Available online at www.sciencedirect.com

ScienceDirect

Procedia Manufacturing 3 (2015) 5397 – 5404

Procedia MANUFACTURING

6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015

A Closer Look On The User Centred Design

Adriana Chammas*, Manuela Quaresma, Cláudia Mont'Alvão

Laboratory of Ergodesign and Usability Interfaces - LEUI - PUC-Rio University
Rua Marquês de São Vicente, 225 – Gávea Rio de Janeiro – RJ – Brazil - 22451-900

Abstract

This paper discusses the User-Centred Design approach. It presents UCD assumptions and concepts, the benefits for users of the products developed under it, and the complications that this practice can bring, since implies in constant iterations and user omnipresence. As a result, we discuss a possible increment of time and budget as well as reviews on this approach front to the market urgency of technology and innovation. It can be seen that although each situation deserves appropriate adjustments for the profile, the best design is still the user-centred. Examples of this approach application with children enhance the discussion over its flexibility and the gains of design projects oriented by user needs and desires.

Peer-review under responsibility of AHFE Conference

Keywords: User-Centred Design, Methodology, Children

1. Introduction

This paper explores the criticism and challenges involving the User-Centred Design approach and the events that this practice can bring. Factors that may become obstacles facing the urgency of technology and innovation market are cited and discussed the technical standardization criticized by Flusser [3] and Norman [9]. Designers must have deep understanding of people for whom design and people should understand the design process [10];[11]. Technical standards governing the User-Centred Design approach will be determined by ISO *(International Organization of Standardization* - ISO 9241-210 [4], and aims to provide the best user experience possible. Before

* Corresponding author. Tel.: +0-000-000-0000 ; fax: +0-000-000-0000 .
E-mail address: ttdri@yahoo.com.br

Peer-review under responsibility of AHFE Conference
doi:10.1016/j.promfg.2015.07.656

the ISO, Usability methods were tested and established by developers, but applied in isolation. The standardization of these techniques changed the practice of systems development processes and became guiding tool. Maguire [6] documents that the regulatory standards predecessors are the practical translation of user-centred approach, reviewed through the years by escalation of technology, processes and people. Bevan [1] promotes the ISO 9241 as the best and most concise management guide currently available for Usability. Ergonomics and Usability must be premise for professionals involved in User-Centred Design. For Flusser [3], an authoritarian universal standard more inhibits and disrupts the industrial process that gives you a guideline. Norman [9] also questions the ISO technical standards, to reveal the political and economic issues involved in the midst of standardized procedures for establishing national and international standards. Frohlic & Sarvas [5] recognize that the speed with which the technology market requires the implementation and the consequent maintenance practices approach can encourage different views on it and seem costly and time consuming for developers, in immediate vision. The management of a project depends on the balance between three criteria: time, cost and quality. Frohlic & Sarvas [5] believe that the UCD problem is not delve into the market limitations. This approach is so important that inspires many others. Placed here some examples, is easy to see that there are critical, but also many DCU successful examples of its application. ISO 9241-210 [4] is complementary to the existing design process, so that its parameters can benefit all parties involved seeking the best interface design, user-centred.

2. User-Centred Design Approach

Electronic interfaces and all optimization possibilities of human everyday they bring, are possible because of software engineering. What makes the interfaces useful, easy to use and fun is the interaction design. Interaction Design trigger the user to incorporate the product (app, system) to your routine or use it just when necessary, to complete their tasks or achieve their goals. Saffer [11] classifies the Interaction Design as contextual by nature and assumes that it must solve specific problems under particular circumstances, using the available material. The author categorizes four main approaches that have been used in the design process of successful interactive products development. The approaches are: Activity Centred Design, System Design, Genius Design and User-Centred Design (table 1). Developers select which one to use according to the project. The best designers are the ones who apply more than one approach in the same project, but points out that of all, the User-Centred Design approach is the most popular and explains that user participation in all stages the process is critical [11]. Below you can check the four approaches:

Table 1. Comparison of four approaches suggested by Saffer [11].

Approach	Overview	User	Designer
Activity Centred Design	Focus on tasks and activities that need to be fulfilled	Activities Practitioners	Tools creator for the actions
System Design	Focus on system components	Set of system goals	Ensure that all parts of the system are in place
Genius Design	Ability and gift of the designer used to make products	Validation Source	Inspiration Source
User-Centred Design	Focus on the needs and user goals	Lead interface design	Reflects the needs and user goals

In the 80s, designers and computer scientists who braved the new field of Human-Computer Interaction began to question the practice of design of the systems be left to the engineers, since issues such as memory, processing speed, number of colors displayed by monitors among others, have been optimized to the extent of enabling new

types of interfaces. The software design movement began to be focused on users and not on computers. This movement became known as User-Centred Design – UCD [11].

The User-Centred Design approach is based on Ergonomics and Usability knowledge to find the user's needs. It is a project-oriented approach to interactive systems development. The technical standards of User-Centred Design approach are determined by ANSI-ISO stands for American National Standards Institute, but properly by ISO (International Organization of Standardization. The ISO 9241-210 [4] is intended to increase the acceptance and productivity of interactive systems, reduce errors and hours of support and training, as well as provide the best user experience possible. It addresses the development of interactive systems focused on users needs and interests, with the application of ergonomic criteria and usability techniques knowledge. This approach increases the effectiveness, improve human well-being, accessibility and sustainability and takes into account of the different effects that these interactive systems can reflect on health, safety and user performance. The user experience is defined by ISO as "perceptions and responses resulting from the use or anticipated use of a product, system or service". Among other feelings, User experience includes affections, emotions, beliefs, and expectations that occur before, during and after use of the product - and is directly and closely related to the user experience, when interpreted from the perspective of the range of user goals. From the foregoing, every effort applied to the account requirements and technical features should have the same importance of applied in search of better user experience.

Maguire [6] states that before the ISO, usability methods have been tested and established by developers, but were applied in isolation and without a guiding concept that orient the integration of these methods and align it to a single process. The standardization of these techniques changed the practice of hardware and software development processes to illustrate how different methods and techniques can be used together and became guiding tool for those responsible for the design of processes and redesign of hardware and software. Technical standards established by the ISO comprehend the User-Centred Design approach and the Human-System Interaction under ergonomics light. The User-Centred Design approach enables the similar procedures use, standard design guides and prepares documentation for future projects. Maguire [6] documents that the ISO 14598 predecessors are the practical translation of user-centred approach and complementary to software development methods, magazines through the ages with the escalation of technology, processes and people. Bevan [1] summarizes the ISO standards as the best references for good practice in interface design, while putting the best definition of usability is the one dictated by the ISO 9241, which reveals that the project should be designed for a specific user reach specific goals with effectiveness, efficiency and satisfaction in a specified context of use. Under the general heading "Ergonomic requirements for Video Terminals (visual display terminals - VDTs)", ISO 9241 was prepared by ISO technical committee of the Technical Committee ISO / TC 159 - Ergonomics, subcommittee SC 4, Ergonomics of human-system Interaction, as a technical review which cancels and replaces ISO 13407: 1999 [4]. The User-Centred Design principles and activities related to it showed no significant change from the ISO 13407: 1999 and have been validated in practice for more than ten years of implementation. In order to organize and conduct the practical application of knowledge in Ergonomics and Usability, ISO 9241 incorporates requirements and recommendations to the original ISO 13407: 1999 [4] witch also includes the following changes [4]: it clarifies the whole iterative process, not just the evaluation; emphasizes that the methods of User-Centred Design can be used throughout the system life cycle; explain the activities of Design; and also clarifies User-Centred Design principles. ISO 9241-210 [4] lists a number of principles that should be considered in the development of the interactive system, when the goal is design an interactive system centred on user and their needs, also useful and easy to use.

- The project should be based on the explicit understanding of users, his tasks and environments. The design should take into account aspects involved in the project, directly or indirectly. The context of is use crucial for the establishment of system requirements. An interface to be used in traffic, for example, must be very different from one to be used to schedule a social activity, even if the user is the same person;
- Users should be involved throughout the development process project; user engagement is a valuable source of knowledge about the context of use and should be used to explore solutions. The nature and frequency of engagement will depend on the type of project in question.
- The project should be conducted and refined through assessments focusing on the user, which minimizes the risk of the system do not reach requirements that meet the users needs and desires - or of the others involved in the

project. This progressive assessment identifies important points for effective product acceptance;

- The design process should be iterative. For ISO 9241-210 [4], the iteration is the review and refinement of design specifications, from the acquisition of new information, seeking to minimize the risks of developing a system that does not reach the requirements and user expectations.
- The design should address the entire user experience; "*The user experience is a result of the presentation, functionality, system performance, the interaction behavior and assistive capabilities of an interactive system, both in terms of hardware and software. The user experience is also consequent of previous user experience as well as their attitudes, skills, habits and personality (...) the capabilities, limitations, preferences and expectations must be taken into account in the specification that features are the user's competence and what system of competence*" [4].
- The project team should include multidisciplinary skills and perspectives. Team members should come from different areas enough that the skills, experiences and views can be shared and benefit projects with this diversity.

According to the ISO technical committee, the approach described in ISO 9241-210 [4] complements existing system approaches and can be incorporated into various methodologies and appropriate to particular contexts. While not taking any particular design process or describe all the activities necessary to ensure the effectiveness of the system design, ISO 9241-210 [4] is complementary to them, so their parameters can benefit all parties involved in the project with the best interface design, the user-centred†. Technology should be used to reduce the user's mental load, so their skills will not be wasted in mechanical actions [9]. The user should be able to find out which actions are possible, and be able to represent both the result of his actions as the system state. The design should take ownership of the user's relations with their peers and with their surrounding and result in the most natural interaction. The interface should become imperceptible, but the system visibility must be readable and clear. The main benefits of the adoption of the User Centred Design approach in accordance with ISO 9241-210 [4] are: 1) Increased user productivity and operational efficiency of companies; 2) Support costs reduction and resulting training easier and understandable products; 3) Increased range of users benefit from the products, including in terms of accessibility, resulting in better usability and best user experience; 4) Reduction of discomfort and stress; 5) Competitive advantage and better image of the brand; 6) Contribution to sustainable goals.

3. Discussion

The User-Centred Design approach explains, "users should be involved throughout the project development process (ISO, 2010)." However, Marti & Bannon [7] disagree with this perspective by arguing that the participation of users in the systems development process must fit the context and may vary significantly from the proposal by the User Centred Design approach. Particular alert to user input stage in the process, Marti & Bannon [7] cite a case study of a specific and special profile as areas such health and rehabilitation. The case study involves requirements and characteristics are also specific and special: people with different levels of mental ability. The conclusions are: There are situations in which user involvement may be difficult or even undesirable. A good example are the profile in question - users with different levels of mental ability.

Activities involving users with different abilities can trigger potentially incorrect interpretations of the real needs of users. It may be difficult or even inappropriate in some cases. To circumvent the limited expressiveness of this profile, Marti & Bannon [7] advise that therapists and caregivers have a voice in the process and take the place of stakeholders mentioned by ISO 9241-210 [4]. Recalling another example on this particular recommendation of the regulation Marti & Bannon [7] says that in psychological experiments, users should be observed, studied and

† The terms "Human-Centred Design" and "User-Centred Design" are synonymous, although the ISO 9241 preferably use the first by believing that it impacts all the humans involved in the system, not only the end users of the product. The preference for the term "User-Centred Design" is justified by this currently position as commonplace in the market (ISO, 2010).

questioned - and have performance on tasks measured. Significant problems to engage children throughout the development process, as established in User-Centred Design were found: (a) Not all children are able to be creative designers, or even informants; (b) Children are oriented to not talk to strangers, and it can inhibit; (c) The school environment can be inhibitor too; (d) There may be other difficulties related to managing the process. For Marti & Bannon [7] users, children between 6-8 years old should assume the role of informants only in three stages: at first, to help the questioning, in the middle of the process, to test and provoke reflection about the project and finally at the end, to evaluate prototypes in a real context.

The User-Centred Design approach encourages the use of multidisciplinary expertise in order to provide creative and collaborative ideas between team members, benefiting the project with different perspectives and skills, but puts the voice of the team should not replace the actual user of the product. Marti & Giusti [8] conducted a study with children, which presented difficulties in playing alone or with other children, autistic and/or with limited mental capabilities. They concluded that with the adoption of the User Centred Design approach, children were not just subjects of study, but actually active agents throughout the design process. They had real impact, enabling the reinvention of technology, new features and new possibilities. Those involved in the project (therapists, teachers, parents) had a significant role. In the design and the experiment debriefing they discussed the methodology proposing. Specific protocols for the conduct of the project, selected the participants (users) and were particularly involved in the interpretation final results. In this study, children were involved very early in the process and clearly comprehend their role. It was possible to extract from it that the User Centred Design approach was essential to link the needs and wishes of children to the aforementioned limitations. Was also possible get from their interaction requirements and design concepts that can be further better explored in future studies. It was concluded from the study that user involvement should be sensitive to the work environment, age and user ability and the need of harness these points to the stage at which the user should be inserted. It is understood for Marti & Bannon [7] that users must be included in the process according to the case, which comes from meeting with premise of ISO 9241-210 [4], which explains that the participation of all types of users must be active throughout the development process, as well as user participation as co-author of the project, in some cases. Another important aspect to remember is concerned to the multidisciplinary team. The essence of multidisciplinary required by User-Centred Design is the variety of skills, knowledge and information that make up the team responsible for the project. Is easy to understand that when children join the team, they bring important contribution not only on the intended uses of the product and the user, but for the whole design process.

Work with multidisciplinary teams - one of the principles of User-Centred Design –can limit the participation in the process [7]. According to the design team composition, inserting it may be delayed: professionals with skills in design and/or interaction, among others, and with some experience with the user can omit the user involvement as professionals and researchers human-computer interaction tend to insert it earlier. Norman [9] argues about the moment of user inputs. For him it should be earlier than the beginning of a new project, and the process is linear and inflexible: research with the users, discovery of needs and desires, all before iterations of design and coding stages. The author aware that this position can be a throwback to the cascade methods. Lawyer of good human-computer interaction, your opinion is that all information should be collected a step before the project development, that is, out of the process. The user's voice is crucial to determine which design develop, but once started, it is too late to hear him. Many projects are improvements of pre-existing others [9]. The author questions whether everything learned was not enough, or whether there is a need to start studies with users again. Focused on dynamics of the market, Norman [9] proposes that the on going process is restricted to the limitations of the market, so the skills of multidisciplinary teams should be promoted and teams must speak by the user on behalf of them past experience and the projects viability. In the same year Norman [9] wrote that humans can have are able to access conscious thoughts and beliefs, but not the subconscious of users. Designers tend to design for themselves, as they were themselves users. The author concludes with this thought: the professional should be able to realize that human beliefs and behaviors are complex and the individual is not in a position to discover all the relevant facts. There is no substitute for interaction with users of a proposed design and without research [9]. The author question the technical standards of ISO to reveal political and economic issues involved in the midst of standardized procedures for establishing national and international standards. In addition to political issues between the production and marketing chain, the development of an ISO process is long, depends on complex steps, respect for hierarchies involved and it may be

that the resulting pattern runs as a "negotiated settlement " between competing positions. As an example the author quotes the international voltage and frequency standards or different pin socket and the respective electrical sockets. By its diplomatic wording, Norman [9] fears that the process of developing an ISO standard seems less political than it actually is, "an agreement between the existing approaches is not, in general, the result of the standardization process, but a initial goal of the developers". Despite the marketing and international standards policies of implementation, this paper focuses on procedural practices of system development in a macro level and believes that this discussion is not relevant to the subject in focus. The standards established by ISO bring positive results to the stakeholders, otherwise would not be used, even as an inspiration to other methodologies. It is noticed that the gains reach interesting values the management, whether measurable, tangible or not, such as sedimentation and brand positioning, gains relating to the loyalty of users, the greater possibilities of the portfolio of products, etc. In another analysis, the cost-benefit ratio, Is easy to read that the investment must be justified by the benefits. The argument raised here is more strategic than operational. Then it is understood that the "agreements" that may happen, are not part of this discussion.

Frohlic & Sarvas [5] defend the User-Centred Design approach, although they also recognize that this practice undermines the urgency of technology and innovation market with constant iterations and user omnipresence - and the time and costs that involves. The race that the technology market imposes may question the use of User-Centred Design approach: the implementation and subsequent maintenance of practice approach can encourage different views on it. Promoter of processes and products more suited to their end users and therefore less costly in the long run, although it may seem costly and time consuming for developers, in a more immediate vision. This discussion has been recurrent when academic and market research knowledge are faced, compared theoretical experience and practice. Gray et al. [2] label this relationship as problematic in an paper which expound on the time and energy devoted by the Academy on behalf of best practices being ignored by practitioners, developers. However, the authors state that the practice of these developers, and companies they represent, are a source of important research to the gym because they can provide other points of view. As one of the User Centred Design approach strengths, Gray et al. [2] point out that the process causes greater engagement between clients and designers, as well as other stakeholders and ultimately facilitate communication around the design.

4. Challenges

Four experienced professionals - Beringer, Blowers, Vigneau and Wallace - exchanged experiences in the Special Interest Group of the CHI 2003 [12] and found operational barriers that may affect the incorporation of User-Centred Design in the real world, witch they divide in categories: acceptance, recognition and incorporation; scarcity of resources; changes in the definition of projects; multidisciplinary team of the administration. Below are the challenges for each item of the categories:

- *Acceptance, recognition and incorporation of the User-Centred Design practice*. If there is the charge of the project support, professionals may feel they have no power. Successful companies feel they already know well its users, maybe this brings difficulties in implementing. Late user involvement in the process: the ideal is to be involved since the project definition phase. Field research needs not recognized as involved in the project believe that professionals can take the user's voice. Can be extracted from the above that the solution to this category would be to have professionals dedicated to implementation of User-Centred Design to become partners of each other and not opponents. The most important is to show that the work of all will be much better if grounded in user data. Present the results and show these gains (instead of only speak), results in a positive effect, especially with developers and other key people in the company.
- *Lack of resources*. Tight schedules and little time for qualitative analysis; Key Professionals dedicated not only for the project or fewer than needed; Inconsistency in the composition of the team; Limited budget. Adjust the project to the business reality can be the solution to the problems of this important category. The issue of planning, well established by ISO 9241-210 [4] states that "planning the content should include proper identification of the methods and resources to the activities required by the User-Centred Design", and include

the definition necessary procedures to integrate these activities to the development process itself. Once structured planning with adequate and, why not, some creativity, the challenge of limited resources tends to be bypassed.

- *Changes in the projects definition*, of the team or the project scope itself, the sample projects that initially would be completely automated and finally require significant human-computer interaction. In this case it is recommended do not underestimate the extent of user interaction, even in cases similar to the example above. ISO 9241-210 [4] states that the "developing effective procedures should establish feedback and communication between activities, as well as clarification of the methods and documentation". It is crucial to clarify the maximum size of the project and surround it formally, to avoid unnecessary changes for its scope and expectations of both the developer team and the others involved in the project are frustrated. Possible conflicts between the objectives of the project leaders or inconsistency in team composition can alter the focus of the project. A solution for this challenge is to encourage changes that are driven by user data, not from people's opinion. The clear documentation, specifications, as well as discarded ideas, are strongly recommended for the team to maintain a user-centred approach.
- *Management of multidisciplinary team*. Even though they are excellent professionals affection to other areas, not always the whole team can have plural skills in design, which can bring noise when the collective thinking is with this focus; It is recommended that the differences between the skills of the team members are not undeserved between team members. As with any organizational context, deploy changes involve resistance and specificities that can become challenging, especially among the professionals. Divergent conflicts and ideas not only can, but must exist. The identification of those responsible for User-Centred Design and the range of skills and views that come from is of paramount importance, depend on the balance in the team choose the success of the approach and hence the system. The mix of experiences, cultures and mental models can be especially healthy to allow and encourage the plural of reasoning.

Finally, it is understood that the management in a macro view must be added to these categories. The management of a project directly depends on the balance between three criteria: time, budget and quality. For the satisfactorily fit of the methodology, it should be built with comfort to the triad of goals - necessary for planning techniques, programming and monitoring of activities is done. The project manager is responsible for provide the team with have the all necessary resources and time due to ensure that the user's voice is heard throughout the development process. The fundamental conditions of the project should be realistic to avoid renegotiations. The organizational culture should be prone to innovations that market emergency calls, including al. More than just one approach, all company culture must be disseminated user-centric, so that those involved, from the lowest to the highest level, will adopt it.

The multiplicity dynamic of technology and the plurality that involves the world nowadays also reflect the desire to unify the development process. This desire encompasses both the user experience in desktop and your mobile devices and the wide range of possibilities for each of these platforms, in terms of design. The technology is dynamic and the processes that follow cannot get lost in time and become speech. Frohlic & Sarvas [5] state that every innovation must be centred on the user to ensure that the benefits of end users justify the cost of the system. The authors believe that it is impossible not to consider user participation in planning their business, since the approach of User-Centred Design is oriented to "maximize the benefits through innovation, reducing costs and market positioning". The problem is that the approach does not delve as much as needed in the limitations of the market and this factor can be restrictive or even impediment to its adoption as it directly impacts the marketing of these interactive products. It is important that user behavior be translated in the product, but this translation is incomplete if they are not associated with it the business environment and the technology in question. For them, the solution to the viability of the User-Centred Design approach in the long term is to keep it engaged in the innovation process, but considers explicit and deeply the factors that affect the business. ISO 9241-210 [4] states that the benefits must take into account the cost of the total system life cycle: design, implementation, support, use, maintenance and disposal. Not only in financial terms but also the emotional and energy costs are bound to be heavy. In the long term the balance will be positive, since the proper use of this approach extends the product's chances of success. More than the Design, the attitude need to be user-centred [5]. The User-Centred Design involves behavioural and organizational changes that are not always easy to be incorporated. Lifestyle changes

require an effort to rebuild, but once those perceive the gains from it involved, are absorbed, retained and become routine and spinal cord. The lack of planning can be one of the critical triggering factors to the use of User-Centred Design, which should be focused and integrated into all phases of the system life cycle. It is imperative to set up a schedule that appropriately encompasses the activities of the User-Centred Design in the system development process, including in it the iteration, use, feedback and the incorporation of possible changes resulting from them. User-Centred Design results in better products to which they are intended. The greatest challenge of this approach is to be a satisfactory development process in terms of design and productivity in which, fitted on project limitations, be replicated in different technologies and different encodings and fit and in all formats of screens - minute to unlimited proportions - and the end result provides the best possible user experience of use. ISO 9241-210 [4] is complementary to the design process and can be incorporated into the agility required by the market. Bring this process for the company can tow challenges, but success will only occur if they are changed people and processes.

5. Final Placings

It is understood from the issues raised in this paper that planning could also be added to the compliance of the regulation, as it is crucial to the successful management of projective processes. All stages of the process and its possible consequences and/or complications should be planned. Issues must be clarified as what the scope, results and success criteria for a successful implementation is expected. The strategy should be turned into a plan of action that will lead the team and therefore fit the limitations placed by the stakeholders. The examples placed here illustrate the importance of the approach, but point to the need of suppleness, according to the profile and/or application context and stresses the importance of broadly design process as a whole. It is important that those responsible for the project have common sense to take into account that the rules should be applied, but each case is one different case – so, they need to figure out how each application must be differentiated without the essence is lost.

References

[1] BEVAN, N.; How Could you Benefit from ISO Standards. In: CHI EA 14 Extended Abstracts on Human Factors in Computing Systems. Anais CHI EA '14: New York, 2014.

[2] GRAY, C. M.; STOLTERMAN, E.; SIEGEL, M. A.; Reprioritizing the Relationship Between HCI Research and Practice: Bubble-up and Tricke-Down Effects. In: DIS 2014, June 21-25, 2014. Vancouver, 2014.

[3] FLUSSER, V.; O Mundo Codificado: Por uma Filosofia do Design e da Comunicação. Cosac Naify: São Paulo, 2008.

[4] ISO 9241-210 (2010) ISO 9241-210. Ergonomics Of Human-System Interaction – Part 210: Human-Centred Design For Interactive Systems. Génève: International Organization Standardization, 2010.

[5] FROHLICH, D. M.; SARVAS, R. HCI and innovation In: CHI 2011 - Session: Innovation & Design, 2011-05-07 - 2011-05-12, Vancouver, 2011.

[6] Maguire, M. Int. J. Human-Computer Studies (2001) 55, 587}634

[7] MARTI, P.; BANNON, J.L. Exploring User-Centred Design in Practice: Some Caveats, Knowledge, Technology et Policy. Springer: Netherlands: 2009.

[8] MARTI, P.; GIUSTI, L.; A Robot Companion for Inclusive Games: a User-Centred Design Perspective. In: Proceeding of the IEEE International Conference on Robotics and Automation. Anchorage, Alaska, 2010.

[9] NORMAN, Don.; Why Doing Observations First Is Wrong. In: Interactions - Gadgets '06 Volume 13 Issue 4, July/August 2006. New York, 2006.

[10] PAPANECK, V.; Design for the Real World: Human Ecology and Social Change. Frogmore: Granada Publishing, 1974.

[11] SAFFER, D.: Designing for Interaction. New Riders, Berkeley (2010).

[12] Special Interest Group - CHI 2003, < http://incontextdesign.com/articles/making-customer-centred-design-work-in-the-real-world/>