.

11   A clear and well structure site map or index is provided (where necessary).

Search

12   A consistent, easy to find and easy to use search function is available throughout (where desirable).

13   The search interface is appropriate to meet user goals (e.g. multi-parameter, prioritised results, filtering search results).

14   Search results are relevant, comprehensive, precise, and well displayed.

15   How many clicks does it take you to carry out a search on X-Y?

Content & text

16   Content available (e.g. text, images, video) is appropriate and sufficiently relevant, and detailed to meet user goals.

17   Links to other useful and relevant content (e.g. related pages or external websites) are available and shown in context.

18   Language, terminology and tone used is appropriate and readily understood by the target audience.

19   Terms, language and tone used are consistent (e.g. the same term is used throughout).

Help

20   Online help is provided and is suitable for the user base (e.g. is written in easy to understand language and only uses recognised terms). Where appropriate contextual help is provided.

21   Users can easily get further help (e.g. telephone or email address).

Source: Expert usability evaluation template