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Improving web user satisfaction by ensuring usability criteria compliance: The case of an economically depressed region of Europe

Maria del Carmen Suarez-Torrente Patricia Conde-Clemente Ana Belén Martínez Aquilino A. Juan

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Maria del Carmen Suarez-Torrente
Department of Computer Science, University of Oviedo, Oviedo, Spain
Patricia Conde-Clemente
Department of Computer Science, European Centre for Soft Computing, Mieres, Spain, and
Ana Belén Martínez and Aquilino A. Juan
Department of Computer Science, University of Oviedo, Oviedo, Spain

Abstract

Purpose – The purpose of this paper is to improve and facilitate the work of developers and usability evaluators by providing an adaptable and effective support. A well-defined set of criteria and a range of evaluation values for each criterion as well as a complete websites classification, will guide evaluators. A usability percentage and a list of prioritized criteria, adapted to the type of website by a new usability metric, will help developers to improve the website. This improvement will increase the degree of web user satisfaction.

Design/methodology/approach – Having established and validated a new usability evaluation framework, several usability tools have been analyzed. None of them totally fulfills the requirements of the evaluation framework. As a result of being unable to customize any of them, a new one has been developed. A study of 42 enterprise websites in an economically depressed region of Europe was performed using the new tool. This study involved 42 evaluators and 118 web users. Users have evaluated the websites before and after the redesign. A end-user computing satisfaction model-based questionary was used to collect data about end-user satisfaction. The results validate the proposal.

Findings – The study confirms that the proposed tool provides valuable information during the process of web development, evaluation and redesign. In adittion, it reveals that improving websites usability by ensuring criteria compliance has a positive effect on web users satisfaction.

Originality/value – Unlike previous purposes, the proposed tool allows to evaluate any type of website with a well-defined set of evaluation criteria and specific criteria values. As outcomes, the tool provides the website usability degree and a list of criteria ordered by priority repair. These results are adapted to the specific type of website. This makes easier and more effective the redesign of the evaluated website.

Keywords Usability evaluation, Usability criteria, Usability metric, Usability tool, Web user satisfaction

Paper type Research paper

Introduction

It is unquestionable that usability is a key factor in building successful websites (Flavián *et al.*, 2006; Tanikawa *et al.*, 2014) and the lack thereof can lead to failure of a website (Calisir *et al.*, 2010; Tezza *et al.*, 2011). Therefore, usability evaluation is considered a very important task when developing a user interface (Ardito *et al.*, 2011; Kılıç Delice and Güngör, 2009; Otaiza *et al.*, 2010). This is why many authors describe

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usability evaluation methods (Hartson *et al.*, 2003; Koutsabasis *et al.*, 2007; Matera *et al.*, 2006; Paganelli and Paterno, 2003). However, developers do not seem to have a clear usability evaluation model and this results in a lack of usability in many production websites (Nielsen *et al.*, 2001). We proposed Sirius (Torrente *et al.*, 2013), a usability evaluation framework based on heuristics, to perform expert evaluations using a specific set of evaluation criteria. Sirius provides a percentage value that quantifies the level of usability achieved on the website. This value is adapted to the evaluated website by considering different categories of websites. The most relevant features of the framework Sirius are detailed in next chapter.

Companies generally consider usability evaluation as a process that requires large investments of time and resources (Bolu *et al.*, 2012; Hayhoe, 2011). Regarding heuristic evaluation, evaluators have described reporting problems on paper as cumbersome and time-consuming (Law and Hvannberg, 2004). This has helped motivate others to provide them with a web tool to perform the evaluations (Hasan *et al.*, 2013; Hvannberg *et al.*, 2007). Using a web tool to support usability evaluation would reduce costs by automating data collection and processing, and contributing to the decision-making redesign. The importance of tool support in web usability evaluation is clearly documented (Dammagh and De Troyer, 2011; Hvannberg *et al.*, 2007) and, therefore, there are many tools with very different characteristics. Usually, these tools generate a list of error messages. In many cases, also suggestions are included in order to fix the website. However, these results do not allow the monitoring of a website over time or to compare the usability level achieved on different websites. Moreover, none of the tools that make a qualitative diagnosis of usability considers the type of website in order to adapt the results of the evaluation. Thus arises the need for a tool to perform web usability evaluation, being adapted to the type of website, providing a value that quantifies the usability degree achieved and providing the developer with a list of elements ordered by priority to fix on the website. These are the main objectives of Prometheus, the tool that supports the Sirius evaluation framework presented in this paper. Furthermore, since the web is constantly evolving, the tool must be easily scalable and, therefore, enabling the incorporation of new types of websites and new criteria to be considered in the evaluation process.

Sirius: a heuristic-based framework for measuring web usability

Sirius is an evaluation framework based on heuristics to perform expert evaluations using a specific set of evaluation criteria. It considers different types of websites, and quantifies the usability level achieved by a website depending on its type. This way, based on these results of the evaluation, measures to improve the usability level of the site can be taken. The architecture of the Sirius evaluation framework can be summarized as shown in Figure 1.

In Sirius we proposed to check a detailed set of criteria that not only contributes to a clear and concrete evaluation framework, but provides a percentual measure of the usability of a website adapted to the particular type of the analyzed website. In order to achieve this tuning of the measure to the type of website, Sirius incorporates a new classification of websites according to their functionality. This classification has been developed by taking into account different documented purposes and encompassing the diversity of current websites as blogs or interactive websites. Besides the definition of the criteria to use in the evaluation process, another basis of Sirius was the establishment of the relevance that the non-compliance of each evaluation criterion has in the global usability level of a website. These relevance values were determined for

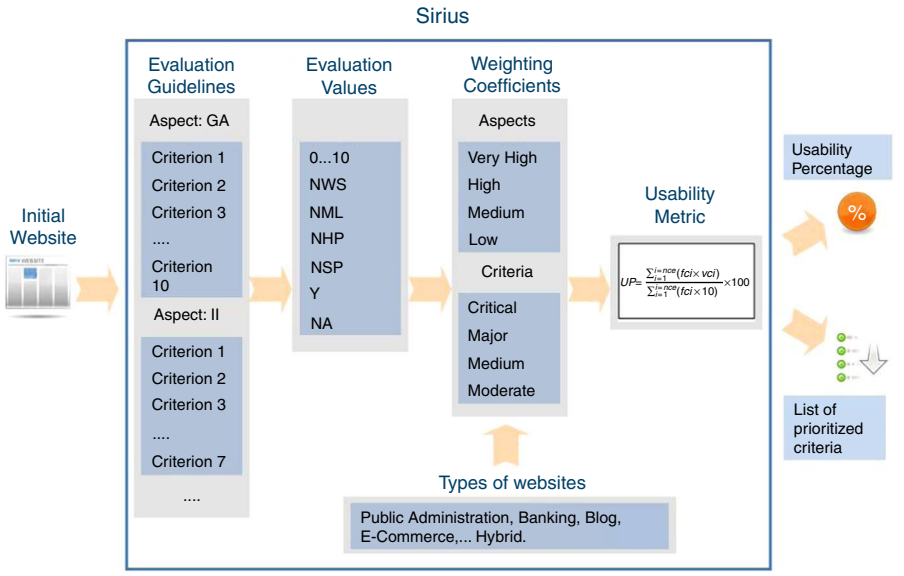

Figure 1.
Architecture of the Sirius evaluation framework

each of the types of websites considered. Finally, Sirius incorporates an evaluation metric that provides a quantitative value that reflects the usability level of a website, as a percentage value. The formalism underlying the definition of the framework allows the inclusion of new types of websites and criteria in a simple way. The addition of a new type of website would only require determining the level of importance of the criteria for this type of website. The inclusion of a new criterion would simply assess the relevance of that criterion in each different type of website.

As an evaluation framework, Sirius can be used in the development process of a website. In the first stages, the guidelines proposed by Sirius can be adopted as a part of the requirements of the website. In the prototype or production website evaluation phase it would be possible to:

- Verify the compliance with the criteria. This will provide the developer with an ordered, clear and concrete list of evaluation items.
- Obtain a quantitative measure that will indicate the level of usability achieved by the evaluated website.
- Know the list of usability errors detected on the website, ordered by priority (impact on global usability), helping the process of improvement of the website.

As support to the evaluation framework and, therefore, to facilitate the inclusion of the framework in the development lifecycle of websites, we have developed a web tool called Prometheus (www.prometheus-usability.com).

Related work

Due to the relevance of websites' usability evaluation, a great variety of tools to support this evaluation process have been developed. This is why various classifications of tools according to different criteria have been established (Alva *et al.*, 2003; Bastien, 2010). Tools are classified based on whether or not automatic, if oriented to expert evaluators,

users or both, if based on questionnaires filled in by the user or if quantifying system performance and interaction behavior by means of interaction parameters (such as task completion time, rate of erroneous links or page-view durations). However, since this work is focussed on the development of a tool to perform usability evaluations by providing a questionnaire (that plays the role of a usability guideline), in this section a review of the most important tools that comply with this feature and can be easily adapted to the requirements of Sirius was made. For this reason, those tools that are based on the capture of user actions or analyzing the HTML code to provide automatic measurement of usability, are not included within the analysis.

We reviewed SUMI (Kirakowski and Corbett, 1993), SUS (Brooke, 1996), WAMMI (Kirakowski and Cierlik, 1998), HEART (Williams and Arvanitis, 2007), WebA (Tobar *et al.*, 2008) and WebUse (Chiew and Salim, 2003). All of them facilitate the evaluation process by providing the evaluator with a set of items to check. Although all of them have this evaluation structure in common with the Sirius evaluation framework, none is adaptable to the particular set of evaluation items proposed in Sirius nor does the evaluator have different rating scales depending on the type of item to check. A tool that does provide different rating scales is Prokus (Zülch and Stowasser, 2000). Depending on the type of questions (the questions could be based on each thinkable checklist, standard, guideline, etc.), the tool offers answering fields for three types of scale: nominal, ordinal and interval scale. Although this tool has this desirable feature for our purpose, neither evaluation items nor tool outcomes fit our needs. Furthermore, all of these tools, excluding HEART, conceived to support heuristic evaluation for technologies of mobile augmented and virtual reality systems, can be used to analyze any type of website. However, the results do not take into account the type of the evaluated website as Sirius does and, furthermore, no prioritized evaluation results were obtained. These are two basic characteristics of the evaluation framework Sirius.

To summarize, the main features of the analyzed tools are presented in Table I.

Following the analysis, it was found that there is no tool to support usability evaluation that allows integration of all the requirements of Sirius. So the development of a tool that meets these requirements is necessary.

Prometheus

Prometheus is a web tool designed to meet the functionality required to assist in the detection of usability issues on websites, before or after operation, providing a reference, evaluation and measurement tool. Tool results will facilitate making decisions about improving website usability by providing a percentage score to

Usability tool	Number of evaluation items	General/ specific purpose	Provides results depending on the type of website	Provides textual fault report	Prioritize the arrangement detected faults	Provides exportable report results
HEART	20	Specific	No	No	No	No
Prokus	Variable	General	No	No	No	No
SUMI	15	General	No	Yes	No	No
SUS	10	General	No	No	No	No
WAMMI	60	General	No	Yes	No	No
WebA	Variable	General	No	Yes	No	No
WebUse	24	General	No	Yes	No	No

Table I.
Main features of the analyzed tools

determine the level of usability achieved on the website and a list of failed criteria sorted by priority. The tool considers the type of website during the evaluation process and allows the inclusion of new types of websites, aspects and criteria to be evaluated in a natural and simple way. The most relevant features of Prometheus are shown in a schematic way in Figure 2 and are described below.

The tool goals

Prometheus main goals can be stated as:

- providing support for web usability evaluation performed by experts, by means of a clear and concrete set of items to check;
- facilitating the evaluator task by offering not only the set of items to check, but also a specific set of values to assign, depending on the item;
- providing a quantitative value of usability as a percentage, a value that depends on the type of evaluated website;
- providing an ordered list by priority of the criteria to fix, so that the first criterion from the list, once fixed, is expected to make the greatest contribution to increase the usability level of the evaluated website and so on;
- allowing the visualization of the values assigned by the evaluators to each criterion, and the comments made, along the evaluation process; and
- generating the Evaluation and Report Language (EARL) report, a machine-readable format proposed by the W3C[1] for expressing test results.

Functionality

In order to describe the functionality of this tool, we will resort to the description of the full cycle of evaluation of a website, starting it at the point in which the website is registered and finishing it when the results of its evaluation have been obtained.

Registration and access to the tool

The process of a website evaluation starts when a user signs up on Prometheus. This tool distinguishes between three types of users: the Administrator of the tool; the Owner or user in charge of a website and the Evaluator, which are all compatible between

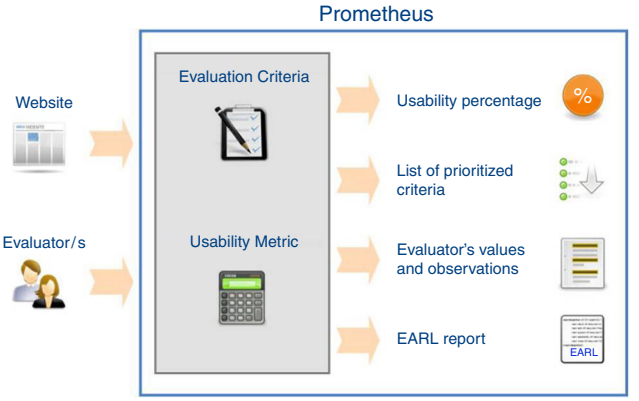

Figure 2. Schematic representation of Prometheus

themselves. A user that has the role of Evaluator is capable of performing the evaluation of one or several websites that had been previously registered by the Owner on the tool. This way, an Owner user is in charge of managing all the websites that will be subjected to evaluation. Therefore, in order to start with the evaluation of a website, the person who is responsible for it must first register with, at least, the role of Owner.

Moreover, there must be at least one Evaluator user registered, in order for the evaluation to take place. Therefore, a user who wants to perform an evaluation must be registered as an Evaluator. The tool allows for the registration of a user that has several different roles simultaneously.

Register the website to be evaluated

An Owner user will register one or more websites to be evaluated, indicating, for each of them, a name that is associated to the website, its URL and the type of website according to its functionality. As proposed in Sirius, the type of website is a key aspect in the process of evaluation, since the final value of usability depends on the type of website being evaluated. As a result, sites with very different types receive different levels of usability while failing the same evaluation items. For example, the criterion "low quality of images" is more important for the usability of an e-commerce site, where images are fundamental for the goals of the site, than for an online banking site, where images are not as relevant. Therefore, the aforementioned incompliance should have a greater impact on the usability level of the e-commerce website than in the online banking one.

Sirius considers the classification of websites shown in the list below, which are, consequently, the types of websites that an owner user has at their disposal when registering a website.

Types of websites considered by Prometheus:

- public administration/institutional;
- online banking;
- blog;
- e-commerce;
- communication/news;
- corporate/company;
- downloads;
- education/training;
- collaborative environments/wikis;
- virtual community/internet forum;
- leisure/entertainment;
- personal;
- service portal;
- image-based interactive services;
- non-image-based interactive services;
- webmail/mail; and
- hybrid.

As shown in the list above, a "Hybrid" category is available for websites that are a combination of other types. This way, both the assessment of the level of usability and the relation of prioritized criteria to be resolved will be dynamically adjusted to the website that is being evaluated.

Usability evaluation of a website

Once a website has been added, it will be available to the community of evaluators registered on the tool. An Evaluator user will select a website based on the availability of websites to be evaluated. In order to ease the selection, the tool will show the name, description and URL of each available website.

Once a website has been selected, the tool will show the evaluator an evaluation form that will present them with the information about the website that is being evaluated, as well as the browser that will be used during the evaluation. Although this last piece of information is merely informative, it may be considered relevant for the person in charge of the website due to the differences in visualization that the website may experience under different browsers. Afterwards, the 83 criteria used will be shown, organized in ten aspects (Evaluation Guidelines in Figure 1), as defined in the Sirius framework. The evaluator will then have to revise the website and assign an evaluation value (Evaluation Values in Figure 1) to each of the criterion that make up the checklist. A subset of them is shown in Figure 3.

In Sirius, the scope of criteria compliance can be Global (must be globally compliant through the whole site) or Page (must be compliant in each page of the site). For this reason, depending on the criteria, the possible values that may be taken will come from a scale ranging from 0 to 10 that shows the level of compliance of the criteria according to the evaluation scale for global criteria or a text scale for page criteria. The Table II shows the possible values of the evaluation.

Finally, to complete the evaluation, the expert evaluator may include, optionally, a set of observations that will help in the process of improving the usability of a website.

Obtaining the evaluation results

Once at least one evaluation of a website has been completed, the user who owns it may access the results. These results include the percentage value that indicates the level of usability obtained in each of the evaluations that have taken place for the website, and the list of criteria that need to be amended, organized by priority of repair.

As mentioned previously, the Sirius framework considers the type of website when calculating the global usability value. This gives different values for different types of sites, even though they may have the same evaluation values for the criteria, as the effect on global usability of a criterion depends on the type of website. Then, the level of relevance of the incompliance with the criteria is computed with weighting coefficients tailored to the type of website. The formula applied to obtain the percentage of usability is defined in the Sirius framework for evaluation:

$$PU = \left(\Sigma_{i=1,nec}\left(wc_i^* sv_i\right)/\Sigma_{i=1,nec}\left(wc_i^* 10\right)\right)*100$$

where

- nec: number of evaluated criteria. It is 83 at most (the 83 criteria considered in Sirius). Some criteria cannot be applied to a given site, and therefore cannot be evaluated (na value in Table II).

General Aspects	
GA 1 - Goals of the website are concrete and well defined	2
GA 2 - Contents and services are precise and complete	5
GA 3 - General structure of the website is user-oriented	5
GA 4 - General look and feel is aligned to the goals, features, contents and services of the website	0
GA 5 - General design of the website is recognizable	5
GA 6 - General design of the website is coherent	0
GA 7 - User's language is used	YES
GA 8 - Other languages are supported	NW:
GA 9 - Translation of the website is complete and correct	NA
GA 10 - Website is updated regularly	YES

Identity and Information	
II 1 - Identity or logo is significant, identifiable and visible	0
II 2 - Identity of the website is present in every page	NW:
II 3 - Slogan or tagline is suited to the goal of the site	YES
II 4 - Information about the website or company is provided	YES
II 5 - Contact mechanisms are provided	NMI
II 6 - Information about privacy of personal data and copyright of web contents is provided	NSP
II 7 - Information about authorship, sources, creation and revision dates of articles, news and reports is provided	NSP

Structure and Navigation	
SN 1 - Welcome screen is avoided	YES
SN 2 - Structure and navigation are adequate	0
SN 3 - Element organization is consistent with conventions	0
SN 4 - Number of elements and terms per element is controlled in navigation menus	NW:
SN 5 - Depth and breadth are balanced in the case of hierarchical structure	NW:
SN 6 - Links are easily recognized as such	NW:
SN 7 - Link depiction indicates its state (visited, active)	NW:

Figure 3.
Part of the evaluation survey completed by an evaluator

- sv: sirius value. Evaluation value of a criterion (between 0 and 10).
- wc: weighting coefficient. Weighting factor applied to the evaluated criterion. This is computed as follows:

$$wc_i = rv_i / \Sigma_{j=1,nec}(rv_j)$$

where *rv* is the relevance value for a given criterion.

As can be seen in the formula, the way each value of relevance of each criterion is integrated into the metrics of Sirius provides information on the degree in which each of them affects the level of usability of the website. This leads to the chance, once the evaluation of the website has been finished, to provide the list of criteria that have not been met, organized by order of priority of repair. This way, the first item on the list will be that which, once solved, provides the largest improvement to the level of usability of the website. Figure 4 shows the aforementioned list for an evaluated website. The columns of the table correspond to the identifier of the criterion; the aspect to which it belongs; the definition of the criterion; the value obtained by the evaluation (*O.V.*); the value recommended for that criterion (*R.V.*); and the percentage increment in usability (*Inc. %*) that would be given if the recommended value for the corresponding was achieved.

Apart from these results, the owner of the website also has the following information available:

- the e-mail of the evaluator in charge of each evaluation;
- the browser with which the evaluation was conducted;
- the values assigned by each of the evaluators to each of the evaluated criteria;
- the set of observations made for each evaluation;
- the list of correct and non-applicable criteria, for each evaluation;
- the average of the level of usability obtained in the different evaluations of the website, should there have been more than one; and
- the report in EARL format, a machine-readable format for expressing test results proposed by W3C.

Evaluation value	Definition
0-10	0: Not compliant at all 10: Fully compliant
NWS	Not compliant in the whole site
NML	Not compliant in the main links
NHP	Not upheld in the home page
NSP	Not compliant in some subpages
YES	Fully compliant
na	Criterion not applicable in the website

Table II.
Evaluation values for criteria

Figure 4.
Prioritized list of criteria to be solved in art.yale.edu

Case study: internationalization project for small- and medium-sized enterprises in an economically depressed region of Europe

The Prometheus tool has been used as support in several studies related to web usability, as documented in Torrente *et al.* (2013). The goal, development and conclusions of one of these studies are described in the following sections.

Project description and goals

The project entitled "Coaching de universitarios para la implantación de las TIC en procesos de emprendimiento internacional de micropymes asturianas" (ESTINCOACHING: Coaching of university students for the establishment of small- and medium-sized enterprises in international entrepreneurial processes of Asturian "micropymes") was started in 2011, approved by the Ministry of Industry, Energy and Tourism of the Government of Spain. The enterprises that participated in the project were located in Asturias, one of the regions that had been most affected by the coal crisis in Europe. Thus, the main goal of this project was to stimulate entrepreneurial culture and support the small- and medium-sized enterprises of the region in a process of internationalization, trying to achieve the highest degree of competitiveness in foreign markets by the enterprises that had joined the project. By taking part of the said process of internationalization, the enterprises faced the question of usability and a possible redesign of their websites, so that, apart from having the chance of becoming known outside of Spain, they had the opportunity of expanding their business with the implementation of an e-commerce platform. During this phase, Prometheus was used as a tool to provide support to the evaluation of the usability of the aforementioned websites.

Quantitative analysis of the evaluation

The process of evaluation spanned the month of March in 2012 and it analyzed the websites of 42 enterprises, of which 31 belonged to the corporative categories and the remaining 11 to e-commerce, both categories being included in the Sirius evaluation framework. The usability percentages obtained from the websites analyzed are summarized in Table III.

Although the average value of global usability represents a value of 76.2 percent, there are critical failures in values that are directly related to the competitiveness of the enterprises on an international level. As detailed in Torrente *et al.* (2013), two criteria closely related to web internationalization are included in the Sirius evaluation framework. Thus, the evaluation values of the criteria GA8 – other languages are supported (11.9 percent of the average value) and GA9 – translation of the website is complete and correct (2.38 percent) showed that, out of the 42 enterprises evaluated, only five of them provided their respective websites in more than one language. Moreover, among these five, only one had an appropriate level of translation. In the websites of the other four enterprises, even if they indicated that they supported other

Usability values	Number of enterprises
< 50%	3
(50%-70%)	6
(70%-90%)	32
> 90%	1

Table III. Number of enterprises for each interval of usability values

languages, they either had translated only their main page or they had translation mistakes in all of the pages that made up the website.

Apart from this generalized failure in aspects of the website that were directly related to the competitiveness within the international market, other general failures were detected by the use of Prometheus (Table IV).

Feedback for the enterprises

The use of Prometheus in the usability evaluation process of the enterprises websites, allowed them to not only obtain a general view on the usability level of their websites, but also a guide on how to approach the redesign of their websites.

On the one hand, the indicative value of the degree of usability of the website has led several enterprises to embark on the global redesign of their websites. On the other hand, the list of the criteria failed by the website, organized by priority of repair, has greatly eased the work needed to redesign the websites, in order to achieve the goal of internationalization proposed by the project. Currently, several of the enterprises have joined a new project (PIATIC: Plan of the Government of the Principality of Asturias), which has allowed them to access the funding needed to redesign their websites.

Impact of websites redesign on user satisfaction

User satisfaction is considered one of the most important measures of information systems success (Doll *et al.*, 1994). So we sought to determine if the redesign of a website, based on the results provided by Prometheus, has a positive effect on users' satisfaction when interacting with the website. In order to analyze the impact of a website redesign on the degree of user satisfaction, measurements have been performed on a sample of websites before and after the redesign. To measure user satisfaction we used end-user computing satisfaction (EUCS) model by Doll and Torkzadeh (1988), an instrument tested and verified by different studies (Pikkarainen *et al.*, 2006; McHaney *et al.*, 2002). EUCS consists of five first-order factors (content, format, accuracy, ease of use, timeliness) measured by 12 items. A Likert five-point scale ranging from never (1) to always (5) and "do not know" option are used in order to evaluate each item.

Methodology

After the evaluation of the aforementioned corporate websites conducted in 2012 by Prometheus, several of these sites had been redesigned in 2014 following some of the

Table IV.
Evaluation criteria that the small- and medium-sized enterprises failed the most

Criterion	Title	Average value (%)
SE8	User is assisted in case of empty results for a given query	22.5
SE6	Advanced search is provided	28.3
SN13	Elements hinting of user location and how to undo the navigation (breadcrumbs, colored tabs) exist	30.92
SN7	Link depiction indicates its state (visited, active)	31.57
GA10	Website is updated regularly	35.13
SN14	A map of the site to directly access contents without navigation exists	35.8
CI6	Coherent or alphabetic order in drop-down menus	47
SE7	Search results are comprehensible for the user	52.5
SN10	Self-links to the current page are avoided	53.75
LA8	Print version of the page is correct	59.2

directions provided by the tool. None of them had all proposed changes implemented. Three of them were chosen to be evaluated by users. These websites were picked in order to have a sample with values of usability provided by Prometheus with significant variations. The selected websites and their usability values are shown in next table (Table V).

For the study, the degree of user satisfaction before and after the redesign in each of the three selected websites was measured. A EUCS model-based questionnaire was used to collect data about end-user satisfaction. The EUCS model questions (Doll and Torkzadeh, 1988) are detailed in Table VI.

A questionnaire for each of the analyzed websites indicating the url before and after the redesign was developed. Each questionnaire was sent to 50 people, all of them internet users aged between 25 and 78. We collected 118 useful values (41 concerning www.pepin.es, 38 for www.tallerescancio.org and 39 for www.hotelesenllanes.net).

Results

By analyzing all the answers, we conclude that for all the tested websites a significant increase in the degree of user satisfaction occurs after the redesign of the websites. The results of each website are shown in Table VII.

Prometheus evaluations made before and after the websites redesign, show a significant improvement in their usability level, as shown in Table V. Items that scored low on the first evaluation, have been increased on the second one. The following table shows, as example, some criteria that scored low and their values after the redesign (Table VIII).

Moreover, it also has been shown that this usability level improvement directly correlates with the end-user evaluations. Considering the percentages of improvement in both the items of the user-satisfaction survey and the usability level obtained by

Table V. Prometheus values of selected websites before and after redesign

Website	Prometheus usability percentage before redesign	Prometheus usability percentage after redesign
www.pepin.es	46.91	79.02
www.tallerescancio.org	66.05	96.16
www.hotelesenllanes.net	86.91	94.62

Table VI. End-user computing satisfaction model questions

Factor	Item
Content	C1: Does the system provide the precise information you need?
	C2: Does the information contents meet your needs?
	C3: Does the system provide reports that seem to be just exactly what you need?
	C4: Does the system provide sufficient information?
Accuracy	A1: Is the system accurate?
	A2: Are you satisfied with the accuracy of the system?
Format	F1: Do you think the output is presented in a useful format?
	F2: Is the information clear?
Ease of use	E1: Is the system user friendly?
	E2: Is the system easy to use?
Timeliness	T1: Do you get the information you need in time?
	T2: Does the system provide up-to-date information?

Table VII.
Means and standard deviations of user-satisfaction values on pepin.es, tallerescancio.org and hotelesenllanes.net

	www.pepin.es				www.tallerescancio.org				www.hotelesenenllanes.net			
	Before redesign		After redesign		Before redesign		After redesign		Before redesign		After redesign	
Item	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
C1	2.220	0.571	4.390	0.586	2.474	0.506	4.789	0.413	4.692	0.468	4.769	0.427
C2	2.317	0.567	4.341	0.530	2.579	0.500	4.658	0.480	4.795	0.409	4.872	0.339
C3	1.366	0.488	4.146	0.358	1.395	0.495	4.289	0.767	2.154	1.159	2.154	1.159
C4	2.805	0.641	4.268	0.501	2.632	0.541	4.526	0.506	4.692	0.468	4.744	0.442
A1	1.634	0.536	4.439	0.550	1.605	0.495	4.553	0.504	4.615	0.493	4.615	0.493
A2	1.561	0.550	4.390	0.542	1.579	0.500	4.447	0.504	4.590	0.498	4.590	0.498
F1	2.024	0.570	4.488	0.597	2.474	0.506	4.842	0.370	3.205	0.409	4.179	0.389
F2	2.244	0.582	4.878	0.331	3.211	0.528	4.684	0.471	3.179	0.756	4.128	0.339
E1	2.488	0.597	4.756	0.435	2.632	0.589	4.789	0.413	2.769	0.742	4.179	0.389
E2	2.537	0.505	4.829	0.381	2.789	0.704	4.816	0.393	4.154	0.366	4.590	0.498
T1	2.829	0.629	4.854	0.358	3.132	0.844	4.684	0.471	4.385	0.493	4.436	0.502
T2	1.268	0.449	4.512	0.506	1.579	0.500	1.579	0.500	1.949	1.255	3.564	0.598

Table VIII.
Low-value criteria and their improvement after redesigning

	Website pepin.es			Website tallerescancio.org			Website hotelesenenllanes.net	
Criterion	Before	After	Criterion	Before	After	Criterion	Before	After
AG1	1	7	AG5	5	10	EN3	7	10
AG4	2	8	AG6	6	10	EN4	0	10
AG10	0	7,5	AG9	0	5	EN5	0	10
II6	0	10	II3	0	10	EN7	0	7,5
II7	0	10	II6	5	10	EN13	0	10
EN4	0	10	EN3	3	10	RO6	0	10
EN5	0	10	EN5	0	10	LA5	7	10
EN12	0	10	EN10	2,5	10	LA6	7	10
EN13	0	10	EN13	0	10	LA7	7,5	10
RO1	0	10	RO3	2,5	10	LA8	0	10
RO2	0	10	LA3	0	10	CR3	0	10
LA1	0	10	LA7	0	10	CR4	0	10
LA9	0	10	EF5	0	10	CR5	0	10

Prometheus, close to 1 Cronbach's α values confirm a strong correlation. Only an exception is found in the item T2 (Does the system provide up-to-date information?). Users values when evaluating hotelesenllanes.net before redesign were very different for this item. This may be explained by the offers published on the website; maybe some users have taken them into account to conclude that the website does provide up-to-date information, while others did not consider this. These data are reported in Table IX.

Therefore, we can conclude the Prometheus tool provides valuable information during the process of developing a website that has a positive effect on the satisfaction of its users.

Table IX.
Cronbach's α correlation values

	C1	C2	C3	C4	A1	A2	F1	F2	E1	E2	T1	T2
% of usability (PU)	0.966	0.972	0.954	0.893	0.950	0.956	0.997	0.851	0.997	0.869	0.998	−0.025

Conclusions and future work

In this paper, we have presented Prometheus, a support tool for Sirius, a framework to evaluate the usability of a website aimed at expert evaluators. The tool provides the evaluator with a well-defined set of criteria and a range of evaluation values for each of them. Once they have been completed, the results offered by Prometheus facilitate to the developer the task of redesigning the website, thereby improving user experience. One of these results is a quantitative usability measurement of the level of usability of a website that depends on the type of the website analyzed. Apart from this percentage value, developers have at their disposal a list of elements that need to be solved according to their priority of repair. The use of Prometheus has been a key factor to approach the redesign of the websites of a group of enterprises of an economically depressed region of Europe, with the aim of expanding their business to the international market. Through the study it was found that the redesign carried out following the guidelines offered by the tool has helped to increase the degree of satisfaction of users in the use of websites.

Our future work is focussed on integrating the values that may be automatized into the tool. We are analyzing which criteria can be automatically measured, and to which extent those criteria explain the usability level of a website. Furthermore, we are also investigating usability analysis for specific application domains, in order to dynamically adapt the list of criteria used to evaluate, as well as the adaptation of Prometheus to the evaluation of collaborative environments. Moreover, we will try to determine the correlation degree between the 83 Sirius criteria and the 12 EUCS items. The aim is to extend the results offered by the tool to developers.

Note

1. Evaluation and Report Language (EARL) 1.0 Schema. www.w3.org/TR/EARL10/ (accessed March 27, 2015).

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About the authors

Maria del Carmen Suárez-Torrente is a Lecturer of Computer Sciences at the University of Oviedo (Spain). She received her PhD in Computer Science from the University of Oviedo in 2011. Her current research interests include human computer interaction especially usability and accessibility. She has published research papers in refereed scientific journals and has taken part in several research projects. Maria del Carmen Suárez-Torrente is the corresponding author and can be contacted at: macamen@uniovi.es

Patricia Conde-Clemente is a PhD Student in the Cognitive Computing Unit at the European Centre for Soft-Computing. She has a Technical Engineering Degree in Computer Science and a Master in Web Engineering Degree both from the University of Oviedo. Her main research interests are the application of Soft Computing techniques in the areas of Language and Cognition applied to Big Data.

Ana Belén Martínez is a Tenured Associate Professor of Computer Science at the University of Oviedo (Spain). She received her MS and PhD in Computer Science in 1993 and 2001, respectively. Her research interests are new paradigms of databases and human computer interaction especially usability and accessibility. She has published more than 30 chapters in books and papers in refereed scientific journals and has taken part in more than ten research projects. She serves as an ad hoc reviewer for various academic journals and conferences on the subject of human computer interaction.

Aquilino A. Juan is a Lecturer of Computer Sciences at the University of Oviedo (Spain). He received PhD in Computer Engineering in 2002. His research interests are software architecture, web engineering and e-learning architectures. He has published more than 30 books and papers in refereed scientific journals and conferences, and he has taken part in more than 20 research projects.