

# A Prototype to Validate ErgoCoIn: A Web Site Ergonomic Inspection Technique

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**Abstract.** This paper presents current actions, results and perspectives concerning the development of the ErgoCoIn approach, which allows non expert inspectors to conduct ergonomic inspections of e-commerce web sites. An environment supporting inspections based on this approach was designed and a tool is being developed in order to accomplish its validation plan. Besides this validation, the actions to be undertaken will allow us to analyze the task of applying checklists and specify an inspection support environment especially fitted for that. This is of great importance as this environment is intended to be an open web service supporting ergonomic inspections of web sites from different domains. A wiki environment for this tool development is also being proposed.

**Keywords:** Usability, Evaluation, Web Sites, Inspection, Web 2.0.

## 1 Introduction

An important attribute for most interactive systems is the level of usability they offer to users while accomplishing their tasks. According to ISO9241:11, usability is characterized by the *effectiveness*, *efficiency*, and *satisfaction* with which users achieve specified goals in a particular environment [9]. In such a way, usability is a blend of objective and subjective task oriented measures. Effectiveness can be objectively measured by the rate of users' achievement (with accuracy and completeness) of specific goals. Efficiency can also be objectively measured by the amount of resources expended on task by actual users. User satisfaction concerns subjective data indicating how well users evaluate the system's comfort and acceptability.

Usability can be measured during user interactions with the system and evaluated by evaluators and/or inspectors that may judge how well the user interface aspects are, *a priori*, fitted to users, tasks and environments. In doing so, they judge the *ergonomics* of that user interface. Usability and ergonomics are linked to a cause-effect relationship. The more ergonomic (or fitted) the interface is the higher is the level of

usability it can afford to its users [6]. Considering the software product quality model proposed by ISO 9126<sup>1</sup>, ergonomics may be understood as an *external* quality of the software while the usability is the quality of its use [8].

Methods aimed to measure usability (usability tests) are known to be usually expensive and complex [13]. Alternatively, ergonomics of the user interfaces can be evaluated or inspected faster and at lower costs. A simple differentiation between *evaluations* and *inspections* can be established based on the type of the knowledge applied to the judgments involved with both techniques. Evaluators apply mainly implicit knowledge they accumulated from study and experience, while inspectors apply primarily the explicit knowledge supported by documents, such as checklists. Inspectors cannot produce fully elaborated or conclusive diagnosis, but their diagnoses are comparatively coherent and generally obtained at low cost.

ErgoCoIn [5] is an approach designed to provide support to *inspectors* in order to allow them to perform objective web sites ergonomic inspections. With the goal of improving the quality of the diagnoses, this approach postulates several considerations about the web site's context of use, including: users, tasks and environments attributes. Among them must be considered the ones concerning the interface of the web site under evaluation [9]. Content of interviews/questionnaires as well as of the others contextual data gathering activities are based on information demand presupposed by the approach's knowledge base. Such strategy allows performing specific objective ergonomic inspections: only pertinent information gathering is proposed to the inspectors in the context of use analysis, and only applicable questions are presented to them while inspecting the web site. The ErgoCoIn checklists can support the inspectors by providing more homogeneous results when compared to those produced by ergonomic experts. This is an obvious consequence of having inspectors applying the same checklist set of questions and sharing decisions about their relative importance.

This approach is interesting to web sites designers and evaluators due to the fact that questionnaires and checklists can be applied by the design staff, not necessarily experts in usability evaluation. Thus, the inspections can be usually performed quickly and at low costs. It can also be considered as a way to introduce ergonomic concepts to designers and to stimulate them in their daily work to be questioning human factors specialists when facing potentially serious ergonomics problems.

In this paper we present details about both the ErgoCoIn logical architecture and the tool built to validate the approach: (i) low cost, (ii) objectivity and (iii) homogeneity of inspection diagnosis. The other requirements that were identified include the variety and novelty of the knowledge base. In order to achieve the fulfillment of these requirements, we propose the development of a collaborative effort aimed to insure that the ErgoCoIn knowledge base can be enriched continuously. We believe that inspections supported by an environment that incorporates these features can be more efficient and reliable.

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<sup>1</sup> In fact, ISO 9214:11 and ISO 9126:1 don't agree completely about the terminology concerning the "*a priori*" and the "*a posteriori*" perspectives of usability. While the first standard employs "ergonomics" and "usability", the second one employs "usability" and "in use quality" to denote these perspectives.

This paper contains 5 sections: Section 2 presents an overview of the ErgoCoIn approach. Section 3 presents the logic architecture of an environment aimed at supporting the software application, as well as introduces the tool that is being developed for validating the ErgoCoIn approach. Section 4 presents the motivation and proposal for developing a cooperative perspective to the development of a Wiki ErgoCoIn. And finally section 5 presents the conclusions that can be considered for this environment future development and use.

## 2 The ErgoCoIn Approach

The ErgoCoIn approach development has been motivated by four considerations: (1) web sites development became achievable to a large spectrum of designers (through easily available design tools), not necessarily skilled in computer science or in ergonomics; (2) web sites are often designed along a fast and low cost design process supported by non expensive tools which may lead designers to include numerous and sometimes obvious ergonomic flaws; (3) usability evaluations using the “traditional” methods can be expensive and (4) their results may lack homogeneity [5].

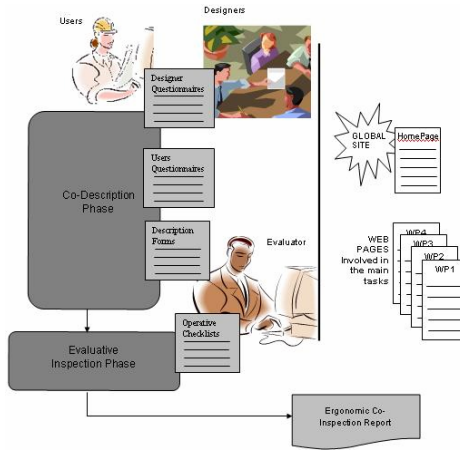
The approach is divided into two main phases: web site Contextual Analysis and Ergonomic Inspection of the components and their attributes (see Figure 1).

The Co-Description Phase is based mainly on surveys. Before conducting questionnaires and interviews, inspectors must identify the components of the user interface that will be inspected. The reason for that is to guarantee that, during surveys, the inspectors will collect only the contextual data that is appropriate to inspections of the actual user interface components. Surveys are supposed to be conducted with both users and designers. From users, inspectors are supposed to gather data concerning their profile, work environment and the strategies they apply to accomplish tasks using the web site. Task strategies are described simply as a sequence of pages that the users may access when accomplishing their goals. Satisfaction issues should also be gathered in surveys from users. From designers, inspectors should gather information about the expected context of use, including data concerning the user profile and task strategies. Results from surveys are examined in order to establish comparisons between context of use elements and particular task strategies as prescribed by both users and designers.

The second phase of the approach is characterized by ergonomic inspections based on checklists. This sort of technique distinguishes themselves by their organization and content, and, specifically, are defined as a set of checklists items organized according to the Ergonomic Criteria [13] basically related to the ergonomics of web sites supporting e-commerce initiatives. This questions based approach was built from the examination of a large collection of ergonomic recommendations compiled by INRIA researchers [1,14]. Each recommendation selected was reformulated as a question and associated to one ergonomic criterion.

Like any other inspection dynamics, application of each ErgoCoIn inspection question follows 3 decision phases: applicability, weighting and adherence.

For objectiveness, the checklists should propose only questions which are applicable to the actual web site context of use and interface components. This is insured by having all questions in the ErgoCoIn knowledge base properly indexed to the context



**Fig. 1.** The ErgoCoIn Approach Framework

of use aspects (user, task, environment and interface) as gathered from both users and designers.

Further, each applicable question has to be weighted in order to allow the production of properly ranked results. Particular decisions about what is more important to be considered when inspecting e-commerce web sites were taken by the ErgoCoIn designers, but they can be modified by inspectors while inspecting web sites from different application domains.

For simplicity, the level of importance of an ergonomic criterion may define the level of importance of each individual question associated to it.

Finally, user interface adherence to a question (or requirement) must be judged by the inspectors. They do that based on the information concerning ergonomic requirements or questions (explanations, examples and counter examples) and also the data describing the web site’s context of use (concerning users, tasks and environment).

Also, the ErgoCoIn application presupposes that information about the context of use should be directly collected from users and designers with the support of questionnaires and/or interviews. As a consequence, the approach can only be applied to web sites that are being used regularly. Furthermore, it is also necessary to have some designers and users available for the interviews or, at least, able to answer some questionnaires.

The ErgoCoIn approach was designed to allow extensions and instantiations. The questions base can be extended to consider other type of perspectives, not just the e-commerce, but other domains, like e-learning for instance. Ergonomic Criteria and associated questions can be ranked differently in order to define a weight for the questions in accordance to the context of use of the web site under inspection.

Another kind of extension that is being considered concerns the integration of the results from the analysis of usage log data produced with this approach. Such data can be collected using specific software tools for this purpose. In fact, a usability oriented

web analyzer called UseMonitor is being developed and associated to the ErgoCoIn approach [4]. This tool can present warnings about the “*a posteriori*” perspective on usability problems, i.e., interaction perturbations occurring while users are interacting with the web site in order to accomplish their goals. Basically, the UseMonitor can indicate when the observed efficiency rate is particularly low. Detailed efficiency indication is about the rates and time spent of unproductive users’ behaviors like solving error, asking help, hesitation, deviation, repetition and so on. Further, the UseMonitor can indicate web pages related to this kind of perturbations. A logic architecture based on the integration of (i) a typology of usability problems, (ii) the ergonomic criteria/recommendations and (iii) a model of interface components is also being defined. This will allow the UseMonitor warning the inspectors about a detailed interface aspect causing an actual usability perturbation (*a posteriori* result), while ErgoCoIn will be helping inspectors identifying the user interface component responsible for such perturbation as well as indicating how to fix it (*a priori* result). The integration of ErgoCoIn and UseMonitor defines the ErgoManager environment [4]. As a tool for usability evaluation such an environment will be automating both processes, the failure identification (by log analysis) and failure analysis (by guidelines processing) [1]. Details of this architecture are being defined and will be detailed in future publications.

### 3 The ErgoCoIn Environment and Validation Tool

A computerized environment was designed in order to support mainly the data capture concerned by the inspection and inquiry techniques proposed by the current configuration of the ErgoCoIn approach [10].

Contextual analysis will be supported by two collectors consisted basically on a series of forms. The *Contextual information collector* is aimed at guiding inspectors while gathering information from designers and users. The *Web site description collector* will collect description data concerning web sites functions and interface components. Description questions concerned by these collectors are extracted from the environment *Knowledge base*. Data gathered (contextual data and site description) in this phase is stored in a *Context of use data base*.

The support to Ergonomic Inspections starts with an *Analytic evaluator*, that is a system component that compares users’ and designers’ information concerning the intended and real context of use features. This component will verify the existence of designer’s misconceptions about users’ features, and if necessary, sends warnings to the *Checklist builder*. The main function of this builder is to create checklists concerning the overall web site and its pages according to the task strategies described by users and designers. It can highlight questions which could reveal ergonomic flaws due to the lack of correspondence between users and designers views about the context of use. These checklists will propose only applicable questions arranged according to their level of importance. A default order of importance is suggested, but it can be modified by the inspectors when considering the characteristics of the current web

site context of use. Also, the inspectors' judgments will be supported by the *Ergonomic judgment support tool* that will supply them with data about the context of use as well as the information about the questions.

In order to validate the ErgoCoIn approach, we are developing a tool which follows the general architecture presented in Figure 2. This environment validation strategy consists in employing this tool to support different inspectors while accomplishing inspections of different web sites and by analyzing measures concerning effectiveness and efficiency of their actions as well as the homogeneity of their results.

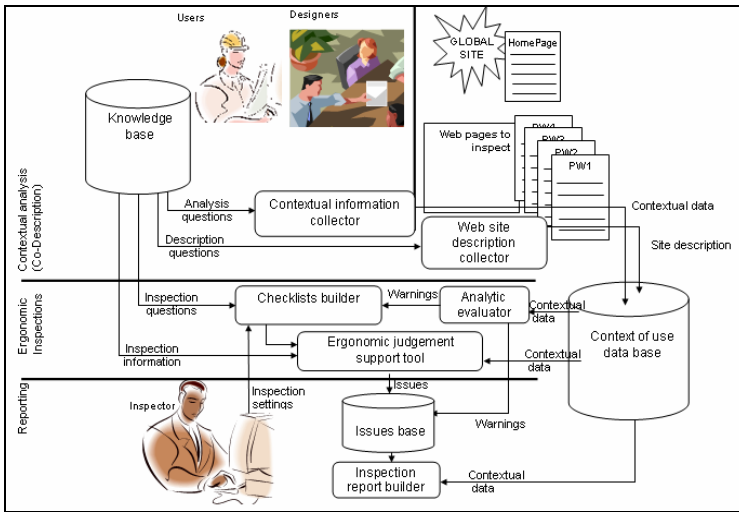


Fig. 2. Overview of the Logical Architecture of the ErgoCoIn Environment

Based on the ErgoCoIn logic architecture, we have modeled data entities and created Entity-Relationship Models. We have also designed a Use-Case Map as well as a Sequence Diagrams for the main tasks. Figure 3 presents the Use Case Diagram for several registering tasks.

Interactions for registering almost all kind of data defined in the Entity-Relationship Model were designed according to the CDU (Create, Update & Delete) Model. They include the registering of inspectors, users, designers, web sites, tasks, web pages, interface components, ergonomic criteria and questions among others entities (see Figure 4). Doing so, we insure that interactions are quite homogeneous all over the interface tool. An exception is related to the interaction aimed at changing relative importance of the ergonomic criteria (see Figure 5).

The first cycle of the ErgoCoIn's implementation took place immediately after the conclusion of the design activities mentioned above. The first prototype is mainly concerned to ergonomic inspections and this version features a total of 182 questions registered that are linked to the 18 Ergonomic Criteria properly ranked.

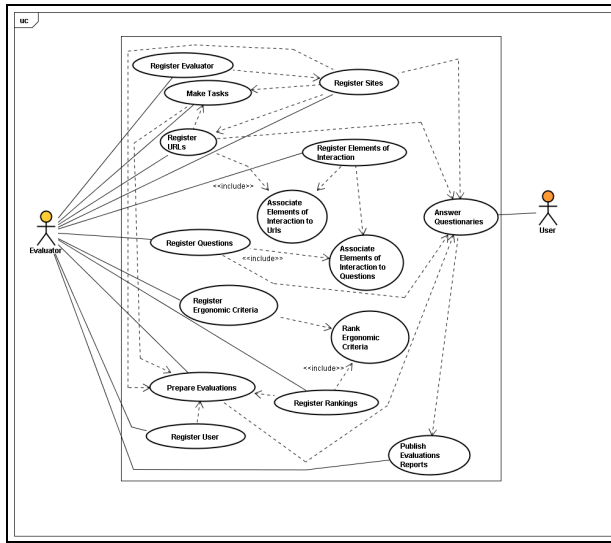


Fig. 3. Use Case Diagram for the ErgoCoIn Validation Tool

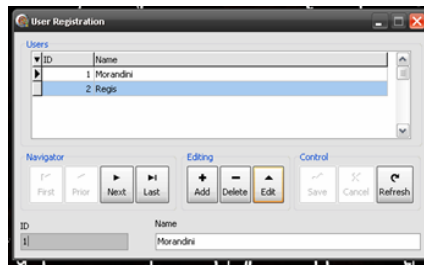
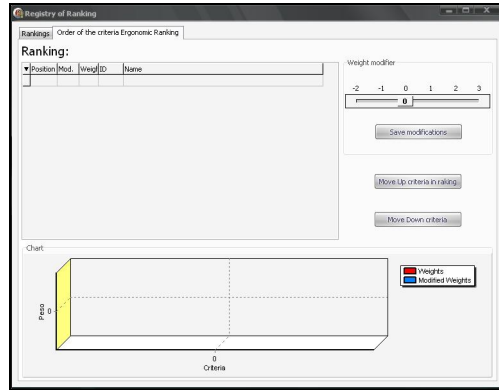


Fig. 4. ErgoCoIn’s Users Storing Screen

The next step of development will be focused on the functions supporting activities of the others phases: Co-Description (screens concerned with users and designers questionnaires) and Inspection Reports (see Figure 1). The *Ergonomic judgment support tool* development will be undertaken in the future as well.

Once the tool is completed, we will start accomplishing cycles of validation studies focusing not only on the tool, but also on the underlying approach. These cycles will be consisted on phases of (i) planning activities, (ii) inspections achievements, (iii) results analysis and (iv) proposals of revision. At each cycle, a number of inspectors will be invited to use the tool in order to perform inspections of a given e-commerce web site. Results from all inspectors, as well as the log of their actions will be gathered and analyzed from the homogeneity and objectiveness points of view [3]. The goal behind revision proposals is to get inspections more objective and reports more coherent. Validation cycles will be repeated until expected objectiveness and homogeneity criteria have being reached.



**Fig. 5.** Screen Aimed at Receiving Definitions Concerning Relative Ergonomic Criteria Importance

The inspections cycles will allow us to have a better understanding of the way tasks concerning ergonomic inspections of web sites are accomplished, and specify a tool specially fitted to those tasks.

Indeed, we intent to specify an ErgoCoIn user interface able to support inspectors spread all over the world performing ergonomic inspections of web sites from different domains, not only the ones concerning e-commerce. The idea is to offer the tool to those who wants to make inspections, and wants to contribute to the enrichment of the ErgoCoIn knowledge base and programming code.

## 4 The Wiki-ErgoCoIn

We propose to change the scope of the ErgoCoIn development in order to support a collaborative initiative. In fact, this kind of initiative is among the most interesting phenomena observed in the recent history of the web. Collaboration is authorized by special functions offered by web sites allowing users to create, share and organize the content by themselves. Best examples of socially constructed web sites are Facebook, Youtube, Flickr, Digg, del.ici.ous and Wikipedia.

Particularly, the Wikipedia is the most successful example of collaboration concerning scientific content on the web. This socially constructed encyclopedia features remarkable internet traffic numbers as it is the 9<sup>th</sup> most visited web site in the whole Web. From 2001 to now, 7.2 million of articles were posted in Wikepedia. Those were produced by 7.04 million of editors following some style and ethic rules [16]. Wilkison and Huberman [17] performed a study concerning 52.2 million edits in 1.5 million articles in the English language Wikipedia posted by 4.79 million contributors between 2001 and 2006. They split out a group of 1,211 "*featured articles*", which accuracy, neutrality, completeness and style are assured by Wikipedia editors. Comparisons between featured and normal articles showed a strong correlation among the article quality, the number of edits and the number of distinct editors. In the same study, the authors could associate attractiveness of the articles (number of visits) to the edits novelty.



The goal of having ErgoCoIn as a collaborative web initiative is to increase the generality and attractiveness of its contents as well as the quality of the results this approach could afford. Indeed, the Wiki-ErgoCoIn is being designed in order to allow ergonomic inspectors all over the world to share efforts and responsibilities concerning the ErgoCoIn knowledge base extension and generalization. In doing so, we can expect that the Wiki-ErgoCoIn will always feature newly proposed questions concerning ergonomics of web sites from different application domains, interface styles and components. Contributions should fulfill a basic requirement: follow free-content collaboration rules like those developed by Wikipedia. We believe that the results obtained by such cooperative approach can be much more efficient and reliable than the ones that would be obtained solely by individual initiatives.

## 5 Conclusions

ErgoCoIn is an inspection approach strongly based on knowledge about ergonomics of web site's user interfaces. This knowledge is intended to guide inspectors while undertaking contextual data gathering and analysis, checklists based inspections and report actions. In this paper we described details of this approach and the environment designed to support it. We have also introduced the tool that is under development to validate its structure and contents. We will perform the validation activities following cycles of application-analysis-revisions until the approach reaches expected objectiveness and homogeneity goals.

But the success of the ErgoCoIn initiative depends basically on the variety and the novelty of its knowledge. Nowadays, this approach is linked to the ergonomics of the current e-commerce web applications and interfaces technologies, styles and components. Indeed, all these aspects may evolve continuously using just e-commerce may be a very limited scope. Consequently, there is the need to undertake actions in order to face the challenge of continuously getting ErgoCoIn contents up to date and varied to support the production of inspection reports in different web sites domains. An open initiative is being proposed by which anybody knowledgeable will be authorized to contribute to the enrichment of the Wiki-ErgoCoIn knowledge base. Consultative and executive boards will be created to define strategies and policies concerning implementation of this ergonomics inspection wiki. Participation demands are planned to be directly addressed to the authors.

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