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Consequences of the Lack of the Non-Functional Requirement Usability in an Information Systems

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Abstract.
Information is the blood of modern organizations. It permeates the organization in several distinctive ways, and more and more, it is a key factor not only in terms of competitiveness but also in terms of public perception. The Internet revolution has made all organizations aware that their information is not only important for internal but also for external consumption.

Information system processes and distributes the information among people in an organization. They are designed with the purpose of establishing a productive interaction between the system and their users in order to increase people's productivity while performing their tasks.

Due to the great value of information, the user interface becomes an important part of information systems. It is the visible part of the system and where the dialogue between man and machine is established. It is necessary to design *user-friendly* interfaces, that is, interfaces that are easy to use. To be friendly, an interface must suit each user's need and satisfy his/her expectations.

To obtain *such* systems´ interfaces, the designers must take in consideration the non functional requirement (NFR) usability at the system definition. These requirements, related to data input and to the display of information, assure that the information given is complete, correct and not ambiguous.

Failure to take NFRs in consideration has been reported in the literature. In this article we show how the lack of consideration of the NFR usability interferes on the quality of a product. We define the non-functional requirements and then analyze how some examples are used in a famous commercial site, *sears.com.* These requirements allow the designer to use facilities that improve the system 's efficacy.

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1. Introduction

Information is the blood of modern organizations. It permeates the organization in several distinctive ways, and more and more, it is a key factor not only in terms of competitiveness but also in terms of public perception. The Internet revolution has made all organizations aware that their information is not only important for internal but also for external consumption.

Information system processes and distributes the information among different people in an organization. They are designed with the purpose of establishing a productive interaction between the system and their users in order to increase people's productivity while performing their tasks. Since systems must satisfy the expectations and needs of users, the NFR usability must be present in any method for systems construction.

Due to the great value of information, the user interface becomes an important part of the information systems. It is the visible part of the system and where the dialogue between man and machine is established. Assuring that systems are developed in such a way that the interface with its users are taken care is only possible if there is a way of guaranteeing that the NFR usability is taken in consideration at the system definition [BIAS94]. Usability is defined by a product being easy and fast to learn, efficient to use, easy to remember, cause no operating errors and offer a high degree of satisfaction to the user, and solving the task it is designed for.

Failure to take NFRs in consideration has been reported in the literature [BREIT99] [DAVI93], [CYSN99]. In this article we show how the lack of consideration of the NFR usability interferes on the overall quality of a given product.

2. Usability

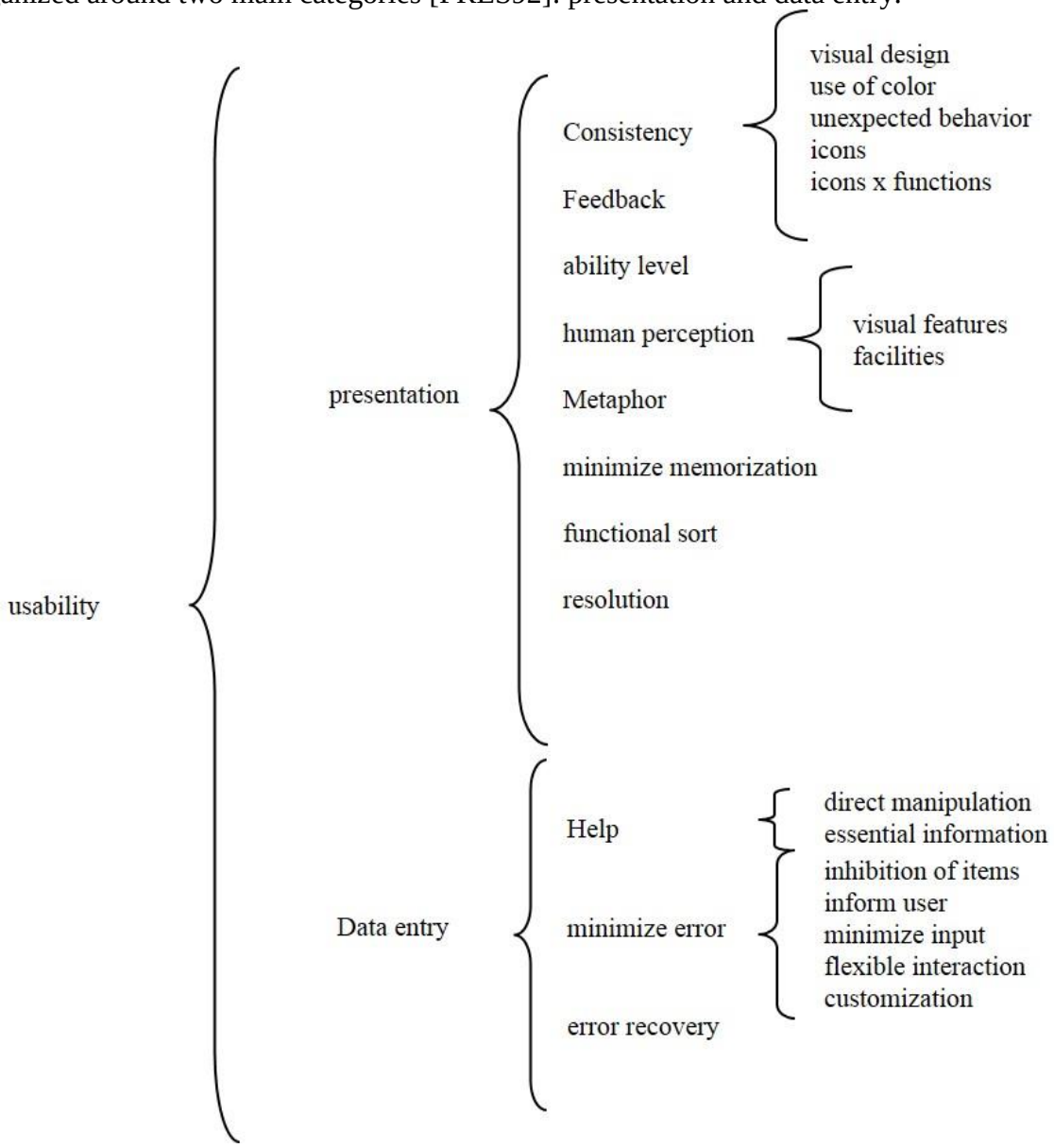
The communication between users and an Information System (IS) is established by means of the IS interface. A good IS design must guarantee a transparent communication, that is, it must assure that when a user access the IS to perform any task, he only needs to focus his energy on the work he wants to do [NORM86].

To have users focusing their attention mainly on their tasks, the process of software development must be "user centered", that is, its interface must be designed with the objective of satisfying the expectations and needs of users. The design of an interface that considers users' characteristics and the NFR usability is a difficult process for many reasons, but most of this difficulty can be traced to the lack of attention on NFRs during the system definition process.

Building systems that take in consideration NFRs, requires the availability of a corpus of knowledge to help the requirements engineer in the task of defining the system to comply with those requirements. Our work is a starting point on the direction of producing a corpus of

knowledge on usability in such a way that it could be used in the context of the NFR framework [CHUN00].

Below we present the taxonomy that we have put together using as source the general literature on design and usability and our own experience with the topic. The usability taxonomy is organized around two main categories [PRES92]: presentation and data entry.



3. What happens when the NFR Usability is not considered?

Different from the approach taken by Cysneiros [CYSN 99] to show the impact of not considering NFR during system definition, we decided to perform a post analysis of an information system available on the Web. Our approach is a qualitative one, that is we use the

taxonomy to analyze the interface of an information system pointing out the problems that an organization may find when the NFR usability is not taken in consideration.

We decided to choose a well know web site, Sears.com, in order to perform our analysis. Your results are presented with the sole intention of showing how important is to consider NFR as early as possible during the process of system construction. We follow the taxonomy to describe the results of our analysis.

3.1 Presentation Category

3.1.1 Consistency

Consistency is one of the main features for the usability of an interface. It helps to avoid the frustration induced when a system does not behave in an understandable and logical way. Moreover, allows a person to generalizes the knowledge about one aspect of the system to other aspects [FOLE90]. To be consistent, menus, commands, information exhibitions, and all the functions of an interface must have the same visual presentation.

Figure 1 shows some screens of the site Sears.com. These interfaces present inconsistencies in several of its aspects. We will see some examples:

Figure 1: Sears.com interfaces

3.1.1.1 Visual Design

The screens have different layouts. Figure 1.A is the site's main page. It presents a horizontal menu above the upper blue bar, not seen in the figures 1.B and 1.D. The blue bar has links to other pages of the site. Once the user chooses one of these links, he/her goes to the respective page.

Figure 1.B shows the page opened when the option *Auctions on e-bay* is selected. This screen is completely different from the others. Its blue bar does not have the links to the other pages (just for Sears' home page); this may cause a frustration on the user, because when he navigates

through the rest of the site, he always see this option, so he probably is expecting for them in this page. Another problem is the absence of the options *Find a Sears Store Near You* and *Buy a Gift Card* (Figure 2) both present in all other pages.

Figure 2: Options present in all pages except on the *Auctions on e-bay*

The screen displayed in Figure 1.C (*Hot Buys*) has a layout different from the others. Its title appears in a different place, beside the *Find a Sears Store Near You* and *Buy a Gift Card* options. Also, its middle part presents vertical bars, with a green horizontal bar on the top.

Some interfaces, like the ones show in figure 1.E (*WishBook)* and Figure 1.F (*Room for Kids)* have a completely different design from the rest of the site. The screen of figure 1.F, *Room for Kids,* is more serious. It not only has a different layout, but it also changes the metaphors used in the rest of the site. All interfaces adopted the metaphor of a cart while this one adopts the *basket* metaphor

3.1.1.2 Proper Use of Color

The color, basic element in any communication ‘s process, may interfere with emotions and cognition process of a person [MARC87]; it can deliberately be used to reach specific objectives. The combination of colors must be carefully chosen [JACK94], [MARC87] and [FERR99]. The appropriate use of colors may help to produce a quick and correct assimilation of the information. Its inappropriate use may turn the information incomplete, ambiguous or intelligible for the user. Its impact in the effectiveness of the interface depends on the relevance of its use for the performance on a task and on the situation and environment where the task takes place [SMIT87_A].

The interface designer of the site *sears.com* was not careful choosing the colors. We can see that color was not used with the purpose of improving communication. Basically all pages are white and blue. Different colors could be used to help users identify different items (each page related to the items Auctions on e-bay, Hot Buys, Gift Ideas …could have been designed with different colors). Only the pages opened with the options (*Appliances, Fitness & recreation, BabyMe* and others) of the page *Clearance Center* (these options are also shown on the upper part of some screens, above the blue bar).

People associate colors the diverse situations of its lives. These associations depend on diverse aspects: geographic, cultural, age. Based in this property, colors can be used to help users to navigate among a site. The site sears.com was designed without considering these associations. Only on the page *Lawn & Garden* colors seem to be used with the purpose of helping users to associate the page with the its objective. This page is green. On the other pages color was used in an arbitrary way.

3.1.1.3 Unexpected Behaviors

Another serious problem on the analyzed site is unexpected behaviors caused by bad design. Some pages, like Hot Buys' page and others (Hot Buys' page is showed in figure 1.C), are built using frames, other no (figure 1.A, 1.B and 1.D). The pages with frames allow the users to navigate scroll down its lower part and always keep its upper part visible. On the ones with no frame, this does not happen. When the users scroll the page, all its content disappears. Probably the user is expecting that all pages behave the same way, what may confuse him.

Another not predictable behavior is when the user chooses the option My profile, which icon is located on the right corner of all screens. Depending from which page he clicks this icon, a different page is presented to him. Figure 3.A shows the page opened from the Electronics Page and figure 3.B the page opened from the Fitness & Recreation page. This is really not expected. What should really happen is the display of a whole new page, called My Profile not inside any other page.

Figure 3: Different *My Profile* pages.

3.1.1.4 Uses of different icons for the same action

Another serious problem is the different icons for one same action. Figure 4 and 5 show the use of two different icons for the action. The one with the cart's picture is the best because users can perceive its action quicker.

Figure 4: The use of different icons for one same action

Figure 5: Other use of different icons for one same action

3.1.1.5 Uses of a same icon for different functions

Using one icon for different functions may disturb the user. Figure 6 shows one icon, used to *continue*, *Finish*, *Search*, *Check Inventory* and *Close Window*. Even thought the names of the functions are written inside the icon, this is not a good technique once is desirable that an icon, a pictogram that represents an action, helps users to find out the meaning of functions without being to read its label.

Figure 6: One icon used for different functions

3.1.2 Feedback

In any form of communication, feedback is very important. When two people talk, they are constantly giving each other feedback through gestures, expressions and others. In order to obtain a good interaction of a person with a computer, good feedback must be supplied, however in this in case, they must be planned and be programmed [FOLE90]. The site studied has some good examples of feedback. Figure 7 shows the use of asterisks to indicate to the user which fields he must fill.

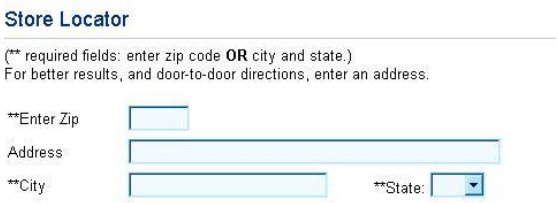


Figure 7: Use of asterisks to inform the users all fields he must fill.

However there are some problems related to the feedback. Sometimes, important messages are not so visible to users. Figure 8.A shows the screen presented to an user when he wants to create an account, through the *My Profile Page*; if he creates a password and makes a mistake when

reconfirming it, the current page is just refresh and is presented to him a message (Figure 8.B), but not so visible. This message should be shown to him in such way that the user would immediately see it (Figure 9).

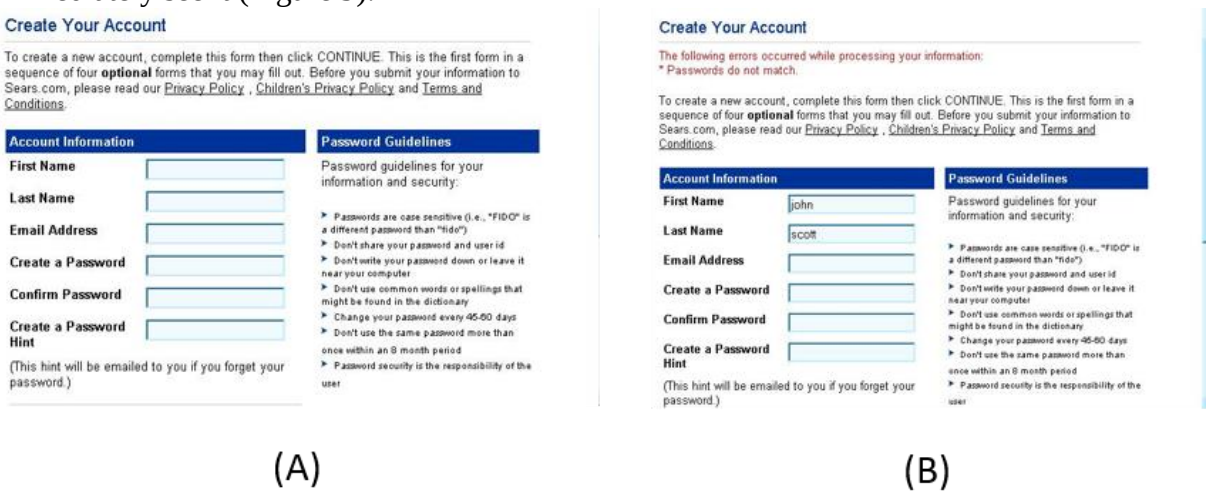


Figure 8: Screens open when the user creates an account.

Figure 9: Message proposed.

3.1.3 Different Ability's Level and Human Behavior

Since an interface must be designed in such a way that it can be used by experienced users and by beginners, it must have some peculiarities.

3.1.3.1 Use of Visual Features

Visual features, such as pictures and icons, are excellent tools for beginners; they help them to visualize its actions better. Sears.com pages do not use visual features in a proper manner. There are many pictures, but most of them are related to banners, with an advertisement function and not an assistant one. The banners are so numerous that they pollute the pages. An example where they are should be used is in the page *Room for kids* (figure 1.F). Instead of using an icon to represent the options *Home*, *Basket* and *help*, words are used. This is a place where the use of icons is essential, once kids sometimes do not know how to read yet.

Another visual feature that should be used is the icon; an icon is a pictorial representation of a function, an object, an action, a property or any other concept. Well designed icons can be recognized faster than words; if well chosen, they become independent of language, making possible the use of the interface in several countries without being necessary any translation. The site dos not use icons in a proper way and many of them are not well designed.

Well-designed icons have the following characteristics:

1. Easy Recognition: how long it takes to a user to find out their meaning. Figure 10 shows easy recognition icons and Figure 11 shows icon not easy to recognize.

Figure10: Easy recognition icons

Figure11: Not easy recognition icons

2. Easy to remember: how long it takes to a user to recall it's meaning once he had already forgotten. Figure 12 shows easy to remember icons and Figure 13 not easy to remember icons.

Figure12: Easy to remember icons

Figure13: Not easy to remember icons

3. Easy to discriminate: how easy is to a user to discriminate the icon among other icons. Figure 14 shows easy discrimination icons and Figure 15 not easy discrimination icons.

Figure14: Easy discrimination icons

Figure15: Not easy discrimination icons

3.1.3.2 Use of Other Facilities

Some Features like menus, forms and prompts are of great aid to the beginners and are present along the entire site. Since many times advanced users consider these facilities slow, well projected interfaces must also allow the use of *accelerators* such as *function keys and textual commands*, in order to make the interaction faster [FOLE90]. Sears.com allow the user to navigate using the keyboard.

3.1.4 Human Perception

The perception of each person depends on hers abilities to perceive and to treat information. Variations of physical abilities, behavior and personality influence the success of a system. Each user possesses a cognitive style that determines how he perceives the information. To create an interface that in fact can be used by different people, it must be possible to display its content in different forms in order to accommodate the different perceptions [PRES92]. Despite the trend if using graphical elements in the web sites design, much information continue to be give in the literal form. Reading constitutes an essential activity in many systems. The text size, the font source, upper/lower case, the location and color are factors that directly affect the easiness with which the information is perceived, that is, its usability.

Sears.com has few customization possibilities. It is not possible to change its text size, not even using the browser. This can prejudice people perception, especially older people that need bigger fonts to read.

3.1.5 Metaphors

The designer must take advantage of people's knowledge of the world around them by using metaphors to convey concepts and features of the site; the use of metaphors that involve familiar turns the interaction less hostile and easier [APPL92].

One of the best example metaphors used in commercial sites is the shopping cart, used in Sears.com. But sometimes, instead of showing a picture, it uses just words to represent the cart (figure 4).

Figure 16 shows some metaphor not properly used.

- To see a picture in a larger view is used the plus signal. The signal plus is a metaphor of the action *add*. To represent the *zoom* action, it should appear together with picture of a magnifying glass
- The *basket* and *cart* metaphors represent the same action. Instead using a *basket* metaphor in the screen *room for kids*, it should be used the *cart* in order to be consistent with the rest of the site and with other commercial sites.
-

Figure16: Wrong use of metaphors.

With the basket example we can conclude that is not a good idea to modify the meaning of items already standardized. It must be used consistent labels, standardized abbreviations and predicable colors. New representations must only be created if they have still not been standardized; in this in case that, arbitrary signs cannot represent them; they must be carefully chosen.

3.1.6 Minimize Memorization

A good interface invokes the user's recognition rather than recall memory whenever possible. Sears.com sometimes forces unnecessary memorization. Few mnemonic names and not well-designed icons are often used. Since the signs (icons, command's names etc.) are the essential elements of a screen, they must be well produced. During development process, the designer must pay attention to the choice and design of the signs so that that they do not induce doubts [PRES92]. Many examples of non-use of icons and use of icons that do not express its objectives had been seen (figures 11, 13 and 15).

3.1.7 Functional Command's Sort

The menu's bars offer may options the user; they consist in a good way to access functions not constantly requested. It reduces the memory load for the users and Its content depends on the site, but generally, the several pages of a site have similar bars, with its items arranged horizontal or vertically.

When a menu's item is chose, it can show a sub-menu below it (pull-down menu or hierarchical menus); in this in case, the names of the items are located one below another. One of the advantages of a pull-down menu is that it is called only when it is necessary, thus saving screen space, without polluting the screen and without offering a series of options that can confuse the

user. Figure 17 shows two horizontal menus used in Sears.com. The items of the menu of figure 1.A are all repeated in the lower part of the page, so this upper menu could have been omitted.

Figure 17: Horizontal Menus

The word *menu* is a metaphor with the restaurants' menu. Normally, in a restaurant's menu, the options are grouped together according to the kind of food (sea fruits, meat, pasta … masses etc.). In the same way, in an interface's menu, the options must be grouped following some functional similarity criteria established by the designer.

When people need to deal with amount of items, it is known that they feel more comfortable if the number of items is not greater than seven more or less two. Thus, a menu must not have more than seven more or less items. Figure 18 shows a menu where there are many more items than what is recommended. Probably the user would feel more comfortable if only the main options *Toys, Gift for Kids, Gift for Grown-Ups, Special Values, Create Wish List, Give Adviser* and *Checkout* were showed. The other items could only be showed as pull-down menus, when the user passes the mouse over the main options.

Figure 18: Vertical menu

3.1.7.1 Direct Manipulation

Direct manipulation makes people believe that they control the objects represented by the computer; an object on the screen must remain visible during while the user is performing any action on the object, in this way, the impact of the operation on the object may be immediately perceived by the user. The same way, when the mouse passes over any object that may be manipulated, this must be highlighted. The analyzed site does not highlight the items. When the mouse passes over them, they remain with the same visual appearance.

3.1.7.2 Exibit only the information that is essential to the context

In order to be better assimilated, only the information relevant to the current context or mode must be shown; the user must not have that to be looking for among many data what he needs to execute its task. To improve the information quality, it must be used, always that possible, distinct windows to show information of different types and, at least one part of each window must be visible [PRES92].

Sears.com's interfaces are poor when dealing with information. As already seen in figure 1, the several site's screens are full of information, pictures, banners … that turns the process of finding something very difficult and boring for the user. Different types of information are showed in the same window. Not even the part called *More from Sears* (*Specialty Shops, Wishbook.com, HomeCenter Catalog, ShowPlace Catlog*…) are showed separately. This part in fact could be considered apart from the rest of the site, and their content could be shown in different windows.

3.1.8 Resolution-Independent Design

Another issue that must be considered when designing usability-oriented sites is the resolution-independent design. In traditional interfaces, the designer knows for which environment he is designing; he has total control on each pixel of the screen that appears for the user, and he can be sure how each element will be seen in the screens, independent of the resolution of its monitor.

In Web, the designer has no control on the layout of the interfaces. Once the user can access the Internet in many ways, design for web must adequately be planned. One of the basic principles of constructing resolution-independent sites is instead of using fixed sizes to design elements of the interface; one must specify layouts as percentages of the available space [NIEL00]. This really must be considered once many people and organizations still have low-resolution's monitors

Figure 19 shows the site in a low-resolution monitor. It can be seen that its design is not resolution-independent. Important elements disappear (the upper icons…) in these monitors the user now has to use the horizontal scroll bars to see the whole pages.

Figure 19: *Sears.com* showed in a low-resolution monitor

3.2 Data Entry

Users spend a lot of time choosing commands, typing data and others inputs. A good interface must minimize the time that the user spends with these tasks. The following guidelines improves the interface's usability when dealing data entry [PRES92]:

3.2.1 Help Facilities

Help must be supplied for every input action. Even thought there exists a Customer service page (Figure 20), where the users can find detailed information about many of the site's features, it does not offer tips when a user passes the mouse over the screen's element (tips are showed only over the upper icons). These facilities should have been implemented; they allow the user to find out the utility of many items without going to the customer service.

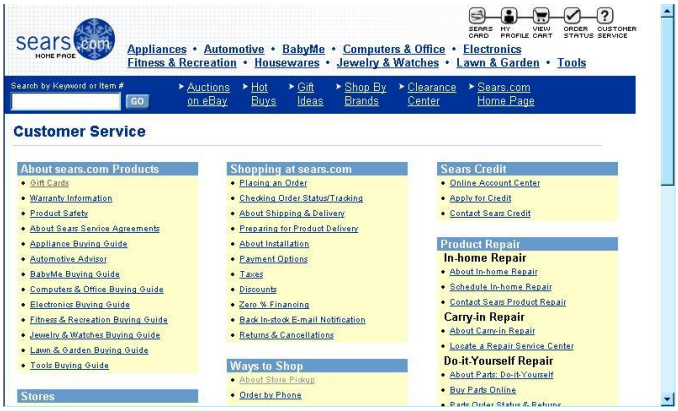


Figure 20: Customer service Page

3.2.2 Minimize Error Possibilities

One of the objectives of a good interface is to prevent that its users commit errors. Well designed interfaces must provide prevention error mechanisms that guide the users to work within any context and make it difficult for the user to do things that are not permissible in that context. Therefore, the user will not choose an invalid option and afterwards receive an error message [FOLE90]. The site presents some of these mechanisms:

3.2.3 Provide Error Recovery

Experimental evidences show that people are more productive if their mistakes can be readily corrected [FOLE90]. So a well-designed site must provide a good error recovery (*undo, cancel, correct* …). By providing this error recovery, the user feels more comfortable to explore unlearned facilities without fear of failure. This encourages exploratory learning. Basically there are two types of errors: functional and syntactic.

1. Syntactic errors: occur when commands are typed with wrong parameters or names; in this case, the site must provide a clear message (Figure 8.B).

2. Functional errors: are the most serious; it occurs the user does a command he didn't mean and unexpected results occur. The studied site presents some error recovery features. An example is the *cancel option*, present among all the screens the user visit when opening an account (Figure 21), or the remove option that appears to allow the user to remove an item he added to the cart.

Figure 21: Error recovery

Figure 22: Remove option

3.2.3.1 Inhibition of Items not Valid

Items not valid in the current context should be inhibited or disabled. When the shopping cart of a user is empty, the site does not disable this invalid item and does not alert the user by changing the icon's appearance (for instance, changing its color). Instead, the site allows the user to choose the cart icon and only then it alerts the user through a message in a new window (Figure 23).

Figure 23: Empty cart message

3.2.3.2 Inform How the User Must Input Data Correctly

The user must be informed of how he must fill any field. Sears.com guides the user in this task: whenever the minimum or maximum length of characters is limited, at least one number is required, these information is given to the user before he fills the field. An example can be seen in the message showed to the user when he uses the credit account center (Figure 24)

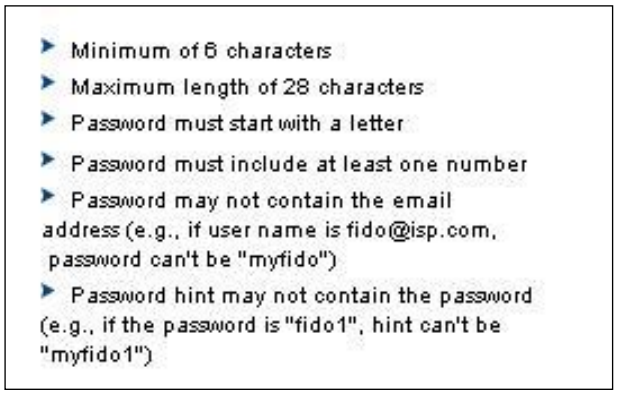


Figure 24 Credit account center Message

3.2.3.3 Minimize the amount of input

A good interface minimizes the number of actions necessary for any input, reducing the task of typing. Sears.com provide such facility, for instance, when the user is becoming a registered

customer, he needs to fill his address. Since only USA residents can become registered, the site shows a list of possible USA states and the user does not need to type (Figure 25)

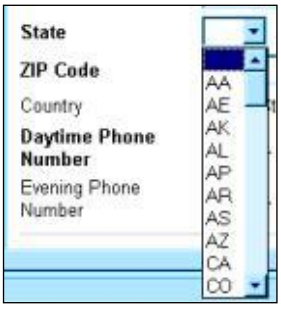


Figure 25 List of USA states

3.2.3.4 Flexible Interaction

A well designed interface must allow the users to control the interactions; he must be ample to skip unnecessary actions, to modify the order of the actions and recover errors without leaving the site. Sears.com has a problem. When the user tries to become a registered customer, if he makes a mistake, he will cancel the action or he will go back using the browser. Even thought there is a error recover facility (cancel option), what really happens is that when re tries to register again, the site informs that he is already registered customer, even if did not finish his registration (Figure 26). To cancel his registration, the user must close and reopen the browser.

Figure 26 Interaction not flexible

3.2.3.5 Customization

A good interface must allow that to the user customize its commands and messages. Sears.com does not allow customizations, not even in the text size.

4. Conclusion

We have argued about the importance of the NFR usability, presented a taxonomy and showed by a detailed analysis of an IS interface the impacts of not considering these aspects from the definition stage of an IS. Our contribution is on the line of stressing the importance of NFRs. We also present some established heuristics from the HCI literature, but with a different point of view.

We see our work on the direction of building a corpus of knowledge about NFR and to represent that knowledge using the NFR framework [CHUN00]. Once this knowledge is represented as NFR graphs we plan to pursue a conflict analysis of on the usability NFR graph.

References

[APPL92]- Apple Computer,Inc: *Macintosh Human Interface Guidelines* - Addison-Weslwy Company - 1992.

[BREI99] Breitman,Karin Koogan, Leite J.C.S.P. e Finkelstein Anthony. *The World's Stage: A Survey on Requirements Engineering Using a Real-Life Case Study*. Journal of the Brazilian Computer Society No 1 Vol. 6 Jul. 1999 pp:13:37.

[BIAS94] - Bias, R.G. and Mayhew, D.G.: "*Cost-justifying usability".*- Academic Press - 994.

[CHUN00] Chung, L., Nixon, B., Yu, E. and Mylopoulos,J. "*Non-Functional Requirements in Software Engineering"* Kluwer Academic Publishers 2000.

[CYSN99] Cysneiros, L.M. and Leite, J.C.S.P. *"Integrating Non-Functional Requirements into data model"* 4th International Symposium on Requirements Engineering – Ireland June 1999.

[CHUN95] - Chung, L., Nixon, B. A. & Yu, E.: *Using Non-Functional Requirements to Systematically Support Change* - Proceedings of the Second IEEE International Simposium on Requirements Engineering, IEEE Computer Society Press – 1995

[DAVI93] Davis, A. *"Software Requirements: Objects Functions and States"* Prentice Hall, 1993.

[FERR99] - Ferreira, S.B.L.; Carvalho, S.E.R.; Leite, J.C.S.P.; Melo, R.N.: "*Requisitos Não Funcionais para Interfaces com o Usuário - O Uso de Cores*" Anais do 2º Workshop Iberoamericano de Ingeniería de Requisitos y Ambientes Software IDEAS'99 - 1999

[FOLE90] - Foley, J. D., Dam, A. V., Feiner, S. K. & Hughes, J. F. *: Computer Graphics - Principles and Practice* - Addison - Wesley Publishing Company - 1990.

[JACK94] - Jackson, R., MacDonald L. e Freeman K.: "*Computer Generated Color: A Practical Guide to Presentation and Display"* - John Wiley & Sons. - 1994

[KLAT80] - Klatzky, R. L.: *Human Memory* - 2nd ed., W. H. Freeman & Co. - 1980.

[LEIT95] - Leite, J. C. S. P.: *Engenharia de Requisitos* - Notas de Aula da Disciplina "Engenharia de Requisitos" - Deptº. de Informática da Pontifícia Universidade Católica do Rio de Janeiro - 1995

[MARC87] - Marcus, A.: "*Color: A Tool for Computer graphics Communication"* - Color in Computer Graphics nº. 24- SIGGRAPH - 1987

[NIEL00] Nielsen, J.: "Designing Web Usability" – News Riders Publishing – 2000.

[NORM86] - Norman, D.A.: "User Centered Systems Design" - Lawrance Earlbaum Associates - 1986.

[PRES92] - Pressman, R. S.: *Software Engineering - A Practioner's Approach* - 3rd ed., McGraw-Hill, Inc. - 1992.

[ROBE98] - Roberts, D., Berry, D., Isensee, S. & Mullaly J.: "*Designing for the user with OVID: Bridging User Interface Design and Software Engineering"* – MacMillan Technical Publising - Software Engineering Series – 1998.
[SMIT87_A] - Smith, W.: "Computer Color: Psychophysics, Task Application and Asthetics" - Color in Computer Graphics no. 24- SIGGRAPH - 1987.
[SOUZ95_C] - de Souza, C. S. & Leite, J.C. : "*Apostila: Projeto de Interfaces de Usuário*" -" - Departamento de Informática - PUC-RIO - 1995.
[YEH84] - Yeh, R.T., Zave, P., Conn, A.P., Cole Jr., G.E.*: "Software Requirements: New Directions and Perspective"s* - Handbook of Software Engineering, Vick and Ramamoorthy, Van Nostrand Reinhold Co. - 1984.
[http_1] - Usability Laboratory -10/06/2001
http://www.oslo.sintef.no/avd/32/3270/brosjyrer/engelsk/index.html