Application of the Usability Metrics of the ISO 9126 Standard in the E-Commerce Domain: A Case Study

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Abstract. Quantitative metrics are one of the few tools that allow specialists in the field of Human-Computer Interaction (HCI) to obtain numerical values about the level of usability of a software system. Although the advantages that software metrics provide, there is not enough evidence about their use in the literature. In this paper, we describe the evaluation process and the application of the usability metrics proposed by the ISO 9126 standard to evaluate a specific software product in the E-Commerce domain. The purpose of this study is to establish a guide that can be used by professionals in Software Engineering and related areas, to determine the correct level of usability of a set of graphical user interfaces that are designed as part of the front end of a system. In the same way, we describe the example of an application in which the entire inspection process is followed.

Keywords: Human factors · Human-systems integration · Systems engineering

1 Introduction

In the e-commerce domain, the usability has become in an extremely relevant aspect that impacts directly on the user's decision of using a specific website [1]. According to several authors [2–4], if a web application is difficult to use or fails to clearly establish the products or services that are offered, the users leave the site in search of other available alternatives on the online market. In this sense, the usability can be determinant and for this reason, a factor to be considered during the software development process.

Given the importance of the usability, several evaluation methods have been developed in order to provide specialists with a formal and systematic procedure that allows them to determine how usable the graphical user interfaces of a software system are [5]. Most of these methods are focused on the identification of usability problems through subjective approaches, and only a small percentage of them establish the protocol to obtain a numerical value about the usability of the software product. However, in many scenarios and situations, obtaining the usability degree of the system

in quantitative terms is necessary, especially, if the company requires to compare itself with the competition, or if there is required to determine the most suitable interfaces from multiple design proposals. For companies, it would be useful to have a methodological procedure that allows them to know the usability degree of their websites and at the same time perceive how far they are from the competition [6]. The software metrics, besides providing quantitative measurements about the usability degree of a software product, also establish the aspects in which the application must improve to be more intuitive and functional. In contrast to qualitative methods such as the heuristic evaluation and the cognitive walkthrough [7], which only allow the identification of issues that are present on the interface design, with the metrics is possible to know precisely the effort that e-commerce enterprises must perform to reach and even overcome their biggest competitors.

The number of usability problems provided by the qualitative methods is not a reliable calculation that can describe the usability level of a system, given that a website can have multiple issues, but if these only represent cosmetic aspects, the scenario is not as unfavorable as if they were catastrophic. A web application with a fewer number of usability issues can be a more critical scenario if the problems are severe. The metrics, on the contrary, provide a more objective perspective since the results of the evaluation are based on human actions performed by real users in interaction with the software system [8]. However, although the valuable information they can offer, there is little evidence in the literature that of their application as a usability evaluation tool [9]. In this paper, we describe a case study in which the metrics are used to assess the usability degree of an e-commerce web application. Likewise, an evaluation protocol is presented as well as an analysis of the aspects that are covered by the standard ISO 9126 for the inspection of software products in this specific domain.

2   Usability Metrics

The software metrics and the questionnaires are the primary techniques to quantify the usability degree of a software product. Both methods are time-consuming and require a previous planning session that allows specialists to formulate the usability tests correctly with users [6]. The questionnaires are focused on gathering subjective data related to the satisfaction of the users through pre-defined questions with Likert scale for subsequent analysis of the numerical values. On the contrary, the software metrics are objective measures related to the user's primary-task performance. Thus, the users are requested to interact with the software product according to a list of tasks, at the same time that an observer is taking notes about the performance of the users. The results of these metrics are based on direct actions that can be easily observed during the interaction, such as the success rate of achievement of certain requested tasks, the time that it takes the users to complete a specific workflow or the number of attempts that it takes the users to reach their goals.

The usability metrics are mathematical formulas that allow specialists to measure the usability degree of a software product in numerical values. According to the ISO 9126 standard, the usability is the capability of a software system to be understood, learned, operated, attractive and compatible with regulations of usability [10]. In this

sense, the metric must be aligned to these aspects that represent sub-characteristics of this quality attribute. An example of a metric can be appreciated in Table 1. Although the metrics are difficult to use, are an objective way to compare design proposals from the user's direct interaction and determine how far the companies are from their main competitors.

Table 1. Definition of the metric: "completeness of description".

Aspect	Description
Name	Completeness of description
Purpose	What proportion of functions (or types of functions) is understood after reading the product description?
Formula	X = A/B A = Number of functions (or types of functions) understood B = Total number of functions (or types of functions)
Interpretation	0 <= X <= 1 The closer to 1.0 is the better
Metric scale type	Absolute
Measure type	A = Count B = Count X = Count/Count
Input to measurement	User manual operation (test) report
Target audience	User
Usability aspect	Understandability

3   Assessment Protocol

The usability evaluation process through the use of quantitative metrics is not formally established by the specialists. There is little evidence about how to apply these metrics for the evaluation of software products. However, a previous systematic literature review about evaluation methods [11] has allowed the authors of this research, to elaborate a proposal of the activities that can guide the process:

1. The supervisor of the evaluation process must develop a test plan, composed of a set of tasks based on the usability metrics that will be evaluated.
2. The supervisor of the evaluation process must select the participants. The selection must be performed through a questionnaire, to corroborate if the people meet the profile of potential users of the system.
3. The evaluation team must prepare a set of materials: confidential agreement, instructions, pre-test questionnaire, post-test questionnaire, test plan, and observation sheet, to document the results of the usability assessment.
4. The usability test begins with a brief explanation to the participants about the tasks they must perform in interaction with the software product.

5. The observer must take notes about the interaction between the user and the software product, emphasizing on the quantitative metrics and according to the mathematical formulas.
6. The evaluators can request optionally the completion of a user satisfaction questionnaire by which the measurement results can be contrasted.
7. Given the results of all participants involved in the experiment, the numerical results for each metric are averaged.
8. The supervisor proceeds to document all findings in a report.
9. Finally, the assessment team identifies opportunities to improve the graphical user interface based on the results.

4   Case Study: Usability Evaluation of *Alibaba.Com*

The authors proceeded to evaluate the usability of an E-Commerce website using the software metrics proposed by the ISO 9126 standard [10]. For this study, the website of a world company specializing in e-commerce and retail was selected: *Alibaba.com*. In this experiment, four participants with similar experience and background in online transactions were requested to interact with the software application. In Table 2, the authors present the results of the usability evaluation for each metric.

Table 2. Results of the Usability Evaluation Using Metrics.

Metric	Results per participant					Average
	P1	P2	P3	P4	P5	
Ease of function learning to perform a task in use	2	7	120	3	60	38.4
Ease of function learning	2	7	120	3	60	38.4
Attractive interaction	4	4	4	4	3	3.67
Completeness of description	1	1	1	1	0.75	0.95
Understandable input and output	1	1	1	1	1	1
Result of the usability of the website						97.5%

5   Conclusions and Future Works

The metrics are an approach that allow specialists in HCI to quantify the level of usability of a software product. This tool can be useful in the sense that allow companies to perform comparisons with their main competitors or in a development process to select the best option from different design proposals. The ISO 9126 standard establishes metrics that are clearly observed during a user test and that can be apply to any kind of software product. However, the aspects that are considered in this norm are general and nowadays, the E-Commerce websites present features that are not covered for the evaluation. In this sense, it is necessary to develop a new approach that can be used to evaluate effectively the usability of the software products in this domain.

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