

A Navigational Evaluation Model for Content Management Systems

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ABSTRACT

Web applications are widely used world-wide, however it is important that the navigation of these websites is effective, to enhance usability. Navigation is not limited to links between pages, it is also how we complete a task. Navigational structure presented as hypertext is one of the most important component of the Web application besides content and presentation. The main objective of this paper is to explore the navigational structure of various open source Content Management Systems from the developer's perspective. For this purpose three CMS are chosen which are WordPress, Joomla, and Drupal. Objective of the research is to identify the important navigational aspects present in these CMSs. Moreover, a comparative study of these CMSs in terms of navigational support is required. For this purpose an industrial survey is conducted based on our proposed navigational evaluation model. The results shows that there exist correlation between the identified factors and these CMSs provide helpful and effective navigational support to their users.

1. Introduction

Web applications are widely used for many purposes for instance shopping, entertainment, education, socializing and much more. Web application is a software system that is based on technologies and standards of World Wide Web Consortium (W3C) that provides Web specific resources such as content and services through a user interface, the Web browser. The hypertext feature has issue of disorientation [1].

Navigation structure defines the links between various pages on a website. Navigation is not limited to links between pages it also tells how we can complete a given task. Structure of a website is an important part when designing a website. Website navigation structure is where you are planning the entire website [2]. Navigation shows how to find certain information. Important elements of a good navigation structure are that we have properly placed the information and it is easy to navigate or locate the information. Navigation of a website is the major part of website usability.

Development of websites has increased in recent years for different purposes such as education, business, shopping and entertainment. Content Management Systems (CMS) are used widely for the development of websites as a cost effective and effective tool. CMS is a computer application that allows editing, modifying

content, deleting, organizing, publishing as well as maintenance from a central interface. Some common features in a CMS are management, revision control, search, indexing, publishing and retrieval of information [3]. Various open source and proprietary solutions are available in the domain of CMS based on various technologies. In our study we will be focusing on the navigational structure of three open source CMSs which are WordPress, Joomla and Drupal.

WordPress is an open source online tool for website creation and is written in PHP. It is one of the most famous blogging and website content management system. An open source system is for which one does not require to pay for license to use it as it is free of cost. WordPress CMS provides with thousands of themes and plugins that can be used to create the website of our desire. There are around 2000+ themes available for WordPress and it started with single initial code in 2003. WordPress works well for small to medium sized websites and blogs [3].

Joomla is a content management system which enables users to develop powerful online applications and websites. It is an open source system which is easily available to everyone. Joomla provides with a number of extensions that allow user to extend functionality and customize it to their own objectives [3]. The CMS Joomla

is more suitable for e-commerce websites but requires some technical coding skills.

Drupal is an open source content management system that allows it users to adapt virtually to any visual design. The projects developed through Drupal encourages modularity, standards, collaboration, ease of use and many more [3]. Drupal is easily scalable that is a website developed can have million pages and can handle 20,000 request requests per second. It is one of the most powerful CMS and is used for developing rich websites.

Navigation plays an important role in Web applications, it is a map to the website. So it is important that the navigation is implemented properly. In our study the focus is to evaluate the navigation of three CMS which provides as medium for development of websites. The problem that we are working towards is a method which will help in answering these questions, “how the navigational structure of a Web application can be evaluated?” and “Which CMS has better navigation structure to support administrators and developers?” To answer these questions first a conceptual framework is developed which is later evaluated through a survey to check if the identified factors are relevant. The remaining paper is structured as follow: section 2 discusses related work, and section 3 focus on the identified factors and conceptual framework. Section 4 highlights methodology used to evaluate navigation and followed by result analysis in section 5. Section 6 concludes this study.

2. Related Work

Navigation is the backbone of any website. A good navigation structure is the one that is not just easy to use but also easy to remember in order to perform tasks in future. An application or website navigation shows how an entire application or website has been organized. Software navigation refers to links, menus, tabs and graphics, that one sees in the software when it is used that allows to move to various sections, and functionalities of the system and perform different tasks [4]. In Web applications, the most important component is navigation, which is directly related to the success of a particular website. Navigation is the gateway into the different sections of websites content [5]. A simple rule to use in creating navigation is to keep it simple, let users know where they are and maintaining consistency in the design.

A significant amount of work has been carried out in the domain of web usability covering aspect like quality of the website and its evaluation. However, navigation has been given very less focus. Various existing usability frameworks [6, 7] also have given less emphasis on navigation. Whereas there is need to study navigation as a whole, because an effective navigation can lead to good website at the end. Some studies, however, have taken a

different approach by looking not at the navigation but at other aspects of a website. Quality is an important element of website navigation structure as seen in [7,8] they proposed a framework for measuring the quality of a website where navigation is a small part.. Usability and quality is given more preference in past studies whereas navigation is given less importance. In [9] the proposed framework discusses quality where navigation is discussed as a part of the framework.

Designing website is a difficult task for which some rules and guidelines are to be followed. In [10] they proposed guidelines that can be considered when developing the navigation of a website. The guidelines they provided looked into aspect of how links are to be placed and how should number of links should be managed. Rosenfeld and Morville have discussed the importance of information placement in navigation and navigational patterns that can be used for placement of this information in [11].

Another aspect of Web navigation is how it can be used on diverse devices. It has been identified that there are different guidelines to be followed for developing navigation that is effective on smaller devices. Responsive Web navigation design is such an approach that provides ease of navigation to website on different devices [12]. In [13] they discussed how shifting from websites to responsive Web design helped in increasing growth of mobile applications and reducing the need for creating separate websites for mobile and handheld devices. Information visualization is very important, as seen in [14] that the information should be easy to view on any type of device. Content is also important for navigation, as discussed in [15] that the information placement and right amount of information placed is important for navigation structures.

Content Management Systems (CMS) have become one of the most widely used platform for website development whether these are personal websites or organizational websites. Different comparative studies have been conducted covering various aspects of CMS. These include comparisons in terms of popularity, number of supported themes, types of suitable users, and usability. Little focus has been given to the navigation structure of the CMS. In [16] comparison has been done on the usability, technical requirements, user friendly characteristics, performance and trust in their built in-support and applications. In another study [17] analysis performed was on the performance of Joomla, WordPress, and Drupal CMS. The points compared were popularity, average budget, feature and social bookmarking. The result showed that Joomla was at top.

Content management system provides facility to create websites with ease without any technical skills required for coding. Not every CMS is best for everyone,

each CMS has different features from one another. There different features makes them unique. One such study has been conducted that has statistically compared the page

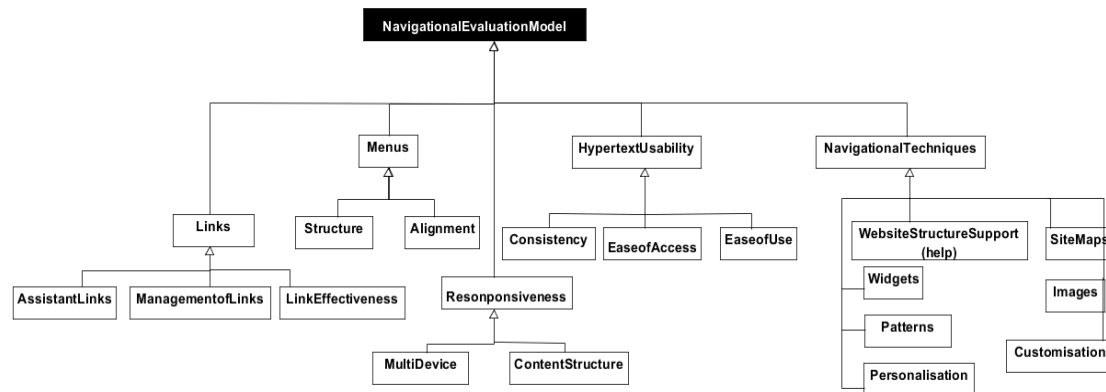


Fig. 1: Navigational evaluation metamodel

performance of various CMS [18]. Page performance on three CMS was performed by creating same number of pages on each CMS. The information recorded was page load time, page size, number of CSS and number of requests. In [19] they compared briefly the three CMS and as a result they stated that WordPress is mostly used for blogging websites, Drupal is for more rich complex websites and Joomla is used for websites like E-Commerce as it provides good functionality and is easy to use. Different comparative studies have been conducted on the CMS but neither focused on navigation structure. So that invokes us to study navigation structure to identify what is an effective navigation structure.

3. Proposed Framework

Navigational structure of a Web application affects directly the usability of a Web application. Therefore, a navigational evaluation model becomes significant. Similarly, CMS are the most widely used Web applications to day as these are used for the development of different types of Web sites. The evaluation of different CMS based on their hypertext structure and support of navigation becomes significant. To fill in this gap, we have proposed a Navigational Evaluation model for CMS. The proposed Navigational Evaluation Model consists various factors that are helpful in designing good navigation. Proposed Navigational Evaluation Metamodel is shown in Fig. 1.

Navigation in Web application consists of hyperlinks where different information nodes and multimedia content are linked with each other. Moreover, these hyperlinks need to be used in such a way that these are usable. Thus usability of these hyperlinks is another important factor in terms of navigational evaluation. A complex website, may consist of a large number of hyperlinks used for navigational menus. Categorization and grouping of these

links becomes signification as well. A widely used pattern for the management of hyperlinks is Menus. These menus can be grouped, placed and used in variety of way and these are generally categorized as the navigational techniques. Thus links, usability, menus and the navigational techniques are some of the fundamental evaluation metrics for navigational evaluation. The above four factors thus form part of our generic navigational evaluation framework. These parameters can be used for the evaluation of any Web application.

4. Methodology

Our study is mainly cross sectional study and mainly collected quantitative data using questionnaire. Two questionnaires were developed evaluating the navigation, first one evaluated the navigation of CMS admin panel through the developers. Second one evaluated the navigation of a website which is developed through one of the CMS, evaluation is performed by end users of the website. Both questionnaires consist of six sections, first section focusing on the user and other five sections focusing on the five factors identified in the framework.

Questions are designed with respect to the identified, factors for navigation. The questionnaires were developed through Google docs and first the survey was floated through email to different software houses in different cities in Pakistan. We received 41 filled questionnaires back. Second questionnaire was floated through Web and 56 responses came back. Correlation is applied on the responses received on first questionnaire to identify which factors are more closely related. Each question was rated on Likert scale between (1-5). (1) Strongly disagree (SD), (2) disagree (D), (3) Neutral (N), (4) agree (A), (5) strongly agree (SA).

5. Results and Analysis

This section presents the results obtained from the analysis of the evaluator's responses. Data collected was both primary and secondary.

Fig. 2 shows user profile of users who responded on developer end questionnaire which evaluated the navigation structure of three CMS. Total responses gathered were 41. On the vertical axes show number of people and horizontal axes shows the attributes of the user.

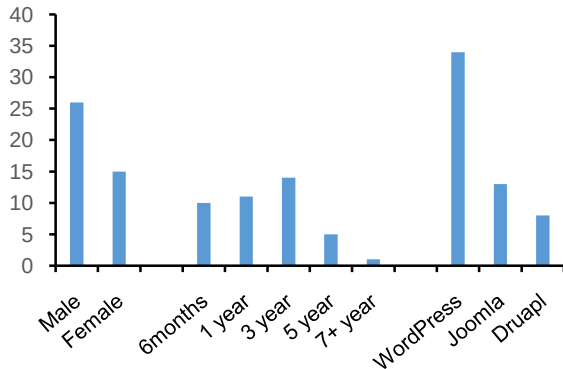


Fig. 2: User profile of CMS users

Table 1 shows correlation applied on the factors identified for an effective navigation. The parameters are selected because they help in navigating the application. The factors are identified through literature study. There are five factors, which makes ten comparisons between which correlation is calculated. Correlation is applied on the responses received on each CMS. From the results obtained the most dominated factor with high correlation is *links*.

Table 1: Correlation between factors

Factors	Content Management Systems		
	WordPress	Joomla	Drupal
Links & Menus	0.998443	-0.59815	-0.83069
Links & Usability	0.608835	0.990121	0.771454
Links & Navigation technique	0.870247	0.87367	0.962721
Links & Responsiveness	-0.32156	-0.76914	-0.29411
Menus & Usability	0.563621	-0.47987	-0.99508
Menus & Navigation technique	0.896373	-0.13267	-0.95032
Menus & Responsiveness	-0.26823	0.97221	0.939641
Usability & Navigation technique	0.139034	0.933257	0.914807

Usability and responsiveness	-0.94694	-0.67193	-0.90113
Responsiveness and navigation technique	0.186617	-0.36105	-0.99947

Other factors that have positive correlation are menus and links for WordPress, links and usability for Joomla and links and navigation technique for Drupal. The correlation results show that's there exist both positive and negative correlation. Values between 0.3 to +1 shows that factors are positively correlated that is when one increases the other increases and values from -0.3 to -1 shows that it is negatively correlated that is when one increases the other value decreases [20]. Zero correlation means there is no relation between them.

Table 2 shows correlation when applied on an individual factor. The result shows that within a factor the characteristics are highly correlated.

Table 2. Factor correlation

Characteristics	Factor Correlation		
	WordPress	Joomla	Drupal
Links working & Links text	0.95834	0.979756	0.937849
Menus accessibility & Menus structure depth/breadth	0.985423	0.966195	0.942795
Adding usability & Consistency	0.988761	0.973178	0.943819
Adding responsiveness & Easily viewed	0.990996	0.950543	0.964486
Website structure & personalization	1	0.930848	0.9

As large group of users remained neutral on responses received which invoked us to identify the problem. For each user who selected neutral as responses their experience level was checked. This analysis was performed on selective questions. Results presented in Table 3 show that they lacked experience and had on average 1 year experience with the CMS.

Table 3: Negative responses

Negative Responses (Average experience of those who selected Neutral as a response)			
Questions	WordPress	Joomla	Drupal
1	3 years	1 year	1 year
2	1 year	1 year	3 years
3	1 year	1 year	1 year
4	1 year	1 year	1 year
5	3 years	1 year	3 years
6	3 years	1 year	1 year
7	1 year	1 year	1 year

8	3 years	1 year	1 year
9	1 year	1 year	3 years
10	1 year	1 year	1 year
11	1 year	1 year	3 years
12	3 years	3 years	1 year
13	3 years	1 year	1 year
14	1 year	1 year	1 year
15	1 year	1 year	1 year

Another comparison shows which CMS received mostly positive responses in terms of navigational quality. As seen in Table 4 that responses received on different characteristics evaluation showed that WordPress has highest number of positive responses.

Table 4: Comparative study responses received on CMS legend SD: Strongly disagree, D: Disagree, A: Agree SA: Strongly disagree

Comparative study on responses received on CMS										
Factors	WordPress			Joomla			Drupal			Agreed
	D	N	A	D	N	A	D	N	A	
Working Links	3	9	29	1	10	20	3	9	18	WP
Self-explanatory Link text	3	10	26	4	11	18	2	12	16	WP
Menus accessible	3	7	29	4	10	16	3	11	15	WP
Menus structure depth/breadth	3	9	28	4	13	15	4	10	16	WP
Adding usability	3	7	30	3	10	20	2	12	17	WP
Consistency	3	5	32	3	11	19	2	11	18	WP
Website structure	3	10	26	2	10	15	5	10	16	WP
Personalization	4	12	24	4	14	13	5	13	12	WP
Adding responsiveness	4	12	24	7	8	16	6	9	15	WP
Easily viewed	5	11	26	4	10	17	3	11	15	WP

Legend: SD: Strongly Disagree, D: Disagree, A: Agree SA: Strongly Disagree

Links shows a way of moving from one page, document, and image to another not just that is also how we complete a task. Table 5 shows results gathered from three questions under the category of links which evaluated how well the links are working, link text and number of orphan pages. The results shows that users mostly agreed with the statements.

Table 5: Links for navigation evaluation and implementation

Links	CMS links evaluation														
	WordPress					Joomla					Drupal				
	SD	D	N	A	SA	SD	D	N	A	SA	SD	D	N	A	SA
Links are working properly	1	2	9	18	11	0	1	10	16	4	2	1	9	16	2
Links text is appropriate	1	2	10	19	7	1	3	11	13	5	1	1	12	13	3

No orphan Pages	3	4	12	14	6	1	6	13	11	2	1	5	9	12	3
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Legend: SD: Strongly Disagree, D: Disagree, A: Agree SA: Strongly Disagree

Menus are used to group related information together. The most important thing in menus is there depth and breadth. Table 6 summarizes the results based on the menus of the three CMS. The results show that majority of the people agreed to the statements but few people remained neutral which shows that the menus might not be that easy to navigate.

Usability is easy it is to use something. In order to evaluate the usability of the three CMS, Table 7 shows questions which were used to gather the responses. The result showed that mostly respondents agreed to the statements and large number stayed neutral for Joomla and Drupal.

Table 6: Menus for navigation evaluation and implementation

Menus	CMS menus evaluation														
	WordPress					Joomla					Drupal				
	SD	D	N	A	SA	SD	D	N	A	SA	SD	D	N	A	SA
Easily accessible	3	0	7	20	9	2	2	10	11	5	2	1	11	13	2
Appropriate depth/breadth	2	1	9	20	8	2	2	13	12	3	1	3	10	11	5
Helpful menu structure	2	2	10	18	7	0	4	10	12	6	1	1	10	12	6

Legend: SD: Strongly Disagree, D: Disagree, A: Agree SA: Strongly Disagree

Table 7: Usability for navigation evaluation and implementation

Usability	CMS usability evaluation														
	WordPress					Joomla					Drupal				
	SD	D	N	A	SA	SD	D	N	A	SA	SD	D	N	A	SA
Adding usability	1	2	7	21	9	1	2	10	13	7	0	2	12	10	7
Consistency	2	1	5	23	9	0	3	11	14	5	0	2	11	13	5
Ease to navigate	1	1	8	23	7	2	1	11	14	5	0	2	12	12	5

Navigation technique is combination of methods which help in navigating. Navigation techniques were evaluated based on the website structure, personalization and moving around. Table 8 presents results obtained which shows that mostly responses received were under the agree category. Drupal received more responses under neutral category.

Table 8: Navigation techniques for navigation evaluation and implementation

Navigation Techniques	CMS navigation techniques evaluation														
	WordPress					Joomla					Drupal				
	SD	D	N	A	SA	SD	D	N	A	SA	SD	D	N	A	SA
Easy moving around	2	1	9	19	9	1	5	10	12	6	2	3	12	9	6

Website structure	2	1	10	21	5	1	5	10	12	3	1	4	10	13	3
Personalization	2	2	12	17	7	1	3	14	11	2	1	4	13	10	2

Legend: SD: Strongly Disagree, D: Disagree, A: Agree SA: Strongly Disagree

Responsiveness shows how an application can be accessed on multiple platforms. The responsiveness of three CMS is evaluated, the results are presented in Table 9 which shows that mostly people agreed to the statements, but a good number of users remained neutral as well. Pattern is formed in the responses received for all categories, where large number responses lied under agree statement and second highest number was of those who chose neutral as an option. Through this it can be said that WordPress has more users therefore it has better navigation structure from other two.

Table 9: CMS responsiveness evaluation

Responsiveness	CMS responsiveness evaluation														
	Wordpress					Joomla					Drupal				
	SD	D	N	A	SA	SD	D	N	A	SA	SD	D	N	A	SA
Multi-platform view	2	1	12	18	6	2	4	11	14	2	1	4	10	10	5
Adding responsiveness feature	2	2	12	20	4	2	5	8	15	1	1	5	9	13	2
Content structured easily viewed	2	3	7	20	6	2	2	10	15	2	1	2	11	14	1

Legend: SD: Strongly Disagree, D: Disagree, A: Agree SA: Strongly Disagree

5.1 Evaluation of eBay

Besides evaluation of CMS, it was also desired to evaluate a Web application created from one of these CMSs. For this purpose eBay was selected, which is developed using Drupal. The eBay website is used as a case study to evaluate how good content management systems are in providing navigation at the front end application that is the actual website. Fig. 3 shows user profile of users who responded on user end questionnaire which evaluated the navigation structure of eBay website. Total numbers of responses received are 56. Vertical axes shows number of people and horizontal axes shows attributes of the users like gender and frequency of usage.

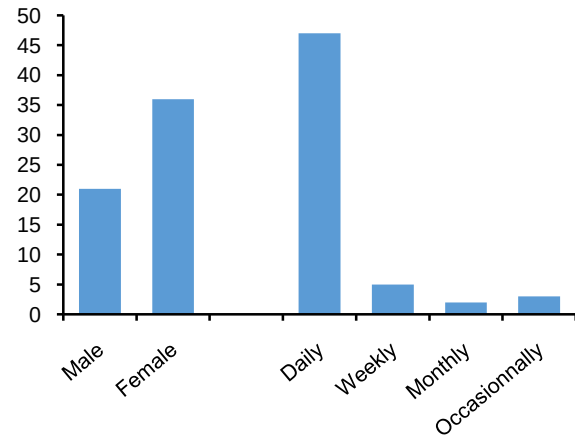


Fig. 3: Navigation evaluation of eBay website Legend: SD: Strongly Disagree, D: Disagree, A: Agree SA: Strong Disagree

Fig. 4 presents the analysis based on five questions. First we focus on the proper working of hyperlinks, almost 34% (19 out of 56) respondents strongly agreed that the navigational links are working properly. Only 1 respondent disagreed about the working of links.

Next question focused on the menus presentation; majority of the respondents (76.85%) agreed that the menus were well presented. 3rd question evaluated usability of navigation; 66.07% of the respondents agreed

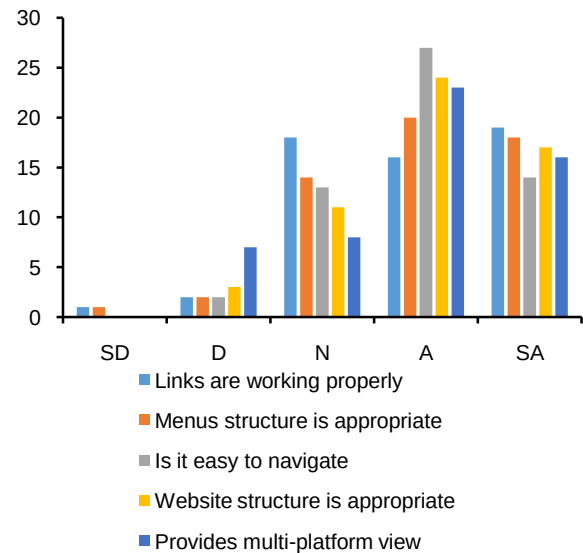


Fig. 4: User profile of eBay users

that the site's navigation has good navigation. 4th question focused on the appropriateness of website's navigational structure; 73.21% agreed that the website's structure was appropriate. The last question focused on the responsiveness of the website, whether it can be accessed on multiple platforms; majority of the respondents

(71.42%) agreed that the site was responsive on multiple platforms and devices.

6. Conclusions

Navigation is the backbone of a website. For a website to be effective it needs to have an appropriate navigation structure. Now a day's numbers of website developers have started the use of content management systems to develop websites. As these are easy to use and makes websites in no time. Which CMS is better is a difficult question and it still remains unanswered. Whereas through our study we can conclude that maximum number of users prefer WordPress and finds it easy to navigate around the admin panel. Through correlation it is clear that identified factors have both positive and negative relation between them. The common factors in all CMS that is highly correlated is quality of links.

Our quantitative study highlights various navigation problems faced by users using both the admin panel of CMS and the eBay website. Through the evaluation of eBay website one thing is cleared that CMS are effective in developing and incorporating navigation on the website. Our future work will extend the navigational evaluation met model into a navigational component in CMSs to make adaptive, personalized and responsive navigational structure based on the user preferences.

The proposed evaluation model can act as a design guideline for the navigational component of CMSs. Moreover, it provides important parameters based on which navigational structure can be personalized and customized based on user's navigational pattern. Our future work will focus on the development of a navigational node generation module for CMS that will apply the factors proposed in our navigational evaluation model for customization and personalization of navigational structure to improve usability of the Web applications.

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