Proposal of Usability Metrics to Evaluate E-commerce Websites

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Abstract. Usability form as an important aspect nowadays for software products, even more, when we talk about transactional websites. However, in the present, there are not enough metrics to help us measuring usability level from an E-commerce portal, for this reason, we present a new proposal of metrics of usability. While working on the proposal, we did a research to identify 39 metrics and 10 existing aspects, then we created usability metrics and finally we validated the proposal with five specialists, based on interviews and questionnaires.

Keywords: E-commerce · Metrics · Usability · Human-systems integration · Software metrics · Usability evaluation

1 Introduction

Internet is offering new forms of business to companies, it can be used as a communication tool, to engage the customers and to sell products electronically. Through this tool, companies can spread information, seize opportunities and take advantage over their competitors [1]. The fast growing of E-commerce has created a new way to do transactions globally, because it breaks the geographical barriers and allow the users to get more customers with no great efforts [2]. For companies, electronic commerce is an easy tool to get information about trading, just using website [3].

When we analyzed metrics research sources and other aspects of E-commerce, you can find that, in the present, there are some tools to test usability of transactional websites. Although they are not metrics, they can determinate how they these applications work.

The lack of usability in E-commerce portals such: design, how easy to use and understand they are, the direct influence on users, because they find the portal less "friendly". They do not feel comfortable using the website, so they decided not to use it. It turns into a technological failure, that has become an important market and a financial lost [3]. Due to these new demands, companies have decided to measure the usability level their commercial websites have. The measurement is achieved through techniques that allow an important feedback for companies about the design and the usability standards and interaction with users in the commercial web [4].

For all the reasons mentioned, we propose the elaboration of a group of metrics that can obtain numeric results that allow comparisons between different aspects of usability of E-commerce, starting with the elaborated and current proposals.

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2 Methodology

In this section, we are presenting the description of the systematic review, the choice of the most relevant articles and the reviews and interviews done with the specialists for the proposal validation.

2.1 Systematic Review

We developed the systematic review of our research sources from previous work [5], which we are using the usability metrics present in the literature. Nevertheless, these metrics are very generic and oriented to general topics, so they can not be used in every domain or software categories, that is the reason why they have to be analyzed and we had to separate those that may be useful for the topic that is being discussed [6]. In addition, the most relevant articles are going to be taken as a source to evaluate the aspects of usability for E-commerce websites.

After analyzing the relevant documents [7–11], we are able of determinate twenty five usability aspects for E-commerce websites which have being compared against the identifying aspect with the existing metrics to know which one of the others is not been taken into account. The results are showed on the Table 1.

Table 1. Comparison of usability aspects for transactional websites.

Usability aspects of metrics found	Usability aspects of literature analysis
Understanding	Accessibility
Learning	User's cultural background
Operability	Attractive
Attractive	Help and documents
Functionality	Information search
Quality of error	Quality of error
Accessibility	Behaviour of the after sale service
Information	Web design consistency
Density of the information	Density of the information
Legibility	Understanding
	Web design standards
	Flexibility and effectiveness
	Functionality
	Information
	Legibility
	Minimize memory load
	Navigability
	Operability
	Transaction status feedback
	Standardized symbology
	Simplicity
	Purchase decision
	Transaction
	Visibility and clarity of elements and status of the system

2.2 Selection

After analyzing the most relevant articles and information of metrics and usability aspects for transactional websites, we made a selection of metrics and the comparison between identifying usability aspects in existing metric and those found in literature.

To proceed with the selection of usability metrics we followed these selection and discard criteria:

1. Domain-oriented: We selected those metrics that let us to evaluate the applications of the E-commerce domain, because it is what this article is orientated to.
2. Metric goal: We selected those metrics with an objective according the website. For example metrics about functionality, errors and others.
3. Target: We select those, which were orientated to the user interaction with software, not the ones focused in developing.

In addition, we discarded the metrics that were too technical, because it is hard to analyze them in a simple way, when the user interacts with the website. For these specific cases, we could use some kind of software that helps to get results with this kind of metrics, for example, how fast the pointer moves, number of pixels used, and others. Likewise, we discard those metrics we cannot apply to the E-commerce, or those that have a similar measuring purpose, or if they are the same as the existing metrics already selected. The results show 25 different usability metrics total that can be used for the proposal.

To compare the usability aspects we found, we identified the aspects being covered with the existing metrics. This way, when compared with other aspects found in literature, we would be able to know which aspects are still not covered, and it would be useful when the new list of usability metrics is proposed.

2.3 Surveys and Interviews

After identifying all metrics and usability aspects, we did surveys and interviewed specialists in the usability subject, so they could review and validate our finds in the literature, and give us their opinion about the matter, so we could notice our possible mistakes and try to improve them. In addition, we did surveys and interviews after we proposed the usability metrics. Since this way our proposal could be validated and know if we directed the proposal to the right field, if they included the usability aspects that allowed to evaluate the transactional websites, and if there was some kind of mistake with the metrics, so we would be able to refine them, and present a completely right proposal.

The surveys and interviews were structured in such a way we could show the specialists the information we found in a clear precise and tidy way, so their opinions and validations would be useful to develop our research.

3 Proposal of Usability Metrics for E-commerce

With the metrics and usability aspects found in literature, we got a group of aspects not considered yet. With this information, we developed a first table with the proposal of usability metrics grouped by aspect. As a result, we created 49 metrics total. We put the metrics on a template that contents the features showed on the Table 2, with an example. We did this way to show them in a clear and tidy way. The results of the consolidated proposal are showed on Table 3 that shows 74 usability metrics, among the existing ones, and the ones created for E-commerce websites.

Table 2. Definition of the metric: "Product Information"

Aspect	Description
Usability aspects	Information
Code	043
Name	Information of the product
Explanation	Required information for customer (stock, description, specifications, etc.) and the purchase
Application mode	Count the amount of labels of information that the user thinks are relevant and found them
Formula	X = A/B A: Amount of labels of information per product the customer finds B: Total of labels of information of a product a user looks for
Result interpretation	$X \geq 0$, the further from 0, the better
Type of result	Value between 0 and 1
Section of application	Product section

Table 3. Consolidated list of usability metrics

Usability aspect	Name	Formula
Accessibility	Loading time	T = Ti where Ti is the loading time of the home page
	Help accessibility	X = A/B where A is the number of correct tasks online found and B the total of tasks evaluated
	Accessibility for users with disabilities	X = A/B is the number of useful functions for disabled users and B is the number of functions implemented
Learning	Easy to learn how to perform a task	T = Tf where Tf is the amount of time a user takes until they achieved the desired result in the task performed
	Average time of component use	T = Hu – Hi where Hu is the final time after the component is used and Hi is the initial time of component use
	Average time to master the component	T = Hd – Hi where Hd is the end time after mastering the component, and Hi is the initial time of the test

(*continued*)

Table 3. (*continued*)

Usability aspect	Name	Formula
Attractive	Proportion of elements that get the customer's attention (banners, animation, etc.)	X = A/B where A is the number of elements identified by the user and B is the total of elements in the website
	Operation interface density	X = A where A is the number of functions found in a GUI
	Attractive interaction	Questionnaire to evaluate the attractiveness of the interface for users after the interaction
	Appearance and aesthetics of user interfaces	X = A/B is the number of aesthetically pleasing screens for the user and B is the number of screens displayed
Help and documents	Categories in help section	X = A/B where A is the number of categories found by the user and B is the total of help categories
	Help messages understood	X = A/B where A is the number of messages understood by the customer (successfully proved) and B is the total of help messages consulted
	Customer support	X = N where N is equal to 0, if a virtual assistance chat does not exist and equal to 1, if a virtual assistance chat exists
Information search	Proportion of filters by category	X = 1 – A/B where A is the number of filters selected by the user and B is the total of filters in the search section
	Proportion of search boxes	X = A/B where A is the number of search boxes showed and B is the number of sections visited
	Proportion of filters to advanced search	X = A/B where A is the number of filters found and B is the total of search filters
	Products related to the search	X = C where C is the number of products related to the search
Quality of error	Help with errors	X = N where N is equal to 0, if the website does not help the user with their errors, and equal to 1 if the website offers help with errors
	Error messages by the density of functional elements	X = C where C is the total number of errors that show up due to overload
	Proportion of error messages that are correctly understood	X = A/B where A is the number of errors that are understood by users and B is the total number of errors
	Correction of the user's entry errors	X = A/B where A is the number of entry errors for which the system provides a suggested correct value and B is the number of entry errors detected
User's cultural background	Payment methods	X = A/B where A is the number of payment methods that the user found useless and B is the number of payment methods provided by the website
	Affiliates registration	X = N where N is equal to 0, if the website does not offer to affiliate with Facebook, Gmail or others and equal to 1, if the website offers to affiliate with Facebook, Gmail or others

(*continued*)

Table 3. (*continued*)

Usability aspect	Name	Formula
Behaviour of the after sale service	Contact information	X = C where C is the number of means to contact with the customer service
	Purchase confirmation message	X = N where N is equal to 0, if an email confirmation does not exist and equal to 1, if an email confirmation exists
	Tracking order	X = N where N is equal to 0, if the user cannot track its order and equal to 1, if the user can track their order
	Order options (returns, changes, cancellations)	X = A/B where A is the number of order options that the user found useless and B is the number of order options that the website provides
Web design consistency	Design style	X = A/B where A is the number of sections with the same style of design and B is the number of sections navigated by the user
Density of the information	Simplified product information	If, A < B then X = A/B If, B < A then X = B/A Where A is the number of elements of information by product the user needs and B is the total number of elements of information of a product
	Relevant product information	X = A/B where A is the total of aspects that the user wants to know about the product and B is the total of aspects that provides the system about the product
Understanding	Metaphors understood	X = A/B where A is the number of metaphors understood by the user and B is the number of metaphors consulted to the user
	Complete description	X = A/B where A is the number of functions that are understood by the user and B is the total of functions
	Demonstration of accessibility	X = A/B where A is the number of satisfactory cases in which the user achieves to watch the demonstration and B is the number of cases in which the user is requested to watch the demonstration
	Demonstration effectiveness	X = A/B where A is the number of functions correctly performed after the tutorial and B is the total number of demonstration or tutorials reviewed by the user
	Understandable functions	X = A/B where A is the number of interface functions correctly described by the user and B is the number of functions available in the interface
	Understandable inputs and outputs	X = A/B where A is the number of input and output data elements that the user understands successfully and B is the number of input and output data elements available from the interface
	Proportion of exceptions that are correctly understood	X = A/B where A is the number of exceptions that were used correctly and B is the total number of exceptions
	Proportion of returned values that are correctly understood	X = A/B where A is the number of returned values that are understood by the user and B is the total number of returned values
	Hover time	X = T where T is the total time of suspension of a component

(*continued*)

Table 3. (*continued*)

Usability aspect	Name	Formula
Web design standards	Standard iconography	X = C where C is the number of icons identified by the user who do not know their usefulness
Flexibility and effectiveness	Recommended products	X = A/B where A is the number of recommended products satisfactory to the user and B is the number of products that recommend the website
	Selected products	X = A/B where A is the number of sections from where is possible to access to the shopping cart and wish list and B is the number of sections visited by the user
Functionality	Response time	T = Tr where Tr is the response time of the website
	Proportion of functional elements with the appropriate name	X = A/B where A is the number of functions with a correct name and B is the total number of functions
	Proportion of functional elements used without errors	X = A/B where A is the number of functions that were used correctly and B is the total number of functions
Information	Product information	X = A/B where A is the number of information labels per product that the user finds and B is the total of information labels of a product that the user is looking for
	Product quality	X = A/B where A is the number of types of qualification found by the user and B is the total rating types on the website for the product
	Information about the delivery of the product	X = A/B where A is the amount of the information the user needs and B is the amount of information about the delivery of the product
	Product availability	X = N where N is equal to 0, if there is no visibility of the information and equal to 1, if there is a visibility of the information
	Hovers	X = A where A is the number of suspensions of a component
Legibility	Understandable information	X = A/B where A is the number of information labels understood by the user (description, specifications) and B is the number of information labels read by the user
	Understandable labels	X = A/B where A is the number of information labels understood by the user in all their queries (categories, sections, etc.) and B is the number of information labels read by the user
Minimize memory load	Appearance of wish list	X = A/B where A is the number of times the desired list icon is found in the sections visited and B is the number of sections visited
	Desired products	X = N where N is equal to 0, if there is no list of desired products and equal to 1, if there is a list of desired products
	Recent search	X = A/B where A is the number of recent searches displayed by the website and B is the total of searches made by the user

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Table 3. (*continued*)

Usability aspect	Name	Formula
Navigability	Loading time between the different sections	T = Σ (Ti) where Ti is the loading time in each section
	Proportion of identified product categories	X = A/B where A is the number of categories found by the user and B is the total of categories of the website
Operability	Operational consistency	(a) X = 1 – A/B where A is the number of messages or functions that the user has found inconsistent with what he expected and B is the number of messages or functions (b) Y = N/UOT where N is the number of operations that the user found inconsistent with what was expected and UOT is the user's operating time (during the observation period)
	Correction of error	T = Tc – Ts where Tc is the time to complete the correction of a specified type of errors of the performed task and Ts is the start time of the correction of the errors of the performed task
	Appearance consistency	X = 1 – A/B where A is the number of user interfaces with similar elements but with different appearance and B is the number of user interfaces with similar elements
Transaction status feedback	Number of steps for the purchase process	X = C where C is the number of steps made by customers to make a purchase
Standarized symbology	Standard symbology	X = A/B where A is the number of icons consulted by the user in all the sections that fulfill the same functionality and B is the number of icons consulted by the user
Simplicity	Relative task efficiency	X = Σ (Ti * Ni)/Σ (Ti) where Ti is the time it takes for the client "i" to complete the task and Ni is equal to 0, if the task is not completed and equal to 1, if the task is completed
	Register	X = A/B where A is the amount of information that the user considers necessary and B is the amount of information requested by the website
Purchase decision	Proportion of visible offers	X = A/B where A is the amount of visible offers and B is the total of offers on the website
	Existing questions	X = A/B where A is the number of questions found by the user and B is the amount of questions sought by the user
	Comments	X = N where N is equal to 0, if you are not allowed to comment and equal to 1, if you are allowed to comment
	Payments	X = A/B where A is the amount of information regarding the payment found by the user and B is the amount of information regarding the payment necessary for the user

(*continued*)

Table 3. (*continued*)

Usability aspect	Name	Formula
Transaction	Purchase time	T = Tc where Tc is the time it takes to complete a transaction
	Help in the purchase	X = N where N is equal to 0, if there is no guide or purchase tutorial for users and equal to 1, if there is a shopping guide or tutorial
	Purchase summary	X = N where N is equal to 0, if there is no purchase summary for users and equal to 1, if there is a purchase summary
Visibility and clarity of elements and status of the system	Visibility of the number of customers	X = N where N is equal to 0, if there is no visibility of the information and equal to 1, if there is a visibility of the information
	Visibility of the system state	X = N where N is equal to 0, if there is no visibility of the information and equal to 1, if there is a visibility of the information
	Visibility on the status of the purchase in all sections of the purchase process	X = N where N is equal to 0, if there is no visibility of the information and equal to 1, if there is a visibility of the information

4 Validation of the List of Usability Metrics

This proposal was validated carefully with opinions from five usability experts. Each of these were shown and explained to them so they can give us an opinion and recommendations. All this process was developed based on interviews and questionnaires, where each expert evaluated each usability metric and rated them according to the importance they believed was feasible.

The opinion of the experts was diverse, for example, one of them told us that although the metrics and aspects of usability proposed served to evaluate a transactional website, they prefer to witness what results were obtained when evaluating a website within a real scenario. Another expert mentioned the proposed metrics covered very important aspects within the E-commerce websites, however, there could be more important aspects for a transactional website. In addition, a pattern should be developed to help to automate the evaluation of them, as it would be very useful for other people who would like to evaluate a transactional website using the metrics.

All these opinions served to revisit the proposal of metrics and to refine them. In the same way, we searched for more scientific articles related to usability aspects for E-commerce to cover all helpful information, for more accurate and reliable results when evaluating a transactional website.

5 Conclusion and Future Works

Usability is one of the most important aspects to take into account in e-commerce websites, since it is focused on the ease of use of the website in the face of interaction with users. Although companies use different evaluation methods to obtain usability, they are qualitative and do not provide numerical results to indicate the level of

usability they possess. In this sense, a proposal of usability metrics was developed, which unites different perspectives of usability aspects to be evaluated in a website. Because this project is focused on metrics for transactional websites, a thorough analysis was made of the current metrics in the literature and the aspects they covered, in order to focus on those that were not taken into account by transactional websites and because next, there were no usability metrics. This analysis evidenced the relevant aspects that were not taken into account by transactional websites, for example the search by information, the purchase decision making, the post-sale behavior, and others.

As future work, we have to test the proposal within a real scenario, putting forward a method of evaluating usability metrics, evaluating different websites, finding their level of usability and comparing the results, going through a validation of specialists and thus provide the most reliable results possible.

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