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Usability Oriented Information Systems

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Abstract

Information systems are often implemented without paying attention to usability aspects, what leads to considerable collateral effects in final implemented systems. These effects not only increase the operation cost of those systems, but also, sometimes, is a barrier to systems effectiveness.

Our work proposes a framework that will help the information system's professional in identifying possible problems in development of usability oriented information systems and dealing with them. We believe that our proposal is a step forward in addressing the collateral effects of not considering usability. Since usability has not been a key factor in developing information systems in Brazil, we are planning to disseminate our framework in order to educate the professional, as well as to provide a basis for implementing an information systems usability laboratory to explore and test different design alternatives.

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.

The Information and Technology market in Brazil is around 15 billion US dollars per year, and this market is considered to be one to the top 10 markets in global terms. It is also a fact that the Internet has been growing at very fast pace, being Brasil today one of the countries with the fastest growth rate in Internet usage [http_3].

Given this context, it is extremely important that information systems dealing with day-to-day information be as useable as the ones geared towards wider audiences, such as the organization web sites. Only recently the matter of usability has been perceived as important to information systems professionals. Driven by the market, organizations are putting forward their web pages in order to position their selves on a new way of performing business. Since the technology infrastructure used to construct web sites has the possibilities of dealing with images, sounds and nice text composition, it became more evident that the output of information should be treated with care.

Notwithstanding the progress on interfaces and the effort to provide them with great usability, it is common to find in the internal information systems of an organization very few traces of usability-oriented interfaces. This is true for many reasons, but mainly due to the fact that older

technology infrastructure had problems in dealing with graphical user interfaces. You can still look at your favorite airline reservation system and notice that most of their software has yet a line driven interface. However, progress made on client oriented languages environments such as Visual Basic, has made possible the construction of better interfaces. In terms of information systems, Lightship (now called Pilot Decision Support Suite) was one of the first products available to support better interfaces for organization information. These types of systems are mainly oriented towards the usage of information by managers, and as such the interface has had more stringent requirements than the type of information available for operational users.

Our main point is that usability should be taken in consideration in all interactions of the systems dealing with information. An interface not well designed can cause serious damages to the organization, but even so, very few organizations take this is consideration when planning their applications. Unfortunately, and more so in organizations that do not have well educated personnel in the area of usability, the lack of well designed systems, from the point of view of their interface with users, has been responsible for losses of different types. In particular, not well designed interfaces can lead to: more time to perform the task, difficulty in seeing the importance of the displayed information, error in providing input information, difficulty in understanding the displayed information, error in interpreting the displayed data and lack of user involvement in the process.

Using the literature and our own experience in consulting, we propose a general framework that will help the information system's professional to identify possible problems in development of usability oriented information systems and deal with them. We are studying ways of disseminate and implement the usability idea in terms of Brazilian information systems

2. Information Systems

There are different types of information systems and different authors have proposed different taxonomies. We understand that it is possible to classify information systems from several viewpoints. One of these viewpoints is the consumer viewpoint, that is, the people who will be using the information. From this viewpoint we understand that there are three types of information systems:

- Decision systems
- Operational systems
- Reference systems

Our taxonomy is not intended to be a final one, by no means. However, we strong believe that this classification will facilitate our approach towards the design of information systems that do consider usability as a mandatory non-functional requirement.
Before detailing each class, we must, however, make a distinction between *users* and *clients*. Both are individuals that will interact with the information system, but in general their roles are very distinct. *Users* are individual that interacts directly with the information system, either by providing or receiving information. *Clients* are individuals that have needs that will be fulfilled by an information system or by parts of it. Clients sometimes do also interact with these systems, and at this stand, they are users. Clients and users are also known as *stakeholders* in the process of definition or evolution of an information system.
Let's now examine each of the classes listed above and point to different usability characteristics that they must embrace.
Decision systems

In this class we will find the decision support systems, or the information systems that are being directly used by managers, independent of their decision level in the organization. Of course that these systems are usually based on the several databases of the organization that will reflect the day to day/ minute to minute flow of information. The point here, is that this type of systems

usually have users who need fresh, fast and solid information in such a way that he/she can take the best possible decision. Of course that these type of information is the one that is usually the most valued one in an organization. Managers need information to base their decisions. Their careers will be based on the decisions that better help the organization. Not surprisingly, organizations are more than willing to invest large sums of money if they can have quality information to base their decision process.

Operational systems

Also called transaction systems, this class mainly deals with the automation part of a multitude of information that is necessary to the day-to-day operations of an organization. These systems do exist mainly because it is impossible to deal with the volume of information without automation.

They range from supporting the processing of payroll information to the controlling of inventories or the processing of information about production lines. Their main objective is to gather data, or to produce documents that support the ends of an organization or to control special devices. Not surprisingly these systems are the ones that populate databases (generate data for the databases), from which most of the other types of systems will derive their data.

Reference systems

These systems are systems that provide information to a large number of users, who needs the information to gain access to other information or processes of a given organization. This type of system is a kind of metaphor of the reference counter on libraries. Here, users can be either

people who works for the organization or people foreign to the organization but who wish to deal with the organization. For instance, electronic manual, rules, general information and others are types of information that are dealt with by these systems. With the support of recent web technology this type of system became of great importance to organizations, not only by providing means to make the organization less dependent on paper information (for inside consumption), but also because it became an important marketing channel once an organization has a site on the internet.

3. Usability Oriented Information Systems - UOIS

Information is essential to any organization success and efficacy. All organizations involve people working and cooperating together. As such, it is important that the information flows, properly, through all parts of the organization. Because of this crucial role of information, organizations spend part of their budget with information systems, and they need quality information.

Due to the great value of information, the user interface becomes an important part of the information systems'. It is the visible part of a system, being the way in which users interact with software to perform their tasks. Since the dialogue between man and machine is established by means of the interface, it has an important role on the information flow of any organization.

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.

The same principle applies to any information system. These systems are projected to bring information and technology to an organization. Their users are faced with growing possibilities but with an enormous level of complexity, but they must be able to use them effectively [http_1]. Even the simplest system can lead to troubles for the people using it if not designed with usability in mind [http_2].

Usability refers to the relationship between users and the systems. It is not a component of the software that can just be included in the product at any phase of the lifecycle, so designers must be concerned with all aspects of usability in the early phases [CATA00].

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 in efficiency of people performing their duties, that is, to increase people's productivity and effectiveness while doing their tasks. Since they must satisfy the expectations and needs of users, usability must guide any information system development and this process must involve characteristics that assure that systems are effective.

It is essential that all users feel comfortable and encouraged to use applications; communication between them must be friendly. Therefore, to be easily and effectively used, their user's interface must be well designed, suit each user's need and satisfy his/her expectations and must allow the final users to communicate with the machine in the most natural way to accomplish their tasks. To achieve this end the designer must to know the potential users of the system [APPL92], [FOLE90] and [PRES92].

To suit each user's need and expectations in any organization, the information systems must be in harmony with the attitudes, motivations and competences of those working in the organizations, and also with the social end environmental characteristics of their work context [http_2].

System development is a process that depends on social factors. Software is developed based on a social context and on the client's and the development team's context. Since human and

organizational factors influence the success of systems, several of these factors must be considered, such as background, social level, personality and behavior among others [LEIT95].

Since all successful organizations spend a great of their budget with information systems, it is essential and convenient for suppliers and clients to invest in usability [BIAS94]. Therefore, efforts have been done to establish ways to increase the information systems' usability. Almost all these efforts are intended to identify techniques, methods and competencies meant to involve users in the design and validation of solutions from the very beginning of the development lifecycle and to anticipate/assess the impact of these solutions in the context of use [http_2].

Usability requirements determine that the variety of users, in any organization, need to be better specified [http_2]. Human beings differ greatly and what we see is they can be sorted into different groups according to their behavioral similarities and conceptual model of the system [COLL95], [HIX93], [PRES92], what makes us conclude that the user analysis must then also include several users' models (users' profiles).

The multiplicity and variability of user needs and expectations, based on the different classes they belong to, represent one of the key factors to be considered when dealing with the usability of a product.

4. A Framework for identifying problems in interface design that contributes to the lack of usability in information systems

Using the literature and our own experience in consulting, we propose a framework that will help the information system's professional in identifying possible problems in the development of usability oriented information systems and dealing with them. Since usability has not been a key factor in developing information systems in Brasil, and since there is few Portuguese literature about this subject available, we are planning to transfer our technology, disseminating our framework in order to educate the professional, as well as to provide a basis for implementing a information systems usability laboratory to explore and test different design alternatives. It is important to stress that since several of these alternatives are cultural dependent, we need to gather data in order to identify and propose better alternatives for aspects that may be to peculiar to local culture.

We also plane to create a site, with our suggestions based on our experiences, to help professionals to implement oriented information systems; designers will be able to use it in order to explore and test different design alternatives that will naturally appear. Since many of these alternatives are cultural dependent, our idea is to make this site a kind of "*open source*" site, where designers will be able to contribute with their own experiences, allowing us to gather data in order to identify and propose better alternatives for aspects that may be to peculiar to local culture.

Even though the advantages of usability are well know, there are still many reasons for the lack of usability requirements in information systems. Below we list the most important problems, in our view, related to the IS usability:

Not considering different group of users with different needs and expectations

This work considers that information systems can be classified in three types (decision, operational and reference) according the consumer viewpoint, that is, from the people who will be using the information.

Using this classification, the types of systems must have different usability characteristics, determined by the users` needs and expectations. We consider that one of the key factors to be considered when dealing with the usability is the fact that users do not think of systems in the same way. Furthermore, as users interact with various applications, their perception about the system changes over time.

The backbone of our framework is that we believe that all three types of information systems must be constructed in a way that they can satisfy different groups of users. So, in order to design a friendly and effective interface, focusing on usability, the process of software development must be "*user centered*"; the interface must be designed bearing in mind the need to attend to the user's necessities [NORM86], that is, the designer must analyze and know different users very well, carrying out a user analysis in order to understand what kind of expectations users have. In this process, activities during the analysis must lead to information about the users, their tasks and about the application domain.

If system development is user centered, usability probably will be obtained, productivity can be improved, better designs can be made, risk of costly design errors can be reduced, effort and development time can be shorten, and as result, the system developed will be more competitiveness and satisfy better the customer needs and expectation.

Designing user-centered systems is essential to assure the usability of a system, that is, to design an application that can really be used by different groups of people, it is necessary to describe how people perform their tasks, what they think about their work environment and their limitations [APPL92].

Independent of which type of system we are building, it is mandatory to identify and understand the several groups of potential users, in order to discover what conceptual models (perceptions) they have of the systems, that is, what they expect from the system. These models are based on the users´ expectations, objectives and understanding of the system and depend on the knowledge and previous experience of each person, so each user has his/hers own conceptual user model. [ROBE98].

Based on this, we conclude that an application's interface may be friendly to a particular group but not so to another; so to friendly, it must matches the conceptual model of each user. So the designer must know the potential users well and find ways to represent this knowledge.

One way of representing this knowledge is by elaborating a "user model" (or "user profile") that describes the user's characteristics. To build a user model, it is necessary to analyze people; one must observe their behavior, their thoughts, feelings and actions; in fact, it is necessary to

understand the user's culture once that culture is the behavior that is learned and that is formed by thoughts, feeling and actions [KROE54]. Culture is learned and not inherited [HOFT96].

Inappropriate providers of information

Usually people responsible for giving the information that will determine the characteristics and functions of the systems are not in fact those who will be the final users of the system. These people many times do not know how the final users will perceive the system interactions.

Often, this information is given by executives or officers (*clients*) who act on behalf of all users of the organization [http_2], and their conceptual model of a system is obviously very different from the conceptual model of the end users.

When developing information systems, we must considerer that there are different users' models, and a number of users from each model should be listened in order to express what they want. Based on our three types of systems, we can identify at least three users' model for information systems:

- Models formed by users that are will have *managing functions,* and therefore they expect that the information to be presented in a way that best support their decisions. As such, the presentation of information for this type of consumers should be mainly concerned with the aspect of decisions making. So, it must stress differences between options, must state clear its confidence level, and should be presented in languages that are familiar to the type of decision to be taken. For instance: pie charts, associating percent based

information with actual values, are usually very valuable for decisions regarding distribution of resources.

- Models formed by users that are will have *operational functions*, these users normally interact with operational systems to do the day to day tasks in an organization and many times they are responsible to provide data to the other types of systems. Special attention with respect to usability should be directed towards interfaces that are special designed to appeal to the information provider and to make his/her task the easiest one. Here, of course, there is a special concern with information filtering, that is, a way of guaranteeing that the information provided is solid. Special consideration is necessary when designing this type of interface. With regard to information to be displayed or to be printed in documents people who design this class of systems should take in consideration that they will be supporting day to day tasks in an organization, so that should be simple, clear and to the point. Regarding information for controlling/operating devices, we consider it to be a separate topic not in the realm of this paper.

- Models of users that use the *reference systems*, formed by a large number of people, who uses these systems with the purpose of access information that might help them in their tasks. Users of this group of system have special needs: they wish that the information be "nice" to look at, they need navigation structures (links) that are easy to follow, and they need to be sure that the information is kept to date. A crucial point here is to remember that many times the clients of these systems, specially web systems, want to develop the system to be as better "designed" (visually speaking) as possible to attract customers and to provide the message that the organization is a "modern" (using up-to-date technology)

one. An aesthetically pleasing system not necessary means it is usability oriented, and aesthetics may not be the main objective of a reference system. The system designer must be aware of all the requirements of an usability oriented system so he can best assist the client in order to develop a product that is aesthetically pleasing system but mainly guided by usability.

Insufficient number of representative users of each user model

As we've seen, the users of each type of information system have different conceptual models and therefore, different needs and expectations. Of course, even considering the users belonging to one single group, they may have little differences that also be analyzed. A significant number of each different group of users should provide the system development team, in order to make clear what they really expect from the system.

But what is seen is that usually, the characteristics and functions of the systems are tailored on the information provided by the clients or by a few users, instead of by a significant number that can really represent the potential group of final users, what leads to a misunderstanding of the final users´ expectations, objectives and understanding of the system.

Lack of involvement of the users during all the phases of the development lifecycle

Seldom are the final users involved with the development team. And, when this occurs, hardly starts in the early phases of the project. What is seen is that users only get involved when the product is about to be released or is on the phase of prototype validation only.

In the same way, tests and evaluations made throughout the semi finished products in the development lifecycle phases must also be carried out by all the potential end users.

Unawareness of user's analysis techniques and usability principles

The process of collecting information from the users is not subject to procedures and it is generally implemented according to the personal receptivity of the designers. The designers, many times, do not possess skills to properly understand the users and collect information from them.

Seldom the designers are aware of user involvement techniques, that is, the methods through which the user's involvement should be organized in a systematic way. Although users express the desire to participate in the definition of the requirements and the validation of the solution, they do not possess procedures or guidelines that guarantee an adequate their involvement in the design process.

Users in general do not have experiences in the development of systems. Designers, on the other hand, have little knowledge about human-centered development methods and, they give very little attention to the contexts of use of the products they develop.

Few usability laboratories

Many times, the designers are not well informed about usability principles, that is, the techniques to assess the usability of applications that are unknown by most designers and by the users who should test the products. This most times happens due to the lack of usability laboratories.

Need of multidisciplinary skill among the design teams

Often the information systems are developed by professionals formed with the objectives to satisfy only the functional aspects, but the user centered design procedures require that the design teams should be multidisciplinary, which they seldom are.

5. Dealing with the Problem

The analysis of the non-functional requirements for usability should be carried out in a more detailed and systematic way, and more attention must be given to the effects of the users' involvement in the analysis and validation of the information systems. Users should become co-responsible for the application.

User-centered methods must be adopted, with more users and group of users considered, long before the release of prototypes and systems and considering more use cases.

The division of the users in various groups, which differ with respect to the users characteristics, gives rise to another issue: the usability of a product is its adaptability to the exigencies of the user and context of use and it should be developed with participation of the user from the early phases of the lifecycle.

Considering the variety of a users' profile, which group of users should be the model one? Certainly, satisfying as many users as possible could be an objective. However, in view of the various profiles of users, what is the right relation in consumer systems between the number of functionalities with their richness and the ease of use for as many profiles of users as possible?

To truly satisfy users' needs, the application must be capable of adapting to different users, offering different levels of interaction according to their expectations. But in fact there are many users' profiles, so one system alone can hardly be expected to suit all the characteristics of different types of users. What is often seen is that either the application presents an excess of functions for determined people or that it lacks features for others. In practice, it has been verified that a great number of users feel frustrated when using a system.

To be accepted, an IS must be able to allow users to use all or part of its features in different ways, offering users different interface visions. Customization facilities can be included in order to allow the user to define different sets of specific commands, modify the default that it is being offered to him and customize tool bars among other activities.

The designer must also remember that people are continually undergoing change. With continual use of the application, the user's perception of the system changes and as he or she creates a new conceptual model of the system, his/her expectations, understanding and objectives also change. This gives a peculiar characteristic to the users' model: since it is based on the features, expectations, understanding and objectives of the user, it must also be able to be modified. The users´ analysis must then include several users´ profiles [HIX93], [COLL95] and [SHNE98] that allow users to change over to different profiles.

To use the customization facilities, the user must first of all learn other tasks related to the customization, which is a difficult procedure for beginners [MURR91], and may affect the usability of any system. What is desirable then is the construction of systems that can be

instantiated, that is, designed with distinct aspects for each user, with different functionalities, so that it can be used by diverse groups of people [APPL92] in different ways.

6. Conclusion

Since information is important to any organization's efficacy, the organizations spend part of their budget with information systems. Due to the great value of information, the user interface, the visible part of a system, by which users interact, becomes an important part of these systems.

Information systems must satisfy the expectations and needs of *many different user and clients*, they must be easy and fast to learn, efficient to use, easy to remember, cause no operating errors and offer a high degree of satisfaction for the user, that is, information systems must be oriented to usability, and is mandatory to design the user interface according to usability's requirements.

To assure the usability of a system, that is, to design an application that can really be used by a group of people, the process of system's development must be "*user centered*"; to achieve this end, users must have an active role in the development process.

Even though the advantages of usability are well known, what is seen is that most systems do not posses or have insufficient usability requirements and there is no involvement of the user. With this issue in mind, we developed a framework in the current work that may help the information system's professional to identify possible problems in the development of usability oriented information systems. We will disseminate our framework in order to educate the professional, as

well as to provide a basis for implementing an information systems usability laboratory to explore and test different design alternatives.

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