

## (Pre-Conference Proceedings)

## Working Conference on

# Usability in Social, Cultural and Organizational Contexts

in conjunction with the 4th Cultural Usability Project Seminar

October 07-08, 2009

Hosted by Human-Centred Design & Computing Group Centre for Development of Advanced Computing (C-DAC) A Scientific Society of Ministry of ICT, Government of India, Pune, India



Organised by



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#### We are thankful to the departments in C-DAC namely finance, purchase, stores and facilitation for helping us in organizing the working conference.



I am happy to know that Human Centred Design and Computing Group of C-DAC, Pune has taken the initiative of hosting and co-organizing the "IFIP HWID2009 Working Conference on Usability in Social, Cultural and Organizational Contexts" in collaboration with Copenhagen Business School, Denmark; Aarhus University, Denmark and Indian Institute of Technology, Guwahati, India.

I really appreciate and value the trust shown by Copenhagen Business School, Denmark for choosing C-DAC to host this event. It will surely help in forming the cross-cultural bridge for usability researchers in Europe, India and other parts of the world to participate in this collective effort.

This working conference on the theme of Cultural Usability and Human Work Interaction Design is very timely and relevant in the context of growing investments by the Indian government on e-governance, e-learning, e-health and application of information systems to empower the rural and agricultural population of India. Also the Indian IT industry has geared to design and develop IT solutions for users across the globe at an economical price. Innovations in information and communication technologies can be best discovered through deeper understanding of the requirements of wide ranging users starting from housewives to farmers and from illiterate to disabled. The technologies are being extended to simultaneously address the design preferences of local as well as global users. In this context, understanding the cultural and social aspects of technology and the design imperatives for enhancing the usability of our technologies becomes very important.

I am sure that the working conference will deliberate upon some of these important issues and come out with the directions for future research. I wish the working conference a great success!

Rajan T. Joseph Director General Centre for Development of Advanced Computing, A Scientific Society of Ministry of Communications and Information Technology, Government of India

## Foreword by the Organizing Chairs

#### Welcome to the HWID2009 working conference.

We are delighted that you have decided to contribute to or participate in this conference, with the theme usability in social, cultural and organizational contexts. The conference is an IFIP event, organized within the workgroup on Human Work Interaction Design (wg13.6) and in joint collaboration with the CultUsab Project. The conference is hosted by the Human-Centred Design & Computing Group, Centre for Development Advanced Computing.

A lot of people have volunteered to use time and energy to make this conference happen. You are currently holding the pre-conference proceedings, which contains 21 blind reviewed papers. We would like to state our gratitude towards the group, who has assisted in performing a number of reviews, which enhanced the quality of the conference, the international program committee of 31 people, and the people assisting in arranging the practicalities of the conference. Likewise we are grateful for the support and financial aid provided by the CultUsab Project.

In the dayes of the conference, we hope you will thrive on the presentations and discussions and enjoy taking time to constructive reflection and knowledge sharing. In addition to the 21 paper presentations, two panels and a talk on HCI and usability research in Indian educational institutions will be given. Presenters are coming from very varied disciplines and countries, making it a truly interdisciplinary and international event. The presentations have been grouped around four topics related to the conference theme, namely:

- Usability Methods and Design Research
- Cultural Usability
- Usability in Social and Organizational Context
- Human Work Interaction Design

This HWID2009 working conference is jointly organized by four organizations: Copenhagen Business School, Denmark; Centre for Development of Advanced Computing, India (Host), Aarhus University, Denmark; Indian Institute of Technology, Guwahati, India.

#### As organizers we wish you an excellent conference and insightful readings.

Dr. Torkil Clemmensen	Dr. Dinesh Katre	Dr. Rikke Orngreen	Dr. Pradeep Yammiyavar
Associate Professor, Department of Informatics, Copenhagen Business School, Denmark; Chair of IFIP WG 13.6 HWID; Project coordinator of CultUsab research project.	Group Head, Human- Centred Design & Computing, Centre for Development of Advanced Computing (C-DAC), Pune, India	Associate Professor, The research programme of Media and ICT in a Learning Perspective, Danish School of Education, Aarhus University; Secretary of IFIP WG 13.6 HWID.	Professor, Department of Design, Indian Institute of Technology, Guwahati, India

#### Theme and focus:

The HUMAN WORK INTERACTION DESIGN 2009 working conference analyzes the concept of usability in social, cultural and organizational contexts. Analyzing usability in context is important for connecting empirical work analysis and interaction design. In industry, a wealth of usability evaluation methods is used to evaluate computer software user interfaces and other interactive products: Inspection methods, Workplace observation, Think-Aloud Usability Test, etc. These techniques often give - seemingly - similar results when applied in diverse social, cultural and organizational settings, but experience shows that we need a deep understanding of the cultural, social and organizational context to interpret the results, and to transform it into interaction design.

The working conference will present current research into and industrial experiences with usability as a way of connecting empirical work analysis and interaction design, with a special focus on contexts in India. Cultural usability is a comprehensive concept, which adheres to all kinds of contexts in which humans are involved (private family, work, public and private organizations, nature and climate, technological, etc.).

The purpose of the working conference is to enable practitioners and researchers to analyze the concept of usability and how it can be used to connect empirical work analyses and interaction designs in different contexts. After the conference, a limited number of selected papers will be published in an IFIP Springer book.

We expect the participants will be people from industry and academia with an interest on usability, work and design in different social, cultural and organizational contexts. The working conference will be conducted in a good social atmosphere that invites to openness and provides time to reflection and discussion about each of the accepted papers and cases.

#### Social, cultural and organizational dimensions of usability

- Usability and social context
- Usability and cultural context
- Usability and organizational context
- Work style modeling in different cultural, social and organizational contexts
- Usability assurance and assessment in outsourced developments
- Usability and technological application areas such as groupware, mobile, social computing, web based and software applications
- Experience design and design conversations

#### Usability techniques and methods applied for design research

- The concept of Usability as a mean to connect empirical work studies and interaction design
- Application of usability design and research methods like think aloud, ethnography, contextual inquiry, GOMS, cognitive walkthrough, other empirical research methods applied for ICT applications design
- Usability engineering and process management
- Case studies of usability in an Indian context
- The use of ethnographic methods to generate scenarios and use cases in a foreign country

Empirical studies of culture-specific or culture-aware usability evaluation methods

### **Programme Schedule**

#### Day – I October 7, 2009

9:00 – 9:30 Registration

9:30 - 10:30

Opening

Inaugural Address Rajan T. Joseph, Director General, C-DAC

Introduction to Conference Dinesh Katre

**IFIP 13.6 Research Themes** *Rikke Orngreen* 

Brief Overview of CultUsab Project Torkil Clemmensen

**Opening Remarks** *Pradeep Yammiyavar* 

10:30 – 10:50 Tea Break

10:50 - 13:00

#### Session – I Usability Methods and Design Research (1)

**Interaction Design and Usability of Learning spaces in 3D Multi-user Virtual Worlds** *Shailey Minocha and Ahmad John Reeves* 

Personas in Cross-Cultural Projects Lene Nielsen

Interaction Design as Multimodal Conversation Arminda Lopes

Usability Heuristics and Qualitative Indicators for the Evaluation of Touch Screen Ventilator Systems Ganesh Bhutkar, Dinesh Katre, Shekhar Karmarkar

13:00 – 14:00 Lunch

14:00 - 15:45

Session – II Cultural Usability (1)

## A comparison of what is part of usability testing in three countries

Torkil Clemmensen

**Online Banking in India: User Behaviours and Design Principles** *Jhumkee Iyengar, Manisha Belvalkar* 

**Cultural Factors Influencing Elements of Interface Design for Indian Youth: Study and Guidelines** *Suyog Deshpande, Kumar Mayank* 

**Development of an intuitive user-centric font selection menu for Devanagari** *Girish Dalvi* 

15:45 – 16:00 Tea Break

16:00 - 17:30

Session - III Usability in Social and Organizational Context (1)

Developing mobile phone based GUIs: A methodology case study on conceptualising a GUI for users in the construction industry *Pradeep Yammiyavar, Prasanna Kate* 

Identifying the Cognitive Needs of Visitors and Content Selection Parameters for Designing the Interactive Kiosk Software for Museums Dinesh Katre, Mandar Sarnaik

Usability Issues in developing an Intra office communication System

Piyush Jain & Pradeep Yammiyavar

#### 17:30 - 18:30

#### Panel Discussion Theme: Human Work Interaction Design

*Moderator:* Anirudha Joshi, Industrial Design Centre, Indian Institute of Technology, Mumbai *Panelists:* 

Rikke Orngreen, Danish School of Education, Aarhus University, Denmark Arminda Lopes, Instituto Politécnico de Castelo Branco, Castelo Branco, Portugal Shailey Minocha, Department of Computing, The Open University, Walton Hall, UK Frederico Figueiredo, Nokia Siemens Networks, Portugal

#### <u>Day – II October 8, 2009</u>

#### 9:00 - 11:00

Session – IV Cultural Usability (2)

HCI and usability research in Indian educational institutions *Pradeep Yammiyavar* 

**Augmenting Usability: Cultural elicitation in HCI** Souleymane Boundaouda Camara, Cecilia Oyugi, José Abdelnour-Nocera, Andy Smith A comparative study of keypad based and handwriting based solution for Hindi text entry Ityam Vasal, Diya Gangopadhyay, Pradeep Yammiyavar

**An overview of 1998-2008 journal publications on Culture and Human-Computer Interaction (HCI)** *Kerstin Roese and Torkil Clemmensen* 

11:00 – 11:20 Tea Break

#### 11:20 - 13:20

#### Session – V Usability Methods and Design Research (2)

**Exploring Persona-Scenarios - Using Storytelling to Identify Requirements** *Sabine Madsen, Lene Nielsen* 

**Moment of Truth (MoT) – A Deeper Insight into User's Culture** *Shrirang Prakash Sahasrabudhe, Prajakta Vijay Bhatt* 

**Promoting Usability in Large Enterprises** *Frederico Figueiredo, Cristina Martins, Tiago Pocinho* 

SMART User Experience Framework 1.0 Making information technology products & services better for users Aparna Raman

#### 13:20 - 14:00 Lunch

14:00 - 15:30

#### Session - VI Usability in Social and Organizational Context (2)

## Sustained Service Provider–Customer Relationships in the Indian Context: Factors Influencing the Choice of Touch Points

Pramod Khambete, Sanjay Tripathi, Uday A. Athvankar

# Graphic interfaces for interactions involving Affect: A case of a consumer choosing colour for a product

Mohsen Jaafarnia, Pradeep Yammiyavar

**Widened Horizons through exposure to Multi-socio-cultural Environments** *Suneet Kheterpal and Bibhudutta Baral* 

#### 15:30 - 16:30

#### Panel Discussion Theme: Cultural Usability

**Moderator:** Dinesh Katre, Group Coordinator, Human-Centred Design & Computing, C-DAC, Pune, India

#### Panelists:

*Torkil Clemmensen, Department of Informatics, Copenhagen Business School, Denmark Andy Smith, Head, School of Computing, Associate Dean (Research and Enterprise), Faculty of*  Professional Studies, Thames Valley University, London, UK Lene Nielsen, Usability Consultant, Snitker & Co. Copenhagen, Denmark Pradeep Yammiyavar, Department of Design, Indian Institute of Technology, Guwahati, India

About the Proposed IFIP Springer Book Torkil Clemmensen

Vote of Thanks

16:45 Tea Break

### Interaction Design and Usability of Learning spaces in 3D Multi-user Virtual Worlds

#### Shailey Minocha and Ahmad John Reeves

Centre for Research in Computing, The Open University, Milton Keynes MK7 6AA, UK {S.Minocha, A.J. Reeves}@open.ac.uk

Abstract. Three-dimensional virtual worlds are multimedia, simulated environments, often managed over the Web, which users can 'inhabit' and interact via their own graphical, humanoid, self-representations known as 'avatars'. 3D virtual worlds are being used in many applications: education/training, gaming, social networking, marketing and commerce. Second Life is the most widely used 3D virtual world in education. However, problems associated with usability, navigation and wayfinding in 3D virtual worlds may impact on student learning and engagement. Based on empirical investigations of learning spaces in Second Life, this paper presents design guidelines to improve the usability and ease of navigation in 3D spaces. Methods of data collection include semi-structured interviews with Second Life students, educators and designers. The findings have revealed that design principles from the fields of urban planning, Human-Computer Interaction, Web usability, geography and psychology can influence the design of spaces in 3D multi-user virtual environments.

**Keywords:** 3D virtual worlds, 3D virtual environments, design guidelines, Second Life, usability, wayfinding

#### 1 Introduction

<u>Second Life</u> (SL) is a persistent, online three-dimensional multi-user virtual world. Users synchronously interact in 3D spaces via their graphical self-representations known as 'avatars' and converse in real-time through gestures, and audio- and textbased (chat and instant messaging) communication [1]. Users connect to the SL environment with a software program called a client or viewer, which is responsible for displaying the 3D world and for negotiating user commands with a central server. Typically the client displays the user's avatar and surrounding portion of the world consisting of other avatars, landscape, buildings, etc. Unlike Massively Multi-player Online Role-playing Games such as World of Warcraft that have a scripted plot or storyline for the role-playing and game(s), SL, is not a 'game' *per se*. SL has a very strong user community, and the content and narrative is constructed and owned by the residents, rather than by Linden Labs, the company who provide the infrastructure, hardware and software to support SL.

IFIP HWID2009 Working Conference on Usability in Social, Cultural and Organizational Contexts, Oct. 7-8, Pune, India. In addition to social recreation and business applications, SL has attracted attention from academic institutions as an addition to face-to-face teaching or to be used in conjunction with 2D technologies such as blogs, wikis and discussion forums [2]. An island of an institution in SL can provide a dedicated environment for learning, which helps to ensure a sense of belonging and purpose for the students. The lack of a guiding narrative in SL provides flexibility for educators to design learning spaces for their pedagogical requirements. Although many educators have expressed the need for best practice design principles for creating learning spaces in SL, few have addressed the interaction design and usability of learning spaces in SL.

In the research project 'DELVE' (Design of Learning Spaces in 3D Multi-user <u>Virtual Environments</u>), we have conducted an empirical study involving SL educators, designers, and students to investigate their experiences with and perceptions of learning space designs in SL. In this paper, we focus on the empirical data related to the usability of learning spaces in SL. It is important to note that in our research that we have focused on the design of the *3D learning spaces* within SL and we have not been concerned with the interface design and usability of the technology as such (i.e. SL client or viewer). Based on our empirical research, we present design guidelines or recommendations for educators and designers for designing usable learning spaces in 3D virtual worlds (VWs).

#### 2 Background

In the disciplines of design, urban planning, and architecture, there are a number of studies that have investigated the design of 3D virtual environments (e.g. virtual reality and 3D VWs) in terms of navigation, orientation and wayfinding. In late 1990s, the emphasis was to apply the understanding of navigation in real world to designing usable interfaces in virtual environments (e.g. [3], [4]). Lynch [5] originally suggested that landmarks play a significant role in our cognition of the real world environment. Based on literature on navigation in real world including the work by Lynch, in [6] the author presents design guidelines for landmarks to support navigation in 3D virtual environments (VEs). A VE containing distinctive landmarks, edges and pathways supports navigation by facilitating the acquisition and application of spatial knowledge (e.g. see [7]).

Another important paper is that of Charitos [8] in which he proposes using Lynch-like components such as signs, landmarks, paths, places, intersections (nodes) and domains (districts) to aid navigation in VWs. However, the effectiveness of the wayfinding strategies on the users hasn't been tested and Charitos's approach is critiqued as being only conceptual [9]. However, in [10], the author (Dickey) has discussed that Charitos' pragmatic approach of aiding the navigation via environmental cues is most relevant to the design of educational environments. Dickey performed an empirical study involving the 3D world Active Worlds with her distance-education students to examine how architectural perspective of VW design, as described by Charitos, could be applied to provide design guidelines for creating 3D educational environments that reduce disorientation for users and aid wayfinding. However, Dickey [10] acknowledges the limitations of her approach in adopting the

real world architectural perspective of designing 3D VEs: for example, real world concepts of weather and gravity have no impact in 3D VEs.

Although the mental models of real world navigation influence wayfinding and navigation strategies in 3D VWs such as SL, the ability to fly in SL and to teleport from one location to another within a space or island implies that not all of the architectural design guidelines from the real world can be applied to the design of SL spaces. Further, in SL, spaces may not always be replicas of real world places but may have varying degrees of visual realism, from photo-realism, or artistic realism, or metaphorical realism to having spaces that have elements of fantasy [11].

With regards to the design and usability of learning spaces in SL, the research has been mostly anecdotal and exploratory but increasingly students, designers and educators are discussing the significance of usability and the user experience on SL-related mailing lists and SL educators' events about the significance of usability and the user experience. For example, Barton Pursel (Penn State University, US) blogs on SL design and usability and makes some observations on usability issues such as navigation, space design and familiarity (see <a href="http://tinyurl.com/Im6dg7">http://tinyurl.com/Im6dg7</a>). Some consultancy companies (e.g. The Otherland Group) have looked at usability issues in virtual worlds (see <a href="http://tinyurl.com/59ce9d">http://tinyurl.com/59ce9d</a>). They carried out an exploratory study that focused on customer experience and issues such as trading, branding and customer retention. However, their study highlights the need to follow generic Human Computer Interaction (HCI) principles and adopt a user-centred design approach to the design and evaluation of SL spaces: e.g., designing for the avatars (users) and not humans; and providing orientation to the user ("where am I?"; "what can I do here?"; "where can I go from here?"; "where have I been?"; and "how do I get back?").

John Wallace, an SL educator, discusses usability of learning spaces in SL by usability principles. applying web His blog and wiki are at: http://instructionalalchemy.com/blog/ and http://tinyurl.com/lg65od, respectively. Other SL users have begun to look at usability in terms of accessibility (for example, the SL group 'Virtual Abilities') by blending universal design principles with webaccessibility guidelines; initiatives include accessibility of SL for the visually impaired and mobility impaired. There are, however, no empirical studies to-date that we are aware of which relate to the design and usability of learning spaces in SL or design of SL spaces, in general. Therefore, when institutions aspire to create learning spaces in SL, there are few studies or guidelines to inform them except for individual case studies (e.g. [12]). In this paper, we report on a study in which we have elicited educators', designers' and students' perceptions of the usability of learning spaces within SL. Based on this empirical research, we have derived design guidelines for educators and designers who are involved in designing learning spaces in SL. Although we have focused on SL learning spaces, we hope that the results will be applicable to design of SL spaces, in general, and to other avatar-based 3D VWs.

#### 3 Research Design

The key research question in our research project DELVE has been "how should 3D learning spaces be designed for student engagement?" We have been primarily

concerned with the realism of learning spaces in SL: whether and how does the realism or non-realism of learning spaces influence student learning and engagement. However, in our empirical investigations, we found that interaction design and usability of 3D learning spaces were considered to be key factors that influence student experience. In this paper, we report the analysis of a subset of DELVE's data that is related to the users' perceptions of usability of learning spaces in SL.

#### 3.1 Data and methodology

Our research methodology consisted of an online survey conducted at the start of the project involving colleagues from UK's further education (FE) and higher education (HE) communities. This was followed by semi-structured interviews with designers, educators and students. The various stages of our empirical research were as follows:

We began by developing and conducting an online survey using the <u>Survey</u> <u>Monkey</u> application. The aim of the survey was two-fold: firstly, to ask a range of questions relating to the design of learning spaces in SL from colleagues in the FE and HE community. Secondly, we wanted to invite the survey participants to take part in a follow-up interview. We received 46 filled questionnaires and 27 respondents expressed willingness to participate in an interview. In parallel to conducting the survey, we developed our research materials such as a consent form, project summary sheet, pre-interview questionnaire and interview templates. The educators' and designers' questions related to the description of learning spaces, factors affecting designs, levels of realism, and learning activities. The students' questions covered similar issues along with an emphasis on the design aspects that either supported or hindered their learning experiences. Our institution's Ethics Committee reviewed and approved the research materials prior to our carrying out the interviews.

From the 27 survey participants who had agreed to participate in interviews, we selected 15 participants and sent out email invitations. Other modes of participant recruitment were: notices in some of the education groups within SL and personal invitations to colleagues. In order to evaluate and improve our research materials, we carried out pilot interviews. In all, we interviewed 7 students, 10 designers and 22 educators. Four interviews were conducted over the phone (audio recorded) while 35 interviews were conducted in SL and transcripts were saved into individual files.

Our research question provided the lens to analyse the data from the participants. An inductive or thematic analysis of the data was undertaken by us (the project team) to identify the themes, sub-themes, and any causal or inter-relationships between the themes [13]. The inductive analysis involved two team members reading the interview accounts. After an independent data analysis, the team focused on finding recurring themes in the analysed data.

#### 4 Main findings of the study

We now report the data analysis from the core subset of the data related to interaction design and usability. For each of the derived themes, vignettes (quotes) from the

interviews are included. In fact, each of the themes and sub-themes are guidelines for designing learning spaces in SL.

Design for affordance of learning spaces and objects or as per real world conventions within learning spaces: Affordance is a property in which the physical characteristics of an object or environment influence its function. When the affordance of an object or environment corresponds with its intended function, the design will perform more efficiently and will be easier to use. One of the participants discussed that the fin of the learning space should indicate the type of learning activity that can be earried out in that space: "depending upon what it is you want to do, the space may need to look different in order to function as you need. For example, row of desks with a lecturer in front is perfect for demonstrations and giving important information, whereas the seminar table is great for discussions and sharing ideas with each other. The informal areas on the sim [island] also show that any space can be a meeting area, just a nice place to meet and talk and reflect" [SL designer].

An educator discussed how the intended function should be integrated within the design: "I say one thing it needs to be very clear what the aim of the space is, ... that should not be because there is a nice sign saying what it is for but it should be in the character of the development. Something in the look and feel, the way you interact with the space is representative of its use so that it will make it easy for the user to understand" [Deep Think]. The objects in the learning spaces should imply the way in which the spaces can be used: "Well, I already mentioned chairs, although totally unnecessary [for the avatars] they do signal that a meeting is going on and certain people have committed to participating for a while" [SL educator and designer].

**Design for storytelling:** Storytelling involving presenting information in a way that will help engage an audience in a design or provide a rich context to enhance learning In our study, both educators and designers mentioned about having story or narrative for the space (as if staging a play): "*the space is like a story, you need to involve the space*". Linking the structure of the space and narrative enhances learning.

This educator also suggested that how scenarios or stories of usage of the space could also be an effective means of communicating within a multi-disciplinary design team. The educator developed user scenarios to understand how the spaces would be used; the scenarios were used in discussions with developers and also to create tutorials: "At some points they [developers] couldn't understand what the problem was or what we were trying to achieve so we came up with user scenarios...we adapted scenarios used in software engineering for a user journey through the island...and I finally understood the way we were thinking the way students would go round this campus and use the space..."

**Use real world metaphors:** Metaphors may be considered as tools or processes that enable understanding of one thing in terms of another [15]. In our study, educators and designers mentioned about using familiar metaphors from the real world, for example, use of mailboxes in SL spaces where students could leave messages, or having search pods in the library, familiar seating (like in real-world), and buildings.

**Consider ambience and aesthetics of the learning space:** Ambience and visual aesthetics are important design criteria. Aesthetic designs are perceived as easier to use and promote creative thinking and problem solving: "*If they feel relaxed here -, from visually stimulation, or aural (sound of water flowing)...then maybe they engage* 

more with the tutorial and say more than they would in real-life in lecture hall or for something comparable with MSc usage - they are distance learners and we use discussion boards, skype, wikis, blogs, email..." [SL educator]

**Consider realism for familiarity and comfort:** A related design principle to affordance is designing visually realistic learning spaces, especially for users who may be new to SL. Visual realism, that is depicting objects and spaces as they are in real world (e.g. lecture rooms with tables, chairs and a podium) helps to support existing mental models of the learners of what to expect [11], and how to interact or behave: "I think having visual realism helps people feel comfortable with the environment, and if they are comfortable then you can extend the boundaries of the activities a bit further..." [SL designer]. An educator said "...some level of visual realism provides clues to a person on how they might behave."

**Design to orient the user at the landing or entry point:** The initial impression of a system or environment greatly influences subsequent perceptions and attitudes, which then affects the quality of subsequent interactions. The entry points or points of prospect are points of physical or attentional entry into a design and should allow users to become oriented and clearly survey available options.

When a student decides to visit a SL learning space, they will normally teleport to the space's arrival point via a 'SLURL' (a direct teleport link to a location in SL), either from the web browser, or from another SL location. Upon arrival in Deep Think, one of the islands of SL, the user is presented with a 3D map of the island showing what is there and how they are located in relation to one another (see Figure 1(a)). In addition, entry points should have progressive lures that attract and pull users through the entry point. In Deep Think, there are information boards and a video that discusses the purpose of the island and its various learning spaces. There are boards which give details of individual learning spaces space (study area, auditorium, etc). There is a teleport board (map of the island) with provision to click on a specific place on the map and to move to that area (see Figure 1(a)). Some learning spaces or islands provide notecards on arrival with details of the island and how the spaces can be used.

Taking the example of webpage 'stickiness' i.e. the attribute of a site to keep users there and clicking more web pages, SL 'location stickiness' can be enhanced through a well-designed and appropriate arrival point. As one designer commented: "An island has elements of real spaces but also has elements of web-pages. People can be channeled to arrive at a specific point (like with an home page) and this orientation space can be used to provide initial information, engage the user and to show them paths further into the function/space. People are impatient just as they are with web pages. Make them walk everywhere and they won't bother looking. Give them a way to click something and be immediately transported to another part of the space, and they are much more likely to explore deeper." [SL designer]. In Figure 1(b), a tour facility at the arrival point takes the user through the various places on the island to orient and inform the user through a textual commentary.



**Figure 1.** (a) An entry point in Deep Think; (b) Tour in Vassar island

A related aspect to entry point is 'wayfinding'. When examining how an architectural perspective of virtual world design may provide guidelines for creating educational virtual environments, Dickey [10] highlighted the advantages of landmarks, signs, paths and boundaries in 3D spaces to support wayfinding. Providing teleport maps or even maps (see Figure 2) help in orientation and provide robust mental representations of the space and aid the user in route decision-making.



#### Figure 2: (a) Teleport map; (b) map showing the various places on the island

Signs and paths help the user to navigate to their destination: "...students need certain reference points when they are entering an unfamiliar space... for example, we created definite pathways through the exhibition and some signposts and a welcome message but after that it is up to the student to explore - a few sign posts to help them ground themselves. Especially for newbies it can take a while to learn to control your avatar and I have been to spaces where I got trapped in labyrinth type buildings the only way out was to teleport" [SL educator] Figure 3(a) shows signage which is similar to real world signage. In Figure 3(b), each path has an arch with the destination's name at the top of the arch, thereby providing a clear route. Along with navigation to areas or buildings comes the issue of navigating within areas or

buildings. Avoiding confined spaces and unnecessary objects all help the user to move freely.



**Figure 3:** (a) Signage to guide navigation; (b) Paths to aid route decision-making **Avoid spaces that can trigger phobic reaction or don't provide an easy exit.** An educator and SL designer discussed her experiences of interacting in confined spaces in SL (note that these interactions are via avatars): "*The spaces in the brownstone [a learning space replicating the era in 1920s-30s] are pretty much consistent with real-life... I find that a problem there as well as some of the other builds I've been in. I suffer from vertigo and the store on four floors in relatively confined spaces and as I was travelling up and down furnishing the areas I found it was triggering my vertigo. So I put in teleporting equipment not yet available in real-life or the 1920's or 30's!" [SL educator and designer]. Figure 4(a) shows a space which has no open window or an exit (the only way to exit is to teleport). The avatars lose their camera/views behind the walls or outside the meeting room. This space made the educators (whom we had taken on a tour in our study) very claustrophobic and uncomfortable.* 

An SL designer said: "I try to steer away from having buildings with roofs as they are actually unnecessary in SL and they mess with people's camera angles". Thus, buildings in SL should be as open as possible: avoiding closed roofs, annoying doors, narrow corridors or cluttered areas that can both constrict avatar movement and cause lag. Clear options and signage to exit buildings should be provided such as through non-solid walls, open roofs and spaces, clear exit signs etc.

**Form should follow function**: This principle implies that aesthetic considerations in design should be secondary to functional considerations. The participants mentioned that the design should reflect the learning activities: "... the design should be functionally and pedagogically appropriate, [and] integrated'... a design for a purpose". One educator gave a specific example: "... I actually used objects that looked like books, so the student would go up to a book and the book would open for them ..., so I tried to keep that form and function consistent with real-life and that sort of worked quite well" [SL educator] (see Figure 4(b)).



Figure 4: (a) Room without a normal exit; (b) Metaphors for conveying the function

#### 5 Discussion and Conclusions

The subset of data and findings presented in this paper has revealed that applying architectural principles of real world designs to 3D virtual worlds as discussed by Charitos [8] and Dickey [10] may not be sufficient. In fact, we have seen that design principles from the fields of urban planning, HCI, Web usability, geography and psychol findence the design of spaces in SL. The design guidelines and vignettes presented in this paper will provide useful guidance and triggers for ideas to educators and designers who are planning to set up learning activities and spaces in SL. In our study, we have noted that educators and designers are clearly taking advantage of the 3D features of SL and its interactivity and flexibility for designing (and re-designing). They are adopting a user-centred design (UCD) approach and the designs of learning spaces are changing and evolving through an iterative UCD and evaluation process.

Our research in the DELVE project has shown that designs of learning spaces in SL may influence student learning and engagement. However, there are several other contextual factors that may impact on student experience: such as student's SL skills, their motivation, and the educator's SL skills and preparations for the activities, whether SL is a compulsory component, whether SL activities will be assessed; and the nature of course delivery (distance education, face-to-face, or blended delivery).

**Limitations of our empirical investigations:** We interviewed a small number of students as compared to educators and designers in our empirical research. Furthermore, there is a need for conducting longitudinal studies where we can capture users' experiences over a period of time. This would enhance our understanding of the inter-relationships between learning experiences and the designs of the learning spaces as the designs evolve over time. Finally, we haven't (to-date) evaluated the design guidelines proposed in this paper for their applicability and usefulness.

**Taking this research further**: There are three key areas that we hope, will contribute towards a better understanding of the design of learning spaces in 3D VWs: (a) it would be useful to draw out lessons from the design of physical learning spaces [16], and particularly, principles of accessible physical designs (b) The principles of game

usability (e.g. [17]) will help enrich the designer's toolbox for designing and evaluating 3D learning spaces for immersion, fun, flow, playfulness, choreography, and engagement; (c) principles of cross-cultural usability. The signs for wayfinding and navigation, the metaphors in the design of objects and the islands, and the symbols and icons used are some of the design aspects, which can be country and culture-specific. As with websites and designs of other products and services, it will be useful to develop guidelines for cross-cultural usability for designing SL spaces.

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### Exploring Persona-Scenarios - Using Storytelling to Identify Requirements

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Abstract. This paper explores the persona-scenario method as a means for requirements determination. More specifically, is investigates how the method can support project participants in generating shared understandings and design ideas. As persona-scenarios are stories we draw on narrative theory to define what a persona-scenario is and which narrative elements it should consist of. Looking at an empirical study reported elsewhere a key finding is, that despite our inherent human ability to construct, tell, and interpret stories it is not easy to write and present a good, coherent, and design-oriented story without methodical support. The paper therefore contributes with conceptual guidelines that delineate a) what a design-oriented persona-scenario should consist of (product) and b) how to write it (procedure) in order to generate and validate as many, new, and shared understandings and design ideas as possible (purpose). The goal and final result of this research is to develop a set of theoretical grounded guidelines. The purpose of the guidelines is to facilitate the construction of persona-scenarios as good, coherent stories, which make sense to the storytellers and to the audience - and which therefore generate many, new, and shared understandings and design ideas.

**Keywords:** Storytelling, personas, scenarios, narrative theory, IT systems development, e-reporting.

#### **1** Introduction

Storytelling has been proposed as a relevant basis from which to theorize and collect, and analyze empirical data about IT systems and IT systems development. It is argued that it is advantageous to research storytelling processes in situ because it allows for insight that goes beyond the neat, happy, and official managerial and public relations story. Research reveal that there are many, often divergent, and competing stories, and story interpretations in circulation when it comes to executive sense making of IT innovations and the hype that surrounds them in the marketplace [2], IT systems development and implementation failure and its political implications [3],

[4], and the understanding and performance of IT systems development as rational, methodical behavior and/or the enactment of myths, metaphors, and rituals [5].

Based on an empirical study of an IT development project in which social actor network and a structural approach to narrative are used as foundation and data analysis method, it has also been suggested that: a) the development process can be researched as a story, b) conceptualization of the IT systems under development as a story, or metaphor, helps facilitate collaboration and the creation of shared understanding among project participants with different backgrounds and expertise, and c) when developed, the IT system presents itself as a story to the user [6].

IT systems development is a complex endeavor with a number of persistent problems [7] because, among other reasons, the process often involves diverse participants that have to work together and share their knowledge and because the mechanisms where by individuals share and integrate their expertise is not well understood [6]. Moreover, simply asking future users to specify requirements and come up with innovative ideas for the IT system will not suffice [8] as it is difficult for people to talk about and relate to a non-existing artifact. For requirements determination this means a significant bias toward requirements based on current practices, already available information, recent events, and inference from small samples of events [8]. The analyst and user have to compensate for these biases, e.g., via methods that provide guidance for overcoming them [8]. In addition, it is difficult for users to describe requirements in terms of facts, fields, rules, and algorithms [9, 10]. One suggestion is therefore that it might be useful to focus on, interpret, and elicit requirements from the stories of existing and hypothetical practices that prospective users tell during requirements interviews [9].

Another suggestion is to use scenarios, which have been described as easy to relate to and remember as they draw on our human ability to individually and jointly make sense of, arrange, and convey information in a narrative form [10]. There are many different types of scenarios. For the purpose of this paper, we make a distinction between scenarios that are not and personas-scenarios that are based on personas descriptions. Our focus is on the latter.

The personas method and its belonging scenario part have gained popularity within systems development. However, even though the persona-scenario is a vital part of the persona method it is not commonly agreed and well defined what constitutes a persona-scenario, what types of understandings and design ideas persona-scenarios generate, and how they might be applied to generate as many new understandings and design ideas as possible. This is in part due to the scant literature on the topic. Numerous practitioner reports that describe experiences with the method can be found on the Internet, but there are few empirical studies at journal level and only three complete books [11],[12],[13] about the persona method. In other words, the persona literature is conceptually and empirically weak with regard to the scenario aspect of the method.

To contribute to the field of systems development in general and to the literature about personas in particular, we set out to study and answer the following research question: how can systems development project participants use the persona-scenario method as a mechanism for creating stories that generate as many, new, and shared understandings and design ideas during IT systems requirements determination as possible? To answer the research question we first look at scenarios as described in the persona literature and compare the literature to narrative theory. From this we define a persona-scenario in terms of narrative elements. Finally we look at an earlier reported empirical study [26] to extract experiences. We wish to explore the persona-scenario method as a means for supporting groups of project participants in constructing and performing multiple stories that complement each other in generating many, new, and shared understandings, and design ideas during requirements determination. As such, our study builds on [9] research into how people use narratives to convey information about requirements.

#### 2 Presenting Personas and Scenarios

A persona is a description of a fictitious user, based on data from user research. In IT systems development the persona description is used as the foundation for outlining a persona-scenario that investigates the use of an IT system from the particular user's point of view.

The scenario term and method is not a novelty. It has previously been used in the Scenario-Based Engineering Process that combines business process reengineering with systems development [14] and to refer to more abstract illustrations of systems use, such as use cases. Even though scenarios have been around for some time there is no single definition in common use [15]. Some definitions are that scenarios are: "descriptions of natural, constructed or imagined contexts for user-product interactions." [16] p. 153, "a description of a set of users, a context and a set of tasks that users perform or want to perform. A scenario sketches future technologies" [17] p. 13, or that they are stories about people and their activities [18] p.17. At the broad level, there seems to be agreement that scenarios are stories and this is also the view we adopt in this paper.

Cooper [11] explains that both scenario-based design and use cases miss the central aspect of understanding the user. Scenario-based design focuses on describing how users accomplish tasks and sees the user as an abstracted role, while use cases treat all possible user interactions as equally likely and important, lack description of context, and use variables and class names instead of more literal descriptions. In contrast, persona-scenarios view the user as a particular person with emotions, actions, and needs and it is the persona who is the focal point of the persona-scenario, not the IT system. However, even though this is commonly recognized, there is no unanimous definition of what a persona-scenario is and what it consists of.

First of all the persona method authors suggest different types of personascenarios. Cooper [11] suggests a progression from initial, high-level personascenarios to more and more detailed ones with increasing emphasis on the userproduct interaction. As a part of this progression, they distinguish between *problem scenarios*, which are stories about a problem domain as it exists prior to, and *design scenarios* that convey a new vision of the situation after technology introduction. Pruitt & Adlin [12] refer to Quesenbury's [19] definition of different types of personas and to scenarios with different levels of detail placed in a continuum between evocative and prescriptive scenarios as well as along the development process. Mulder & Yar [13] focus exclusively on web development and only propose one type of scenario that describes a persona's journey through a website. Second, the method authors provide different lists of elements that could/should be included in a 'complete' or 'good' scenario. Between the authors [12, 13, 14, 20] the lists of scenario elements are somewhat similar, but also that only [19] and [13] explain the elements that should be included in a scenario and this only in a brief manner. [13] state that the scenario elements they outline are the classic components of storytelling. However, they do not explain what classic storytelling is. In general, the persona literature is clearly inspired by, but does not explicitly reference narrative theory as an established knowledge base and source of already defined (if controversially discussed) key concepts, such as story elements. We suggest that it is relevant to look more closely at the narrative aspect of persona-scenarios and to draw more explicitly on narrative theory in doing so.

#### **3** Presenting Narrative Theory

In this paper, we draw on narrative theory positioned within the cognitive and the technical approaches to the study of stories [20]. The cognitive approach describes narrative as an operation of the mind, as a way to create meaning. The technical approach defines narratives and narrative elements. Thus, narrative is considered both a process (mental story construction) and a product [20]; both performance and text [1].

Narrative theory refers to the narrative as consisting of the overall story and the narrative discourse [21]. The overall story is the events in sequence, bound by the laws of time and proceeding in one direction starting with a beginning, passing through the middle and arriving at the end. The narrative discourse is the representation of events. The narrative discourse is not bound by the laws of time and can present the events in any order [21].

Another relevant distinction is between 'being a narrative' and 'having narrativity' [20]. 'Being a narrative' refers to any semiotic object produced with the intent of evoking story construction in the mind of the audience, while 'having narrativity' means being able to evoke such mental story construction [20]. From this it follows that a narrative text can have low narrativity meaning that the audience is not able to (re)construct the overall story and that pictures, prototypes, etc. can have narrativity without being narratives in a literal sense.

It is by no means an easy task to define which elements a narrative consists of. Discussions range from how the smallest elements of a narrative are defined to whether media should be considered. We draw on the strand of theory that argues that a narrative has to have more than one event and that these events have to be causally connected [22], [23], [20], [24]. Moreover, for a text (in the broadest sense of the word) to qualify as a narrative it must [20]:

**Create a world** and populate it with characters and objects; the world must undergo changes of state that are caused by non-routine physical events: either accidents/happenings or deliberate human action.

Allow the reconstruction of an interpretive network of goals, plans, causal relations, and psychological motivations around the narrated events.

According to the prototypical story form [25] a story begins with a setting in which characters, location, problems, and time is presented. After this presentation, one or more episodes follow, each having a beginning and a development towards a goal. In the opening episode, the character reacts to the beginning events, sets a goal, and outlines a path to reach the goal. Each episode focuses on the goal, attempts to reach the goal, and obstacles for reaching the goal. The attempts are understood as the causes to the outcome. Each episode links to the overall story, thereby creating the plot.

#### **4** The scenario in a narrative theory perspective

Below presents an overview of the story form [22, 25]and our 'translation' here of to a persona-scenario context. The translation of narrative theory to a personascenario context address the theoretical gap and confusion about what a personascenario is and should consist of currently existing in the literature.

**Character(s):** a protagonist as well as minor characters. A character can be any entity that has agency, involved in the action.

In persona-scenarios the persona is the protagonist. (In scenario-based design the main character and protagonist is the IT system.)

**Time:** both the time in which the actions take place, e.g. the future, and the story development over time - beginning, middle, and end.

Most persona-scenarios are set in present time but they can also concern a distant future. The story time can last minutes, days, months, etc.

Problem: a loss, a need, a lack of something, an obstacle to overcome, a conflict.

The persona has a problem.

Setting: presentation of characters, location, problems, and time.

The narrative begins with a presentation of the persona, his or hers problems, the place where the action takes place as well as the time (present time/distant future).

**Opening episode**: the character reacts to the problem, sets a goal, and outlines a path to the goal.

The persona defines the goal and starts to act.

**Episodes**: development toward the goal. Episodes consist of: Beginning, attempts, events (accidents, obstacles, happenings, deliberate human actions), development

The persona-scenario develops through a sequence of episodes that concern the problem, the goal and the attempts to reach the goal, the events involved in these attempts and the obstacles hindering fulfillment of the goal.

Resolution: the problem is solved and the goal is reached - or not.

There are two types of persona-scenarios (as well as other types of scenarios) – one where the problem is solved and the goal is reached, and one where they are not.

**Plot**: the linkage and order of the episodes.

Most persona-scenarios (as well as other types of scenarios) are presented in a linear manner, without deviations from the story time.

**Overall story**: starts with a beginning, goes through a middle, and arrives at the end. The overall story is sensitive towards what is considered ordinary social practice within a given culture and explains deviations from accepted social practice. Each episode links to and has to be meaningful in relation to the overall story.

The persona-scenario has to explain why non-routine actions and events happen and how they are dealt with.

Narrator's perspective: The narrative is told by someone.

Most persona-scenarios (as well as other types of scenarios) are told in third-person allowing the narrator to be omnipotent.

Design-oriented persona-scenarios are stories about personas using IT systems. Looking at en empirical study of project participants involved in writing scenarios for systems development [26], persona-scenarios are stories, that establishes a sort of interdisciplinary understanding and they help the project participants to get the persona 'under their skin'. The purpose of the stories are to serve as a mechanism for generating and sharing many new understandings about the prospective users as well as multiple design ideas for the future IT system.

Narrative theory [21] suggests that humans have an intuitive understanding of and expect stories to follow the story form. The case study analysis showed that for scenario writers once the story is started it develops in its own course. When a certain setting and the elements here of are introduced they can have unexpected consequences for the story and can lead to plots and endings that are too simplistic *- from a design perspective*. Such plots and endings are intuitively perceived as unconvincing, both by the scenario writers and the audience. However, the case study also showed that it is much easier to instinctively interpret a scenario's level of narrativity and plausibility than it is to write a scenario that follows the story form, and solves the persona's problems in a design-oriented way.

To construct a convincing design scenario, we propose that while the persona is the protagonist the future IT system has to play a prominent role as well. But how? Orlikowski & Iacono [27] argue that it is essential to explicitly conceptualize the IT artefact and based on a literature study, they suggest that it can be done as follows. IT can be seen as: 1) a labor substitution, productivity, information processing, and social relations tool; 2) proxy; 3) ensemble, i.e. as one element among many; 4) computation; and as 5) nominal, i.e. the IT system is abstract or even completely absent as the emphasis is on other topics [27], especially the last view is prevailing in the literature. In the reported study the scenarios are described in abstract terms, lacks the future system, and the future system is present and somewhat concrete, but the focus is on other aspects. And finally in one scenario the future IT system takes on the role of a main character, or object, conceptualized as a productivity and information processing tool. In line with [27], we agree that it is necessary to conceptualize the IT system in a concrete way. However, when it comes to persona-scenarios the IT artifact is a part of the story and therefore, it also has to be conceptualized as a part of the narrative elements that make up a story. Thus, within the story and with regard to the narrative elements, the IT system is a part of the events - rather than a character or tool-like object - because the emphasize should be on, and the IT system becomes tangible in, the interaction that takes place between the user and the IT system. This also means that the more detailed and concrete the events are and the more they address obstacles and design-oriented ways of overcoming the obstacles, the more concrete the future IT system and design ideas for the future IT system stand out within the story and get validated from the persona's point of view. Therefore, we also recommend that in design scenarios the problem should always be solved and the goal should always be reached.

IFIP HWID2009 Working Conference on Usability in Social, Cultural and Organizational Contexts, Oct. 7-8, Pune, India. The implications of the presented findings for research and practice are as follows. The existing research on storytelling tends to stress how easy and natural it is for people to construct, tell, and interpret stories. However, [26] shows that it is difficult to write and present a good, coherent and design-oriented story without methodical support. This suggests that more theoretical and empirical research is needed to investigate what kind of theories, methods, and detailed guidelines that are needed to support the practical work of generating IT systems requirements via storytelling. In particular we suggest that more research is needed to refine the persona-scenario method by providing clearer definitions of concepts and 'how-to' guidelines based on narrative theory and narrative analysis of the content and performance of persona-scenario workshops so that they are organized around a focus on the story form and to provide guidelines and templates for working with the story form.

#### 5 Conclusion

In this paper we investigate persona-scenarios as a mechanism for supporting the work of diverse IT project participants during requirements determination. We conclude that because persona-scenarios are stories and thus, draw on our human ability to intuitively arrange and understand information conveyed in a narrative form they allow for interdisciplinary knowledge sharing and creation of a common understanding about personas and their use of the IT system. However, despite our inherent human ability to construct, tell, and interpret stories, it is not easy to write and present a good, coherent story that generate many new understandings and design ideas. A set of guidelines concerning how to construct and present persona-scenarios is therefore needed.

Narrative theory suggests that stories that are in line with the story form and its narrative elements are easier to relate to, remember and in general more convincing. Narrative analysis [26] of the content of four persona-scenarios supports this and further shows that:

- In order to generate design ideas the events in the persona-scenario have to be described in a concrete and detailed manner.
- In order to generate as many new understandings and design ideas as possible the persona's problem presented in the beginning of the persona-scenario as well as the obstacles the persona encounters as events unfold should be investigated and solved within the story. Thus, design scenarios should have a happy ending.
- In order to validate understandings and design ideas from the persona's point of view the persona-scenario should concern the use of the future IT system.

The IT system is a part of the events and becomes tangible in the interaction that takes place between the user and the IT system. Therefore, the more concrete and detailed the events are and the more they emphasize obstacles and design-oriented ways of overcoming the obstacles, the more concrete aspects of and design ideas for the future IT system will stand out and get validated from the persona's point of view. Below, we present a set of theoretical and empirically grounded guidelines that outline a) the narrative elements that a persona-scenario should consist of (see Table 2) literature-based findings are shown in normal text, case study findings in *italic*) and b) a procedure for how to construct and present persona-scenarios to generate as many, new, and shared understandings and design ideas as possible.

Narrative	Narrative elements in Persona-Scenarios
elements	
Character(s)	The persona should be the protagonist, not the IT system.
Time	Most persona-scenarios are set in present time but they can also concern a
	distant future. The story time can last minutes, days, months, etc.
	The persona-scenario should concern the use of the future IT system.
Problem	The persona has a problem. A problem can be a loss, a need, a lack of
	something, an obstacle to overcome, a conflict, etc.
	The problem should be investigated and solved within the story.
Setting	The persona-scenario should begin with a presentation of the persona, his or
	hers problems, the place where the action takes place as well as the time
	(present time/distant future).
Opening	In the opening episode, the persona should define the goal and start to act.
episode	
Episodes	The persona-scenario should develop through a sequence of episodes that
	concern the problem, the goal and the attempts to reach the goal, the events
	involved in these attempts, and the obstacles hindering fulfillment of the goal.
	Events have to be described in a concrete and detailed manner.
	The IT system is a part of the events and it (only) becomes tangible in the
	interaction that takes place between the user and the IT system.
	Obstacles should be overcome as a part of the events to as high a degree as
	possible.
Resolution	In design scenarios, the problem should be solved and the goal reached.
Plot	Most persona-scenarios are presented in a linear manner, without deviations
	from the story time.
Overall story	Each episode should link to and be meaningful in relation to the overall
	story.
	The persona-scenario should explain why non-routine actions and events
	happen and how they are dealt with.
Narrator's	Most persona-scenarios are told in third-person allowing the narrator to be
perspective	omnipotent.

Table 2: What a design-oriented persona-scenario should consist of

In order to write and work with persona-scenarios in future workshops we suggest the following procedure:

**Introduction**: The workshop leader a) introduces the workshop participants to the persona-scenario method and the distinction between problem and design scenario as well as the story form and the guidelines presented in Table 2 and b) hands out the scenario start situations, the guidelines in Table 2, and a template that can support the groups in working with the story form.

Preparation: The workshop participants fill in the template.

Writing: The workshop participants write the persona-scenario, using the filled-in template.

**Analysis:** The workshop participants analyze the written persona-scenarios in accordance with the narrative elements and guidelines outlined in Table 3. Special attention should be given to whether the initially stated problem and encountered obstacles are defined, investigated, and solved in a convincing, design oriented way within the story. Based on the analysis, the persona-scenarios are revised.

**Requirements determination**: The written persona-scenarios are read out loud, and from each persona-scenario, understandings, design ideas, and requirements are collaboratively extracted by the scenario writers and the audience.

More empirical research is needed to investigate and understand how the guidelines in Table 2 can best be implemented in a supporting template and how an intermediate step, where the written persona-scenarios are analyzed in accordance with the story form and its elements, will affect the experience and the understandings and design ideas generated.

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#### **Design as a Multimodal Conversation**

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**Abstract.** This paper explores the concept of design as a multimodal conversation, in the context of observed case studies within interdisciplinary collaboration. Five case studies were video recorded and the verbal and nonverbal designers' behaviours as well as the designers' interactions with the artefacts were analysed. The analysis revealed an experience based on dialogue which was considered a clear paradigm of all forms of interaction using words or images.

Keywords: Design, Interdisciplinary collaboration, Behaviours, Artefacts, Dialogue

#### **1** Introduction

Design teams have conversations during the design process. Conversations are multimodal in the sense that communication occur with speech and also with visual media including non-verbal behaviours. During the conversations designers discuss their ideas, and it is apparent they come from different angles – differing levels of experience, differences in age and profession, differences in abilities to deal with technical or non technical tasks, among others. The use of dialogue as a tool allows ideas exchange, finding connections and meaning, and interests in a real collaborative environment.

Design is actively constructed, with clear step by step progressions. Designers construct themselves in the production of dialogue by speaking and behaving in a certain way which is in accordance with themselves, with those around them and with what they are engaged in doing at the time. Due to both these factors, the way in which they cooperated to generate design was easily observed, helping to reveal a shared sense, and which also displayed the motivation and the enthusiasm they had or had not in the formal and informal environment that surrounded the design process. The dialogue conversations transversed all the process of design but the way the designers communicated was better understood by the way they used language.

This paper explores what designers said and how they behaved during the design process. It was understood that design is a facilitator of interactions between humans through objects that have some sort of ability to sense and respond to human input via communication. Design is also about behaviour, the behaviour of artefacts, with how artefacts work and the behaviour of designers interacting with others and with artefacts. Designers interact through verbal and non verbal behaviours, which is

reflected on the produced artefact/artwork, and that will contribute to facilitate the design process and to enhance design quality.

The kind of design practice observed in this study is focussed on what designers experience and the actions that create these experiences, the ideas, emotions, and memories they had. In conjunction with the presented approach a design thinking process was also identified for practical, creative resolution of problems or issues.

The reflections presented in this paper are the result of the analysis of five case studies.

#### 2 Communication as the Interaction Vehicle among Designers

Communication is one of those human activities that everyone recognises and for which a variety of definitions can be found. It is common, and people tend to, quite naturally, think of communication as a process rooted in the use of words. But communication has to do with more than just the spoken or written word. The status of design, as practiced by designers, in this study, was established through a combined communication of both action and words. The designers considered the idea they wished to develop and selected the best means of communication: drawings, photos, verbal comments, and models.

Communication played a central role in the design process as the way by which information was exchanged between designers through a common system of symbols, signs, opinions or behaviours. It was the vehicle of interaction, transmission of ideas and exchange of meaning.

The process of communication was seen as a process of intervention where the position of the designer of the information and that of the interpreter (other design participants) worked together in search for a common ground. Design communication was concerned with affecting the knowledge, the attitudes and the behaviour of people (designers and others participants).

Design is itself communication. Nelson's (2003:174) definition of design emphasises communication: "every design is in some sense a social communication, and what matters is...the emotional intensity with which the essentials have been explored and expressed." Jim Wilson in Frascara (2002:30) pointed out that "I would argue that designing is not just a visual process – rather, in important respects, it is a verbal process. This does not mean that visuals, models, and software (as end products) are not the reason for design – they are – but that the process, when properly executed, is inherently verbal."

#### **3** Multimodal Design Conversations

Conversations are multimodal in various senses, for example, communication can occur not just with speech, but also with visual media including gesture and gaze. When people interact with others, face to face, they are constantly sending and receiving messages through signs, expressions, gestures, postures and

vocal expressions. Buchanan et al. (2004:190) Secondly, different media sets must be used for different communications.

We present here conversation features, verbal and non-verbal behaviours and visual elements conveyed through artefacts which were analysed within the observed case studies and which were considered conversation features.

Verbal and non verbal behaviour go hand in hand, often simultaneously, and both either together or apart in face-to-face interactions. They have a significant impact on whether or not people achieve their objectives with other people. Verbal behaviours analysis is considered to be the process of breaking behaviour down into smaller elements – sentences or utterances.

The benefits of verbal behaviour analysis are that they give precise information for describing what was going on in the design and dialogue interaction processes: that they are a practicable means of monitoring, in this research, designer's behaviours.

The use of non-verbal behaviour has some advantages. First, it provides extra information, which aids understanding what people are in reality, what they are thinking, feeling or meaning. The other advantage permits us to have a more successful relationship with and understanding of people. However, non-verbal behaviours are easy to observe but difficult to interpret. The problem is deducing a correct meaning from what has been seen, and it cannot be generalised because of the diversity of people's cultures. Guirdham (2002:184) describes non-verbal behaviour as a "*relationship language*". This language is the tool through which people, without stating feelings openly, communicate, for example, trust, boredom, submission, dislike and friendship. When decoding non-verbal behaviour, it is important to pay attention to the context, and to the pattern or cluster of verbal and non-verbal behaviours on display.

Artefacts are the designers' outcome. They reflect the designer's experience, skills, conversations, emotions and culture. Artefacts are expressions with different signs on different levels of design language.

#### 3.1 Dialogue as Conversation

Design as a communication process is a dialogue between all the participants in the design process and elements of design. All designs tell something, through text, image, symbols, or styles. It is a conversation between the designer and people.

Cheepen (1995), Anderson (1999) and Isaacs (1999) consider dialogue as a conversation. Cheepen (1995:01) argues that "conversation (...) is dialogue (...). A conversation has no overt goal in terms of the world outside the encounter; it serves simply to allow the participants to develop interpersonal ties, so that it is the relationship of the speakers (...) which becomes the goal of the talk."

Anderson in McNamee (1999:65) states that "by dialogue, I mean a dynamic generative kind of conversation in which there is room for all voices, in which each person is wholly present, and in which there is a two-way exchange and crisscrossing of ideas, thoughts, opinions and feelings".

Isaacs (1999:09) defines dialogue as "a conversation in which people think together in relationship; thinking together implies that you no longer take your own position as final" (1999:19).

According to Bohm (1996) dialogue is a multifarious process which encloses an amplitude of human experience including personal values and cultural myths, the nature of emotions, and ways of thinking. For him "dialogue is the collective way of opening up judgments and assumptions".

Design is conversation or dialogue in the sense that, for example, both are forms of inquiries; in design thinking there is no judgment; in dialogue suspension of judgments is recommended; design thinking is a creative process based around the building up of ideas; dialogue suggests the sharing of ideas amongst teams – collaborative design; design thinking promotes the effect of cultural and knowledge transfer in the design activity; exchange of knowledge is also an important goal within dialogue.

Our definition of dialogue, in a design context, is: a process of conversation between designers and other participants which is reflected on the produced artefact.

We believe that dialogue is the ideal form of human communication, where the interpretation allows for exchange and adjustment, and for the building and extending of a shared ground. Dialogue is very effective, paraphrasing Isaac (1999) as a collaborative communication method. It is a process for gaining common understanding and common meaning among individuals in a group (Nelson 2003).

#### 4 The Study

This research was conducted within the Leonardo Network group and the White Rose Network for Affective Communication in Consumer Product and Exhibition Design. From the former case studies were considered: Case Study one - Chindogu Challenge (Team1, Team2, Team3); Case Study two - Human Beans – Culture, Creativity and Interaction Design; Case Study three - TIDE – The Integrated Development Environment Art; Case Study four – Threshold. From the latter network one case study was analysed: Case Study five - Human Beans – Affective Communication.

There were about twenty institutions in the former and four in the latter; and about 55 artists and technologists that took part in the study. The methods used to collect data were centred on a qualitative study, a combination of research methods was used to collect the data, literature review, including documentation, records of individual and group's experiences and behaviours, case studies, interviews and observation.

Concerning conversations, data was gathered about the "actual" words of people and their conversations were reproduced to the best of our ability from the transcripts and participant observations. We attempted to preserve the context in which things were said and done.

The data analysis main concern was not just in how utterances were made cohesive, nor in how cohesion was achieved across turns. There was also interest in

how interactivity was achieved: that was, what roles speakers took on, how they positioned other participants into particular roles, how turn taking and topic change occurred in contexts where one person was not in control, and the different kinds of feedback strategies that designers used.

The main objective was to understand what designers said during the design process and in what ways they spoke. Were they interested in listening to the others' opinions or were they imposing their ideas, speaking all at once without allowing the others to speak? Was the conversation sequentially organised according to the design phases or were they mixing subjects along the process?

In pursuing these questions, Conversation Analysis (CA) methods were used:

- The turn taking mechanisms in conversation (Sacks, Schegloff and Jefferson, 1974);
- The adjacency pair structure of conversation (Schegloff and Sacks, 1973/1974);
- How speakers initiate, shift and close topics, referred to as topic management (Sacks, 1992);
- How conversations can keep going indefinitely and continue to make sense.

Verbal and non-verbal behaviours were presented as a complement to dialogue to understand what was said and in what conditions and also how designers were motivated throughout the design process.

#### 4.1 Methodologies

Mixed research methodologies were undertaken: Grounded Theory Methodology (GTM), Ethnography, Actor-network Theory (ANT) and Discourse Analysis (DA). Some of their principles were deeply taken into consideration and others were not. The justification to not choose only one methodology was because of the multidisciplinary nature of the research and it was found that all of them could complement each other and give a richer strategy for the research.

In GTM studies data gathering and analysis are tightly interwoven processes; data analysis guides future data collection. Data collection is not considered to be a specific phase that must be completed before analysis begins; after the first collection exercise it is a matter of carrying out the first analysis, finding indicators for particular concepts, expanding concepts into categories and, on the basis of these results, collecting further data. In this mode of procedure, data collection is never completely excluded, since through the process of coding and memo writing new questions always arise which can only be dealt with if new data is collected or earlier data reexamined.

Ethnographic methods and techniques helped to guide the researcher through the swamp of personal observation and to accurately identify and classify the bewildering variety of events and actions that formed social situations. Ethnographic research has most of the following features which were followed in this research:

• People's behaviour was studied in informal contexts, rather than under conditions created by the researcher;
- Data was gathered from a variety of sources, observations and /or relatively informal conversations;
- The approach to data collection was unstructured, in the sense that it did not involve following through a detailed plan set up at the beginning, nor were the categories used for interpreting what people said and did entirely pre-given or fixed;
- The analysis of the data involved interpretation of the meaning and functions of human actions and mainly took the form of verbal descriptions and explanations.

ANT legitimated the interaction between humans (the designer) and nonhumans (technology/artworks). The notion of network enhanced better understanding and aligned the interests of actors and their interaction with a multiplicity of different materials.

DA, using the Conversation Analysis method allowed exploration of the contributions of different designers dialoguing and their different types of working methods.

Data gathering methods included semi structured interviews, observations during meetings and workshops and document analysis. Data was gathered from the initial sample group in a cyclical process: observations; interviews; collection of sketches; more documents; more observations; more visual images such as photography and sketches. Video recordings were used to record observations – both visual aspects and verbal interaction.

The data analysis process was a complex task, especially because of the variety of information and diversity of methods used. Data was collected and dated; descriptions for each case was written; key themes and coding for them were identified; arguments/analysis with supporting evidence in the data/literature was built; transcriptions were made.

The participants were recorded with videotape and for example, hand-written notes were used. Video was used to allow the interaction analysis. The recorded activity was transcribed and involved recorded dialogue, description of non-vocal aspects of interaction, including gestures and body language; and description of interaction between people and artworks.

# **5** Discussion

This section presents a summary analysis of the conversations and behaviours observed within the observed case studies. Concerning non-verbal behaviours, it is not the aim of this study to judge people's behaviours according to the gestures that could occur as a demonstration of personality and also because all of the observed gestures could be misunderstood and not correspond to people's intentions. Some people create impressions of their personality through posture.

Another reason to not judge is based on the time and the environment during which the observations took place. The atmosphere was informal and the time

schedule to develop each artefact was very short which was not, probably, enough to understand all the gesture occurrences or other behaviours. The interpretation made will ensure that the meaning of gestures are clarified and not misunderstood along the dialogue established. To avoid reaching untrue conclusions, no judgements will be made.

#### 5.1 Conversation Organisation

Within conversation analysis, there were some relevant questions to be answered in the description of conversation. The following answers are given in relation to designers because they were the actors on this study. However, these answers could be given by anyone in any conversation. The goal here was to apply conversation analysis rules to design teams' dialogue – a specific type of individual performing specific tasks - to show that when they are producing an artefact, at they behave in the same way as any individual behaves in doing any task.

- Why did the designers speak one at a time? In conversation there are no pre-set rules, for who talks when or for how long wasn't defined. Designers seemed to respect themselves and they made use of turn taking to take the floor.
- How do designers know when to change turns? Transitions from one turn to another with no overlap were regular. The current speaker selected the next speaker by addressing a question or speakers self-selected in starting to talk.
- How do designers know when to initiate new topics? They know because, generally, the last speaker ended with a sentence like: "Okay it's done. Now (..."); or the next speaker introduces the new topic by himself, by using a question or even a declarative sentence.
- How do designers know it is appropriate to interrupt? Frequently, one speaker talked at a time but it happened that, by the use of gaze or eye contact, and also through some gestures, a speaker interrupted another. In some cases they made overlaps.
- How can a designer complete another speaker's utterance? Usually they interrupted the other, or waited for their turn to complete the first speaker's utterance.
- How do designers recognise when a speaker wants to close a conversation? The length of conversation was not specified in advance. When a speaker wanted to close a conversation they said something like: "Well", "Okay" or direct information "You need to leave", "We've finished".

Sometimes a speaker positioned another participant into a particular role when he wanted more information to be added and the other was the expert in a specific subject. In both Human Beans workshops the problem was fully explained to the group. Each group worked separately to generate their own ideas and possible solutions. All of the written or drawn ideas were put down on paper. During the design process they decided on the idea to present and they conversed about how to reach the proposed goal. No one took a significant position or defined role; they worked together as a team. Each idea was presented and clarified to the other groups at a scheduled time. A kind of evaluation was performed by the workshop leaders and other groups. It was understood that designers, in general, enjoyed these tasks and engaged themselves in solving it, as can be interpreted from the case description presented before.

In the Chindogu case studies, they carried out, in some of the cases, a more or less structured approach to accomplish their tasks, but overall they answered the following questions: What do we have? What can we create from these objects? Can we connect these things together? Where does this solution fit into the challenge themes and Chindogu tenets? Why should we or not develop this idea? In all cases, after brainstorming and dialogue, they reached their goal, and a great enthusiasm was found, as the following expressions reveal:

> S – "I quite like it! N – I quite like it as well! D – I like that! S - It has got potential!" – Group I

Al – "Wow (...) Yeah (...) that would be really useful (...) to charge up our phones (...) we could communicate while we are in the wild (...)" – Group II

P - I quite like the idea of interacting and I like the idea of cats. (...) There is a lot of potential!" - Group III

In TIDE, although they didn't develop the artwork during the phase of presenting ideas, they also displayed being engaged and enthusiastic in settling ideas for the artwork as observed in the following transcripts:

C – "The great satisfaction, I think, may be we would share that (...) the great satisfaction is producing something that works and that can be an aesthetic work or can be an audience work (...)

S - (...) what do you want? C - Acclaim, applause!"

C - "The project it's faulty, it's incomplete but I think it fulfilled the criteria of the original brief. And in so much that there has been a general collaboration."

Threshold had a different analysis; the only information gathered from it was from interviews. However, reading peoples expressions as opinions or comments, it could be understood that they were happy with the results:

N - "It was successful to a certain extent in that we've got along very well."

C - "I think that is an interesting project and Nadia has collected a lot of data by recording how interaction took place and that will provide raw data for analysis about interaction design and how spaces can be augmented potentially by that kind of interaction technology."

J - "I think that there's lot of potential in this particular installation. I think that I learned a lot about architecture and design by working with these people."

N - "It seems like a great project to me."

Designers adapted their speech according to the person they were talking to and also according to the point behind the speech. The transcript's use of language functions, during conversations helped to understand verbal behaviours variations through the way designers influenced and interacted with the kind of language used and how they made use of associated functions which language fulfils in different situations. There were some dominant functions including especially the referential and emotive. It was found that when one function was accentuated, it tended to diminish the importance of all the others; the emotive function did not refer to emotions but with the conditions of their senders; the referential function was related to the "things" spoken of, (Jacobson, 1969:355); metalingual function was used to establish mutual agreement, for example, through definitions or questions like "*What do you mean by*?" This function was manifested directly, when asking a question or indirectly, when only the answer was presented.

In considering if the designers used the main dialogue features, the designers presented their assumptions and opinions. The way they carried this out was by stating not by defending against somebody who had another opinion. They contributed their knowledge to the dialogue in progress: it was a process of sharing. Suspension involved attention, listening and looking and it also involved exposing a designer's reactions, impulses, feelings and opinions in such a way that they could be reflected back to the others in the group; Inquiry and reflection was made by asking open-ended questions as a form of exploration of assumptions and beliefs. Reflection provided the opportunity to review and connect with what had been said. Reflection also provided the opportunity to slow down and collect their thoughts. This was done with questions like: "What if ..?" or "what does it mean to you?"; Listening - Good listening was both an active and passive skill, it took an effort to really hear and digest what was being said. One of the goals of a dialogue is to learn by clarifying what people don't understand, and to open their minds to other approaches and perspectives. In so doing, they were uncovering of what was getting in the way of effective communication. The tools they used to accomplish this were: listening actively, asking clarifying questions to make sure they understood, and repeating back what they had heard to confirm that they were interpreting accurately.

#### 5.2 Verbal Behaviours

Verbal behaviour has to do with the way people express themselves. Honey (1988) refers that behaviour has nine categories that occurred as steps within the design and dialogue processes. Jaques (1991:35) considered eight verbal behaviour

categories: Seeking ideas; Suggesting/Proposing; Supporting; Seeking Clarification; Disagreeing; Clarifying/Explaining/Informing; Expressing Feelings; Relationships within Group. Lopes (2008) in her analysis considered only four categories: seeking ideas and clarification and added expressing feelings and relationships within groups.

During the design process whilst designers were working to produce the artefact and talking, they made use of these categories to dialogue which permitted to observe their structured behaviour.

In some way they had the preoccupation to share knowledge and they behaved in an ideal mood for the collaboration being productive and proficient. Designers had the preoccupation to share not only their knowledge but also their experiences to reach the goal of constructing an artefact and they created propitiate collaborative and communicative environment for that.

Seeking Ideas - In this category designers requested facts, or relevant information, or even they asked ideas. They asked more information using declarative or interrogative sentences, as verified, they used especially interrogative sentences. In both TIDE and Chindogu projects, the sentences were longer than in Human Beans case studies. The justification for this, respect to the characteristics of these case studies: people talked during short periods of time being concerned with the goal of producing, at the same time, drawings representing their ideas. Conversely, each task had a short time schedule.

Suggesting/Proposing - Suggestions/propositions were given in an explicit form: by using the personal pronoun in the plural making the sense of agreement between participants "we *could create a random* (...)"; "we can use (...)"; "It seems to me that this is viable and we can (...)" or by an interrogative, inquiring someone or the group: "S how about (...)?"; "why we don't do what S suggested?"; or also by using "let's". They were also given in an implicit form, which means that through the content it could be inferred that the speaker was proposing: "Now, we need to get the dreams sequence, we need to see if it works."; "We can use the mouse to interact in a different way". Or finally, they used sentences that content information appealing to a change or modification: "I think the problem is the frustration of not contact the outside world".

Supporting - Supporting was a category easily understood by the use of agreement expressions such as: "Yes, I agree, Right, Yeah, Uhm". Or by the use of adjectives: "remarkable, very, really well" or by the verb: to "like" and finally by using the possessive pronoun: "your".

Seeking Clarification - In this category, demands were expressed almost of the time by using open questions, for example: "*How do you do that?*"; "*What do you think about (...)?*" "*Do you think (...)?*" "*Did you think (...)?*". Another form of asking clarification was by the phatic expression "*Isn't it*".

Disagreeing - There were few sentences expressing disagreement: "I don't think."; I'm really reluctant to (...)"; "It's the opposite with me.". Or by the use of adjectives and exclamatory sentences "(...) rubbish ideas!"; "(...) ridiculous!."

Clarifying/Explaining/Informing – In this category it was found many examples and it was quite straightforward to read them and understand that they are exemplificative of each subcategory.

Expressing Feelings – Designers expressed their feelings by using emotional expressions and adjectives: "*Uhm, much better.*"; "very good!"; "beautiful"; "I like that!" or by the content of the sentence: "I got the feeling of a cell (...)"; "We want to be at the beach, and we want to be relaxing."

Relationships within Group – The relationships within the group and the mood of the group was analysed in terms of the formality and informality – the way people treated themselves and expressed their feelings. In general, participants referred to each other using first names and they expressed freely their emotions by laughing and non verbal behaviours. It can be said that those meetings had an informal characteristic and some of the participants already met others in different occasions.

Concerning TIDE case, they also had some relationship before meeting for the project purpose: two elements were husband and wife and they already met with one of the others.

Expressions such as: "folks"; "pals" or sentences informing the group's engagement: "you fell part of a story" – the story was the meeting, the goals and the feelings about the artwork.

In Chindogu case study it was found the mood of the group through expressions like: "Looking into a who we are and what we learned of each other in this 45 minutes (...); or by the use of the personal pronoun "we" all the time they refer to ideas and tasks. The sense of belonging and cohesion was showed: "Can we?"; "We got (...)"; "were we?".

Each group was formed by different members and they come to play different roles: participants and leaders.

Factors such as knowledge, skills, ability, competence and experience could influence the exact position each member could acquire within the group structure. However, other factors such as personality traits or social factors, for example, being a good communicator or being socially skilled may also had impact.

It was sometimes perceived as dominance, the way someone, not reluctant to communicate openly in front of the others. And in those case studies this personal characteristic was identified by the period of time each member spoke, as it as presented before. Although, according to what was observed, dialogue occurred, in a free way, between members, and they worked closely together without any individual prominence.

The observations showed that there wasn't leadership and instead, the leader behaved in all the cases as a facilitator.

There are some differences between patterns of behaviour in the observed groups, such happened in TIDE group, which existed over a period of time, near two years, however, it drawn together, solely, for the purpose of this particular project. The same happened with the group of Threshold project, although, the characteristics of the group were different, people met, talked but they split tasks per participants.

For the case studies of both Human Beans projects, members of the group came together for the first time, and they devoted some energy to getting acquainted with one another and with the group's task. Even though, they managed very well and some of the members already knew others. They came to the workshop with some expectations about it but they had some ideas concerning the meeting's agenda, except that they didn't know the strategies to follow neither the themes to develop.

It was observed that the cohesiveness of each group was shown by the informal, and sometimes friendly and relaxed way people behaved and also by the use of the plural of the personnel pronoun "we" and the way each member supported one another and the use of informal communication – people addressing each other by first names.

Other remarks are: in general, not speaking with whole sentences; relaxed rules of turn taking; interruptions; change in conversation and several people talking at once; expression of feelings and emotions.

The success of each group was also been measured in terms of how much work it got done. In all the case studies they reach the goal and they produced an artwork or a drawing according to the case as it will be analysed in the next section.

From the explanation above it can be argued that design was informed as dialogue along the design process stages. Designers thought directed towards some end product the nature of which was communicated to other participants helping to design it. They grouped together information and they reflected and produced artefacts or artworks. They made design as a communicative tool and the communicative quality of the artefacts was explained to others.

They used different behavioural categories in different parts of the design process by generating a meaningful understanding by the tone, voice, look and feel they expressed.

#### 5.3 Non-Verbal Behaviours

When using non-verbal behaviours during dialogue, designers were influenced by them and, whether intentional or not they expressed some emotional state.

The problem was inferring an accurate meaning from what had been observed. The possibility of a wrong interpretation could be reduced by staying focused and not bound to a conclusion based on the observations of isolated pieces of behaviour. Therefore it was decided to base the interpretation on a number of different non-verbal behaviours that fitted together into a coherent pattern.

Another aspect to consider when analysing non-verbal behaviours had to do with generalising. It is one of those topics where there are more exceptions than agreements to every generalisation or rule. It is, therefore, misleading to assume that because doodling, for example, signifies boredom in some people it does for all people.

Allan Pease (1985, 1997) suggests that one can recognise somebody else's attitudes and emotions from their non-verbal behaviour. We consider that this is not always possible. One must be careful when judging this non-verbal behaviour because each gesture and expression can not be completely understood even in a specific context. People can behave differently spontaneously or can disguise their true emotions by pretending, forcing a wrong interpretation. However, it is possible to exchange meaning with non-verbal codes as long as verbal and non-verbal components are evaluated together within the context, as it will be argued.

The following non-verbal behaviour categories were considered:

Body posture was understood as the way designers stood, sat or walked or was concerned with hands, arms and legs movements or positions.

Posture was mainly observed in sitting positions by being still, sitting back or sitting on the side of the chair with changes of positions on seats like perching or displaying a sterner posture by sitting up straight and rigidly. One of the teams sat around a table with just one person stood up to write on a board. They sat still and moved, frequently, standing up or walking around the room.

Designers used hands and arms to complement speech almost constantly. A variety of movements were made by hands and arms. Hands were either in a relaxed position, or in pockets, which demonstrated an informal talking form; and hands were used especially to draw in space or to emphasise speech. Hand movements in rapid motions and to draw visual images were used frequently, using their hands to explain visual images, making visual images with their hands. Also simple gestures of placing hands on the face or mouth often occurred. The same happened with arms. They were crossed or folded, sometimes showing a relaxed posture. Participants positioned their arms resting on the table frequently. Legs were crossed and uncrossed all the time.

Bodily behaviours contained information about all the movements made by body parts or observed positions, mainly using the head, face, neck, fingers and feet, such as resting the chin and elbows on their hands and hands sometimes on the table or at the waist. The body behaviours were comprised essentially, of nodding movements for agreement, fiddling with pens and doodling, which could be considered as suggesting gestures of tension or boredom, but it was not the case, and touching the self. In the described contexts, it seems that people used those movements to occupy their hands while speaking and drawing or from habit or also as aids to concentration.

Facial expressions performed by lips, mouth, eyebrows etc or to express an emotion were made, and used to complement language, to substitute speech and also to indicate to others that the speaker had finished speaking.

Gestures, such as nodding and pointing were made as were movements such as fiddling, twiddling, playing, tapping and holding.

Gaze and eye contact were constant among participants sometimes, in an abusive way, to signify agreement and interest in what had been said. In general, they looked at each one when speaking. Gaze and eye contact were used to convey information about understanding, interest, reinforcement, or agreement. It seems, also, that a number of personality dimensions were related to gaze; people used it in the initiation of interaction or at the end of an encounter. There was a regular connection between talking and looking.

Quality of speech presents information about a variety of speech related elements, in different ways, such as tone, rate, silences and pauses. The differences between silence and pauses, in this context, are that a pause of speech could be speechless but with some sound production, such as nodding, tapping, expressions like "Uhm", and silence means no speech at all, no sound or gestures. The main observations about quality of speech in the observed teams were laughter, the use of louder voices, overlapping and sometimes, by speaking fairly quickly. However in some situations a low tone voice and calm way of speaking was used. There were pauses and silences frequently at the end of each turn taking within some teams whereas within others, they were almost inexistent. The quality of speech was in some cases, different from others, mainly through the changes in voice tone. It was observed that in almost all the case studies people laughed frequently which demonstrated the enjoyment and engagement during the interaction. In other cases just smiles were prevalent.

It was also considered interesting to observe proximity in sitting - referring to the place and closeness between people - proximity dealt with closeness which suggest more intimacy, although different cultures have different rules, and especially in HB – Affective Communication, groups were constituted by people from different countries, and so, some people were more closed with others, for example British persons, where cultural rules define a relatively distant position. Within some teams it was observed that participants were seated, and a small amount of space was found between them, in others they sat side by side and also in front of the others, and also in some, a participant was in a more prominent position than the others.

What verbal and non-verbal behaviours tell us about design as dialogue is how their uses are central to, and constitutive of the ways in which designers conduct their interactions. How each one talked about a topic during the design process reflected certain aspects of the speaker's attitude towards that topic and that had implications on the ideas being presented and steps to follow to attain the teams' goals.

Concerning non verbal behaviours, it is considered that all the behaviours had more to do with the designers' personality and the influence of the meeting's contexts. The relation between gestures and some aspects of personality depended on several different procedures: some gestures reflected a prevailing emotional state, or a style of behaviour; designers could control and manipulate their behaviours, and they could even produce the opposite gesture to their true state; some designers gesture style was, partly, a result of his/her cultural and professional, background, age, and sex or even health or fatigue state. Some designers made unconscious movements which could be considered as being closely integrated with the content of the speech itself.

#### 5.4 Artefacts

Artefacts reflect the dialogue conversations occurred during dialogue and the design processes. A detailed discussion of the analysis undertaken is out of the scope of this paper. However, some clues are presented to underline that dialogue conversations, really, took place during the design process.

The approach followed in the analysis was a social semiotic and a multimodal social semiotics. The former concerns pictures analysed as a meaningful texts, as social semiotics is interested in deconstructing a text to identify the elements that make up its structure.

The latter, according to van Leeuwen (2005: preface) "multimodal social semiotics is concerned with the way people use semiotic 'resources' both to produce

communicative artefacts and events and to interpret them ... in the context of specific social situations and practices".

Figures or texts were analysed within this perspective and also following Olesen et al. (2001) who consider that to describe a '*thing*' we need to describe its qualities and the '*context of the things*'. The qualities referred in this context are related to the object properties such as colour, shape, weight and size.

The analysis was an exploratory process involving a visual analysis of a dialogue through a series of drawings that were made in a dialogue context.

Far from being a subjective experience, we consider to be a profound dialogical achievement. During the visual analysis of the designers' interaction, the form of dialogue observed was: vocal and sketching in that they engaged in dialogue via both words and images.

The artefacts/artwork analysis was carried out in different deepening degrees based on the features presented in table 1.

Representational Meaning	Compositional Meaning	Interactive Meaning
Syntax (qualities of the artwork - lines, shapes, colours and textures) and Materials	Semantic (forms, purpose, and meaning)	Pragmatic (relationships)

Table 1 - Artefacts Analysis Features

In representational meaning, materials were included since the choice of materials is the vocabulary used to convey message, to allow dialogue. Donald Schon (1995) suggests a characterisation of designing as a conversation with materials.

Designers' attitudes, emotions and skills were reflected in the designed artefacts through the type of drawings (lines, shapes, colours and textures), the objects' forms and ways of sheet's presentation, the included texts, the use of more or less technology resources, and the reference to each object's interaction.

Two texts are presented as examples of the outcome produced by the designers involved in two of the case studies.

Figure 1 is the final presentation they did. The given story was "Dad waiting in a hospital for five hours with injured six year old boy" and the designers did the representation suggesting the slogan "A waiting room that you won't want to leave" which meant a room with communication facilities: internet connections, telephones, a blue tooth or a bleeper system which would enable those waiting to be able to wander around the site without worrying that they would miss a call for the next phase of the medical process.

Figure 2 presents the design process of the artefact different phases "Remote wild animal interaction device".



Fig.1 Dad waiting in a hospital with injured boy

Fig.2 Remote Wild Animal Interaction Device

According to the analysed artefacts/artworks, designers are, in general, preoccupied with social interaction solutions.

### **6** Conclusions

In this paper we focus on the conversations that designers had during the design processes. They were in a dialogic form according to Bohm (1996) and Isaacs (1999). The focus was to understand how conversation was organised, how designers behaved and a reference to the designers' outcome, the artefact, was given.

We also proposed a definition of dialogue within design which was identified along the observed case studies: a process of conversation between designers and other participants which is reflected on the produced artefact.

Our main point was that, in practical terms, the use of dialogue conversations in collaborative design practice permit, if designers real use it, that the relationships established along the design process and that the changed and sharing experiences might create an ambience more accurate. For that, all the design participants have a similar level of engagement and then, the ended result, the artefact, may have to be better created and so, better used or interpreted by the final user.

The researcher advice for other researchers to carry out similar endeavours is: in the design process it should be considered four inter-related strands – dialogue, behaviours, artefacts and contextual features (communication, creativity, collaboration and culture) to structure and analyse design as dialogue.

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# Usability Heuristics and Qualitative Indicators for the Usability Evaluation of Touch Screen Ventilator Systems

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Abstract. A ventilator system provides respiratory support to critically ill patients in the Intensive Care Unit. Increasing complexity in the user interface, features and functionalities of ventilator systems can cause medical errors and cost the life of a patient. Therefore, the usability of ventilator systems is most crucial to ensure patient safety. We have evolved a specialized set of heuristics combined with objectively defined usability indicators for the usability evaluation of touch screen based ventilator systems. Our study presents the heuristic evaluation of three touch screen based ventilator systems manufactured by three different companies. The heuristic evaluation has been performed by four different usability evaluators to ensure the reliability of heuristics linked with user interface components and the objectively defined usability indicators are found more reliable in identifying specific usability problems of ventilator systems.

**Keywords:** Touch Screen Ventilator System, Intensive Care Unit, Specialized Heuristics, Usability Indicators, Usability Evaluation, Patient Care

### 1 Introduction

Modern healthcare is supported by variety of complex medical equipments like ventilator system, multi-parameter monitoring system, defibrillator, ECG analyzer, etc. Mechanical age medical equipments are now undergoing major technological upgradation with the advent of embedded electronic equipments, small size displays, information technology and ubiquitous applications wherein the equipments can be networked together. This effort is directed at reducing process inefficiencies, improving the quality of patient care and controlling the healthcare costs. Increasing complexity of functionalities and features in healthcare systems is also resulting in potential usability and design errors.

Medical error is a leading cause of death along with motor vehicle accidents, breast cancer and AIDS [13]. Many medical devices have user interfaces that are so poorly designed and difficult to use that they cause a variety of human errors. Usability of

medical devices is most crucial to ensure safety and to enable physicians to focus on their patients rather than technology [1, 4]. Therefore, it is necessary to consider all such aspects of device design in a practical sense to ensure the optimal usability as well as performance of the medical device.

During our discussions with physicians, many of them highlighted the criticality of ventilator systems from the point of view of usability and recommended it for our usability evaluation. A ventilator system gives respiratory support to critically ill patients [5]. Ventilators can be classified as: mechanical, electronic or touch-screen based. We have specifically considered touch-screen based ventilator systems for our study.

There are many techniques available for usability evaluation [10] such as cognitive walkthrough, expert reviews, focus groups, Delphi technique, heuristic evaluation etc. We observed three ventilator systems manufactured by different companies to find major design problems in all touch screen interfaces. It lead us define a specific set of heuristics for evaluating the usability of ventilator systems.



Fig. 1. Touch screen ventilator system and the environment in the Intensive Care Unit

# 2 Related work

Nielsen proposed 10 broad heuristics of interface design [11]. Also, Ben Shneiderman has described eight golden rules [12] that all good user interface designs should follow. Based on their work, Zhang et al. [13] selected a set of 14 heuristics called as Nielsen-Shneiderman heuristics for evaluation of patient safety of medical devices. They also conclude that such adaptation of heuristic evaluation for medical devices is very useful, efficient and cost effective for evaluating patient safety features.

We have come across several usability evaluations which are carried out using the Nielsen-Shneiderman heuristics. Some examples of these are briefly presented here. Graham et al. carried out heuristic evaluation of infusion pumps [7] using Nielsen-Shneiderman heuristics. The evaluation exercise carried out by 3-5 evaluators is reported to have captured 60-70% of the usability problems [13]. Edwards et al have applied Heuristic Walkthrough (HW) method to evaluate and improve the usability of the Electronic Health Record (EHR) system [4]. In another case study, the usability evaluation of Automatic External Defibrillators (AED) was conducted according to Nielsen-Shneiderman heuristics [2]. Diabetes tele-management system is also evaluated using Nielsen-Shneiderman heuristics [9]. For usability evaluation of this system, they have used 1-5 Likert scale and applied it uniformly to all heuristics.

#### 2.1 Need for a specialized set of usability heuristics and indicators

As per our assessment, the interface design heuristics proposed by Nielsen and Shneiderman are meant for general-purpose software applications. Therefore, these heuristics tend to miss out the unique nature of user interfaces of ventilator systems such as-

- Combination of touch screen interface and physical interfaces like touch buttons, knobs and LEDs
- Direct, precise and immediate communication and control (less scope for metaphoric representations)
- No scope for trial and error and exploratory approach to figure out the user interface
- Always used in time and life critical situations
- Fatal consequences in case of errors and delay

In case of ventilator systems, we need to specify the user interface components, a set of usability heuristics supported by objectively defined usability indicators [8] so that at least the major usability problems are not missed out during the evaluation. It is an imperative for medical usability because patient safety cannot be compromised and the consequences can be fatal. We have directly mapped the evaluation ratings with the usability indicators. We have attempted to reduce the vagueness and subjectivity in heuristic evaluation.

# 3 Methodology

### Involvement of a physician

The usability experts have limited medical knowledge despite of putting sufficient effort in understanding the functionality and actual usage of a ventilator system. Therefore, it was an imperative step in our usability evaluation to involve a physician with the required medical expertise. The physician was to also help in sharing their expectations, priorities and experiences.

Ventilator systems

Three touch screen ventilator systems by different manufacturers were selected for usability evaluation. The names of manufacturers and equipment models of these ventilator systems are not disclosed to maintain confidentiality.

#### User interface and usage scenarios

The usability experts developed adequate familiarity of the ventilator systems [6] with the help of the physicians and medical staff. It was very difficult to observe and evaluate the ventilator systems in the intensive care unit. Therefore, the physician was requested to perform the tasks while explaining the significance of use and this was video recorded for further observations. The video recording was helpful in noting the minute observations and the final usability evaluation.

### Usability heuristics and indicators

Usability problems and design deficiencies commonly prevalent among all three ventilator systems were identified based on which the heuristics were formulated. The design priorities and medical priorities were fused together wherever applicable through deliberations between the design / usability experts and the physician. The user interface components and qualitative usability indicators [8] were identified to measure the compliance. Instead of applying the 1-5 Likart scale [9] uniformly across all parameters, we have chosen a indicator based evaluation method. Some heuristic indicators are checked in term of their absence or presence and some are elaborated in terms of their qualitative attributes. Each indicator is rated between 0 and 1.

#### Usability Evaluation

The heuristic evaluation has been performed by four different usability evaluators to ensure the reliability of heuristics proposed in this paper.

# **4** Introduction to heuristics

#### 4.1 Value input interface



Fig. 2. Value input interface of ventilator systems

The input values for related parameters can be provided to the system through interface shown in Fig. 2A after selection of ventilator mode. The interface does not indicate valid range of values for parameters with proper upper and lower limits. It does not provide a selection of measuring units for corresponding parameters. Abbreviations are used for describing the parameters like PEEP or I/E and it does not visually represent those values. We found that some of the abbreviations and parameters were unfamiliar to the physicians. For alarm settings shown in 2B, units are not placed next to corresponding values. **Most of the time, the physicians have to input variety of values in the ventilator system and therefore the interface for inputting the values must be error free and user friendly.** 

The list of heuristics for evaluating the touch screen interface for value inputting is elaborated in table 1.

Table 1. Heu	ristics for a	evaluating	the touch	screen	interface	for val	ue inputti	ng
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Inter	face for input of values	
H1	Indicate valid range (maximum and minimum	Indicated (1)
	thresholds) of values for various parameters	Not Indicated (0)
H2	Allow selection of units for measurement	Allowed (1)
		Not Allowed (0)
H3	Validate the inputs before acceptance	Validated (1)
	I	Not Validated (0)
H4	Confirm in case of proceeding with default values	Confirmed (1)
	1 0	Not Confirmed (0)
H5	Highlight the selected text input area and gray out the	Highlights (1)
	other text input areas	Grays out (1)
	•	Does not highlight or
		gray out (0)
Inter	face for controlling the value input	
H6	Both on screen controls and physical knobs be	Both Provided (1)
	provided for adjusting the values	One is provided (0)
H7	(Applicable in case of on screen interface)	Co-located (1)
	The input box and controls for adjusting the values to	Not co-located (0)
	be co-located for every parameter	
Labe	eling of value input interface	
H8	Use full form expressions for describing the	Used (1)
	parameters	Not used (0)
H9	Use full form expressions for describing the units	Used (1)
		Not used (0)
H10	Units to be placed next to the value	Placed (1)
		Not placed (0)
Visu	al Representation	
H11	Form a visible group of related parameters	Common color (1)
		Boundary (1)
		Proximity (1)
		Scattered (0)
H12	Visually represent the values	Represented (1)
		Not Represented (0)
H13	Use unique colour code for quick identification and	Used (1)
	recall	Not used (0)
Cult	ure Specific Preferences	

H14	Date format (dd/mm/yyyy or mm/dd/yyyy)	Given (1) Not given (0)
H15	Weight measurement unit (Pounds or Kilograms)	Given (1) Not given (0)
H16	Height measurement unit (Feet or Centimetres)	Given (1) Not given (0)

#### 4.2 Interface for selection of option

Fig. 3A shows the screen for setting the patient configuration that provides two pairs of options namely "invasive or non-invasive" and "pediatric or adult". From each of these pairs one option needs to be selected. But this expectation is represented in a very ambiguous manner. Fig. 3B provides options for selecting the ventilator modes like (A)CV or PSIMV. Such abbreviations are obscure and unclear for the medical staff. Proper understanding of options and their selection is important. The heuristics for evaluating the touch screen interface for selection of options are enlisted in table 2.



Fig. 3. Interface for selection of options

 Table 2. Heuristics for evaluating the touch screen interface for selection of options

Interface for structuring of options					
H17 Logical sequence of options	Logically arranged (1)				
	Randomly arranged (0)				
H18 Form visibly proximate groups of related options	Common color (1)				
	Placed a boundary around the group (1)				
	Closeness by distance (1)				
	Scattered (0)				
Visual Representation of option					

H19	Consistent sizes of buttons by following a grid	Consistent (1) Inconsistent (0) Grid followed (1) Grid not followed (0)
H20	Use appropriate symbols or icons for related options	Used (1) Not used (0)
Dece	rintion of ontion	
LI21	Use full expressions for describing the options	Used (1)
П21	Use run expressions for describing the options	
		Not used (0)
H22	Describe the screen / groups of options by precise title	Title given (1)
		Title not given (0)
H23	Provide tool tips for explaining the options, their	Tool tips provided (1)
	implication and the number of options one can select	Tool tips
	at a time	not provided (0)
H24	Avoid all capital letters for normal text (Acronyms to	Upper-lower case (1)
	be excluded)	All capital letters (0)
H25	Legibility of text	Legible (1)
		Not Legible (0)
Food	hadr	
r eeu	Dack	
H26	Highlight the option(s) to indicate the selection	Highlighted (1)
		Not highlighted (0)
H27	Ask for confirmation before accepting the inputs	Provided (1)
	I B I	Not provided (0)

# 4.3 Interface for screen locking





Screen locking feature can protect the settings from unintended changes. The touch screen ventilator systems without screen lock facility are prone to the danger of undesired changes in the settings. The touch screen lock is shown in fig. 4. It is obvious that the 'locking and unlocking' icons are not located in a consistent place. The heuristics for evaluating the screen locking interface are enlisted in table 3.

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Table 3. Heuristics for screen locking interface

Availability of Lock	
H28 Screen locking / unlocking provision at any stage	Provided (1)
	Not provided (0)
Location of Lock	
H29 Screen Lock / Unlock toggle buttons to be located in a	Unique (1)
unique place	Not unique (0)
Visual Representation	
H30 Clearly visible and understandable iconic	Provided (1)
representation	Not provided (0)
Functional Behavior	
H31 Store the settings selected till the stage of locking	Stores (1)
	Does not store (0)
H32 Resume from the stage of unlocking	Resume (1)
	Does not resume (0)
Feedback	
H33 Visible feedback after locking and unlocking the	Provided (1)
screen	Not provided (0)

# 4.4 Data entry



Fig. 5. On-screen keyboard and patient record interface

Touch screen ventilator systems require to provide an on-screen keyboard interface for data entry as shown in Fig. 5A. Fig. 5B shows patient record screen with numeric keyboard. The ventilator systems evaluated by us do not provide the facility to store and manage multiple patient records. Also the settings can be stored only once, if you change the settings and save then it overwrites the earlier. The heuristics for evaluating the on-screen keyboard interface and patient records are given in table 4.

Table 4. Heuristics for the on-screen keyboard interface and patient records

On-s	creen Keyboard	
H34	Onscreen keyboard for alphanumeric input	Provided (1)
		Not provided (0)
H35	Separate onscreen keyboard only for numeric input	Provided (1)
		Not provided (0)
H36	Provision for closing the onscreen keyboard whenever	Provided (1)
	necessary	Not provided (0)
H37	Key size to be adequately large for fingure touch	Large (1)
		Not large enough (0)
H38	Adequate distance between keys so as to avoid wrong	Adequate (1)
	key-press	Not adequate (0)
H39	QWERTY keyboard layout (with minimum necessary	Provided (1)
	keys)	Not provided (0)
H40	Allow onscreen movement of keyboard	Provided (1)
		Not provided (0)
Patie	ent Data Input	
H41	Allow selection of data format for input	Provided (1)
		Not provided (0)
H42	Allow selection of units for measurement	Provided (1)
		Not provided (0)
H43	Check in case of proceeding with default values	Checks (1)
		Does not check (0)
H44	Validate the inputs before acceptance (e. g. admit date	Validates (1)
	should not be prior to birth date)	Does not validate (0)
Patie	ent Record	
H45	Patient ID must be assigned to the record	Assigns (1)
		Does not assign (0)
H46	Rules may be applied while forming the ID	Rule-based (1)
		Random (0)
H47	Every patient record should have unique ID	Unique (1)
		Not unique (0)
H48	Storage of patient records	Stores (1)
		Does not store (0)
H49	Retrieval / deletion / updation of patient records	Supported (1)
		Not supported (0)
H50	Updation and Deletion of record by authorized users	Supported (1)
	only	Not supported (0)

### 4.5 System feedback

A ventilator system has to be extremely communicative with the physicians and medical staff. Changes in the settings, internal processing, consequences of actions, warnings, error messages, status updates, alarms, etc have to be communicated from time to time. It is possible to design effective communication with the help of audio, visual, text and mobile messaging. The heuristics for evaluating the system feedback are given in table 5.



Fig. 6. Right-handed design of interface

Table 5. Heuristics for evaluating the system feedback

Feed	back	
H51	Give feedback to communicate confirmation, status of	Provided (1)
	progress, consequence of action, warnings and errors	Not provided (0)
H52	Effective use of visual communication	Appropriate use of signs
		& symbols (1)
		Color code (1)
		Animation (1)
		Culture-specific
		depiction (1)
		No visual
		communication (0)
Alar	m	
H53	Provide alarms in audio, visual and mobile messaging	Audio (1)
	forms	Visual (1)
		Mobile (1)
		None (0)

#### 4.6 Neutral interface

Most medical equipments are designed only for right-handed users as seen in Fig. 6. It is clearly reflected in the layout of control panel, placement of knobs and buttons. Such design may not prove efficient for left-handed users. Therefore, neutrality for both left and right-handed users and ergonomic design are most desirable. The heuristics for evaluating neutrality of user interface are provided in table 6.

Table 6. Heuristic for evaluating neutrality of interface

Neutrality			
H54	Neutrality towards left and right-handed users	Neutral (1)	
	. •	Left-handed design (0)	
		Right-handed design (0)	

#### 4.7 User manual / online help in local language

Mostly the user manuals are provided in English. Help is not provided as part of the software of ventilator system. The physicians are proficient in English but the assistive staff in the hospitals, which usually operate the ventilator systems are not familiar with English. Therefore, provision of user manuals and online help in English as well as local language is a must for reducing the possible medical errors.

Table 7. Heuristics pertaining to user manuals and online help

User	manual and online help in local langua	ge
H55	User manual in local language	Available (1)
		Not available (0)
H56	Online help in local language	Available (1)
		Not available (0)

### **5** Evaluation of ventilator systems

We have evaluated the usability of three different touch screen ventilator systems using the heuristics and usability indicators with following objectives.

- i. Measure the usability and overall efficacy of touch screen ventilator systems
- ii. Compare the quality of touch screen interfaces
- iii. Study the reliability of the heuristics by involving three more usability evaluators to carry out the evaluation of same set of ventilator systems

This heuristic evaluation was carried out by totally four Usability Evaluators (UE). In this, UE1 are the authors of this paper who have formulated the heuristic guidelines. UE2, UE3, UE4 are other usability evaluators who used our heuristic evaluation method for evaluating the same set of ventilator systems.

We ensured that the usability evaluators had adequate understanding of Human Computer Interaction (HCI). They were sensitized about the proposed heuristics, criticality in the ICU environment and the usability evaluation of ventilator systems. Their queries about the heuristics and related evaluation were discussed and then they carried out the heuristic evaluation of all the three ventilator systems individually.

The total scores of usability evaluations by all four usability evaluators are consolidated in table 8.

User Interface for	Max.	Usability	Scores of Touch Scre		Screen
	Score	Evaluators	Ventilator Systems		stems
			VS-I	VS-II	VS-III
1. Value Input	21	UE1	03	05	09
		UE2	04	07	11
		UE3	05	05	09
		UE4	04	04	09
2. Options	14	UE1	07	08	11
		UE2	06	11	9
		UE3	05	8	10
		UE4	06	8	11
3. Screen Lock	06	UE1	05	00	06
		UE2	06	00	05
		UE3	05	00	05
		UE4	05	00	06
4. Data Entry	17	UE1	00	07	02
		UE2	00	07	00
		UE3	00	07	01
		UE4	00	10	01
5. System Feedback	08	UE1	02	03	05
		UE2	04	05	03
		UE3	04	04	04
		UE4	03	04	05
6. Neutrality	01	UE1	00	00	00
-		UE2	00	00	00
		UE3	00	00	00
		UE4	00	00	00
7. Help in local language	02	UE1	00	00	00
		UE2	00	00	00
		UE3	00	00	00
		UE4	00	00	00
Total	69	UE1	17	23	33
		UE2	20	30	28
		UE3	19	24	29
		UE4	18	26	32

 Table 8. Heuristic evaluation of three Ventilator Systems (VS) by four different usability evaluators

\* UE1 are the authors of this paper who have formulated the heuristic guidelines.



**Fig. 7.** UI component wise usability of all three ventilator systems as per the evaluation of UE1

Considering that UE1 have formulated the usability heuristics and the indicators, their evaluation score is compared with the evaluations by other usability evaluators to find the closeness in their results.



# 6 Reliability of usability heuristics

VS-I

**Fig. 8.** Comparison of usability evaluation of ventilator systems by four usability evaluators (UE1,2,3,4)

VS-II

VS-III

The usability evaluation by other usability evaluators differs from UE1 by 11.77% for VS-I, 16.09% for VS-II and -10% for VS-III. The evaluation by UE2 is significantly different than the other usability evaluators because his interpretation of some heuristics (H18, H21, H27) and the importance given is slightly different than expected. On an average the evaluation of other usability evaluators has differed by 5.95% (addition of all % / 3) which is not very significant if compared with the results of Nielsen-Shneiderman heuristics in the context of medical devices [2,7,9,13].

# 7 Conclusion

Our observations of several ventilators systems available in Indian hospitals and the outcomes of heuristic evaluation show that the interface design of touch screen ventilator systems need significant design enhancements.

The specialized set of heuristics linked with user interface components and the objectively defined usability indicators are helpful in identifying specific usability problems of ventilator systems.

Heuristic evaluation in medical context cannot afford to be very subjective and open ended as in case of general-purpose software applications. It must identify specific usability problems in order to ensure patient safety and accuracy of treatment otherwise the consequences can be fatal.

The reliability of our approach in terms of reduced subjectivity and objective definition of UI components, heuristics and usability indicators specifically designed for ventilator systems is much higher.

# **Future Work**

We propose to design the prototypes of user interface for a ventilator system which will comply with the heuristic guidelines. We would like to collaborate with the manufacturers of ventilator systems to design more usable interfaces.

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# A comparison of what is part of usability testing in three countries

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**Abstract.** The cultural diversity of users of technology challenges our methods for usability evaluation. In this paper we report and compare three ethnographic interview studies of what is a part of a standard usability test in Mumbai, Beijing and Copenhagen. At each of these three locations, we use structural and contrast questions do a taxonomic and paradigm analysis of a how a company performs a usability test. We find similar parts across the three locations. We also find different results for each location. In Mumbai, most parts of the usability test are not related to the interactive application that is tested, but to differences in user characteristics, test preparation, method, and location. In Copenhagen, considerations about the client's needs are part of a usability test. In Beijing, the only varying factor is the communication pattern and relation to the user. These results are then contrasted in a cross cultural matrix to identify cultural themes that can help interpret results from existing laboratory research in usability test methods.

Keywords: Usability test, cultural usability, ethnographic interviewing.

## 1 Introduction

Culture plays an increasing role in discussions of information and communication technology. As of today, we do not have any formal methods to guide us in evaluating a product to a certain standard while being sensitive to cultural issues. Cultural usability tests are not yet established methods. In this paper we look at the methods that companies already use.

In the past few years researchers have suggested paradigms for culture-specific Human-Computer interaction such as 'cultural computing' [13], 'culturally sensitive IT' [19], and 'cultural usability' [2] 13]. Attempts have been made to include cultural knowledge such as cultural dimensions [9], cultural factors [15], cultural constraints [11], and cultural models [7], in research into HCI in general, and into cultural usability specifically, e.g. [18][12, 14]. What is common is a focus on the diversity of users and use of technology around the globe, on social-cognitive approaches to usability (as opposed to psycho-physiological approaches) and on the utility of HCI.

A major finding from the existing literature on cultural models in HCI is that there are differences in cultural models in the East (Asia) and in the West (USA, Europe). These differences imply the need for localized designs [9] and for local adaptations of usability evaluation procedures [16]. Specifically, empirical studies show that Chinese users adapt a more holistic approach to using software compared to European users [15]. This resembles the general finding from cultural psychology on human cognition that easterners are context focused, while westerners are object focused [10]. An example of this is that asked to report what is on a scene, easterners mention the background, while westerners report the focal objects. The cross cultural differences in usability evaluation.

Here we study the following research questions. How does the practice of usability testing address cultural diversity for both the evaluator and the user? What is part of a standard usability test in India? What is part of a standard usability test in Denmark? What is part of a standard usability test in China? What is part of a standard usability test across all three countries?

# 2 Method

The study that we report in this paper is part of a multi-site, cross-cultural, grounded theory field study of think aloud (TA) usability testing in eight companies in three countries (Denmark, China and India). The method in the study was a classical ethnographic interview [17] done as a follow up study in one of the companies one year after the first round of observation.

My three informants in this study were from a) a Mumbai based company with more than 200 usability and user centered design specialists that is an Indian branch of an international usability consulting company, b) a Copenhagen based usability vendor with 12 employees, and c) a Beijing based branch of a major telecommunications international company with an in-house group of usability specialists. From our observations the years before of how these companies ran a standard TA usability test, we had initial ethnographic recordings consisting of videotaped tests, interviews with usability managers, evaluators, notetakers, and test users and notes from confronting the employees of the company with our observations. All of this we analyzed with grounded theory using Atlas.ti @ [4].

The initial ethnographic record helped me create a taxonomic and a paradigm analysis [17] of what is a part of a usability test in the companies in question. During a two day procedure of ethnographic follow up interviewing with our key informants from the year before, in all three cases a usability evaluator with senior responsibility, I did a taxonomic analysis [17]:

- 1. Create network/set of codes related to the code 'Usability test' by an is-apart-of relation.
- 2. Print a code hierarchy (a specific procedure in the software used in the analysis).
- 3. Ask the informant questions about each term (code) in the hierarchy: name, other of same kind, difference to others etc.

- 4. Do it for one sub domain at a time.
- 5. Enter all the responses in the code hierarchy
- 6. Go back, change the network of codes accordingly
- 7. Iterate the process, if necessary

In the day 1 interview, I created, adjusted and verified the taxonomy by asking the informant structural and contrast questions such as [17]:

- Is <x> a term (code) you would use?
- Would most people here at <this company> usually use this <X> term?
- Is <Y> a part of <X>? Are there different parts of X? What other parts of <X> are there?
- Do you see any differences between <X .1> and <X.2>? and <x.1 >and <x.3>? (and so on)

The <X> term could for example be on the highest level of the taxonomy 'usability test' or on a lower level for example 'inform participant'.

In the day 2 interview, I created the paradigm by this procedure:

- 1. Place the first level of the taxonomy in a column in a worksheet.
- 2. Inventory all other codes related to "usability test" by other relations than is-a-part-of relations and place them as the top-row in the worksheet.
- 3. Prepare contrast questions such as "is moderating dependent on the test user's age or gender?"
- 4. Conduct an interview with the informant to elicit needed data.

The final step in the classic ethnographic interview study is to use the analysis to discover general cultural themes. This remains to be done, and here we report only on the initial taxonomic and paradigm analysis.

To give an example of the procedure, in the interviews with the Indian informant the final taxonomy showed that 182 concepts are part of a standard usability test in the studied company. Of these, 23 were main concepts that had up to three sublevels. I exemplify one of these concepts in Figure 1, which shows that a part of a standard usability test is to make the participant (the test user) comfortable. The purpose is to get the user to 'open up' and varies in duration, depending on the user. It is also done to get users to think out loud in the proper way.

Making participant being comfortable	
Open up, open to talk important everywhere	
Give some time to socialize	
Begin the test immediately	
Remind	
Remind the user the majority of time	
Remind the user few times	

Figure 1. Excerpt from taxonomy of usability testing, showing an entry: 'making participant being comfortable' and sublevels.

The paradigm for the Indian informant is shown below in Figure 4. The rows illustrate the different parts of the usability test, and the columns are called 'contexts'. Technically speaking, the elements in the upper row have, in the word of the interviewed informant, other relations to the usability evaluation than <is part of>,

and these elements are therefore 'contexts', i.e. part of the 'paradigm' in the sense of [17].

Several parts of the usability test depend on users' diversity, e.g. greeting, compensation and thanks depend on the user's gender: "...I may not have a handshake with a lady..." The findings are presented in more detail in the next section of this paper.

Comparing the taxonomic and paradigm analysis across the three countries/companies/informants is not a straightforward business, but requires numerous choices. I chose to first describe what are the common parts (taxonomy analysis) and common context (paradigm analysis) of a usability test across the three countries. The result is a cross cultural paradigm for a usability test with cross cultural parts (those parts all mentioned) and cross cultural context (those contexts which all the informants said had influence on one or more cross cultural parts). Second I describe for each country, in addition to the common cross cultural elements, what are specific parts and specific contexts for a usability test in each country. The results are three country specific paradigms (those parts and contexts that were not mentioned by all three informants, but mentioned by the relevant informant).

# **3** Cross cultural findings

In this section I present what parts of a usability test and context that were common across the three countries. The descriptive terms that I have chosen for these are cross cultural parts and cross cultural context.

From the analysis of the interviews we learn that cross culturally there are four main parts of a usability test anywhere in the world, as the interview-based taxonomy in Table 1 shows.

Main part of usability test	Sub part of usability test				
Instruction and tasks	Introduce user to think aloud				
	Introduce user to technology to be tested				
	Introduce user to test task				
Verbalization	Probe for specific information				
	Remind the user to think aloud				
	Communicate with the user				
Reading the user	Observation room, one way mirror				
	Video of user and screen				
	Expectations to users task performance				
Overall user-evaluator relationship	Explain user not tested, design tested				

 Table 1. The interview-based, cross cultural taxonomy for a think aloud usability test

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From the interview I also learned, however, that the four parts should be interpreted differently in the three countries. In a usability test in Beijing it is important, my Beijing informant told me, during 'Instructions and tasks' to "explain test to give user an overview [of the whole test]", and, in order to facilitate 'Verbalization', to use a "direct and encouraging communication style" when talking to the user. The first of these statements pertain to the holistic cognitive style identified by e.g. [10], and the second statement indicate that verbalization of your thoughts is an unusual activity that needs to be directly addressed in a Chinese situation. In Danish usability tests, the focus on the client (customer) needs, which we will discuss more in the country specific sections below, could explain why the Copenhagen interviewee did see not see important distinctions between those who 'Observe the user', but simply talked about varying groupings of people could observe from the "observation room". For the last part: 'Overall user-evaluator relationship', my informant in Mumbai insisted that it was most important to "make the user feel comfortable"; the validity of this statement it is supported by interviews, observations and group discussions with fifty plus employees of a major Indian usability vendor that we did previously [4].

The influence of context on one or more parts of the usability test is seen in Table 2. Cross culturally there are four main contexts that in some way or another influence the main parts of a usability test.

	Context for usability test								
	Is a								
	Consi	nsi property							
	der in	of the test							
	recruit	Depends on the users'			methodol	Influence the communication of			
	ment	diversity			ogy	test results to the client			
	-	Age	Person-	Cultural	-	In the	Consoli-	Design	
Usability test parts:			ality	back- ground		final report	dating the data	recommend- dation	
Instruction and tasks	Yes	Yes	Yes	No	Yes	Yes	No	No	
Verbalization	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Reading the user	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Overall user- evaluator relationship	No	No	No	No	Yes	No	No	No	

Table 2. The interview-based, cross cultural paradigm of a usability test

Already during recruitment, it may be important to consider how to introduce the to-be-tested technology solution to the future test user. The Indian informant pointed out that "the client may define a target audience that require that...[issues of] computer literacy or application awareness". Furthermore, the think aloud technique may sometimes requires what the Danish informant described as "smooth talkers",

and she also said that it may be important during recruitment to tell the future test users that there will be an observation room with people from the client.

Second, how to execute the main parts of a usability test depends on the context that the users' diversity provides. The instructions and tasks may be different related to age; my Indian informant described the situation like this: "introducing that to older people requires a bit more explanation sometimes, this is how it is going to work, they are not very techsavy as such...". Age does also play a role for verbalization, as my Chinese information said: "older persons need more encouragement", and for expected task performance when observing the user: "young or very old people are not expected to be able to solve the same tasks as a standard adult" (Danish informant). Interestingly, despite the common sense nature of the statements there are only few studies that deal with usability across the life span (see e.g. [3], and the few findings on specific age groups like the elderly, shows that they are just as technological savvy as the other population [14]. I have not been able to find studies that compare usability testing with different age groups, which could corrode or confirm my informants' views.

The user's personality is a contextual factor that is relevant for giving 'Instructions and tasks', 'Verbalization' and the 'overall user -evaluator relationship. For 'Instructions and tasks' "you would like to give the same [instructions], but in a different language" (Danish informant). For 'Verbalization' "it depends on the extrovert- or introvert-ness of a person, if he or she feels comfortable with verbalizing..." (Danish informant). Both the Danish and Chinese informant felt that when and how to encourage and stop a test user from speaking depend on the test users' personality. Finally, "if he is an introvert, your body language and everything will move towards making him comfortable ..." (Indian informant). These statements can be compared to experiences from other fields that apply evaluation methods. For example, in the field of administering psychological personality tests, the tester is expected to adapt the communication with the test taker according to his or her personality. This may in usability testing also be developed more, but so far few studies of usability has included personality or briefly state that they consider personality unimportant, e.g. [5]. One exception is a study of interactive television prototypes that were designed in color and shape to show different degrees of extrovertness, and evaluated in reference to the users' measured personality traits [1].

The user's cultural background influences the 'Verbalization' and 'Reading the user' parts. Usability evaluators may experience that "...in Singapore the users are more shy than in the US...[we do not] give as many reminders [to think aloud] in US as in Singapore and India..." (Indian informant). A difference in cultural background is something the evaluator can use "...you may use the difference, you can take the role as the stranger entering from outside..." or something to be learned "...culture can be a professional qualification that you do not have..." (Danish informant). Cultural background can also be viewed as a matter of differences in education "...[yes, cultural background matters] if we talk education, people with low education need more encouragement..." (Chinese informant). There seems to be three aspects of the concept of cultural background: national/ethnic culture (Indian informant), professional culture (Danish informant) and educational culture (Chinese informant). Despite these multiple meanings of the concept, I decided to keep the cultural background as a context in the cross cultural paradigm for pragmatic reasons; for a

discussion of the usefulness of the concept culture in usability research and practice, see [8].

The test methodology as a context acts as a container for the parts of a usability test in the sense that though all four parts of a usability test are fixed in a summative evaluation/beta test, in formative evaluation or design evaluation the properties of the test vary. The variation is related to how to instruct the user in thinking aloud, how to tell the user about paper prototype etc., if there are any real test tasks or only interview questions, how much the user should think aloud and how much qualitative data is needed, the expectations to task performance which are more plastic: "...yes, if they say something outside the expectation, you should reverse the expectation, if all the results go far away...you can stop and reverse it" (Chinese informant), and the necessity of making the user comfortable. The existence of such variation in formative usability testing, which is not the case in summative usability testing, indicate a need for investigating more how this variation in the context of a usability test influence the test procedures. It has been suggested to limit research on criteria for evaluating usability evaluation methods to formative usability evaluation [6].



**Figure 2.** The interview-based, cross cultural paradigm of a usability test (Graphic view of the information presented in table 2).

The communication of test results to the client is influenced by 'Instruction and tasks', 'Verbalization', and 'Reading the user'. In some cases the 'Instructions and tasks' are written in the final report, which may also contain information about the 'Verbalization' "... usually we write if we had to lead them [the test users] a lot, if they were helped or not, if they acted spontaneously or not..." (Danish informant), "...if probing happened [we write it]... especially if there is a common response from that kind of user, this kind of user needs more encouragement..." (Chinese informant). 'Reading the user' will be entered into the final report "...if the client has certain expectations we show them the graphics [on user performance]" (Indian informant). Consolidating the data and giving design recommendations is done dependent on how the verbalization occurred and how the user was read. This influence from the way the test is done to the context of the usability test is congruent with recommendations

IFIP HWID2009 Working Conference on Usability in Social, Cultural and Organizational Contexts, Oct. 7-8, Pune, India. from research on communicating the results of usability tests to designers, which says that evaluators should be explicit about the data behind their claims, and on one hand not overwhelm the designers with information, but on the other hand involve them in a learning process [12].

# 3.1 Culturally specific parts of a usability test

In each country, the informant mentioned parts and context that were not shared by the informants in the other countries. My Beijing informant told me about many parts of a usability test that I could not recognize from our studies in the other countries, see Figure 3. These standard parts of a usability test in Beijing were 'translation' (you always consider the need for translation for client's, moderator's or test user's sake), 'Problem fixing' (there are always some problems with the test that you have to fix and continue), 'Usability problem description' and 'User experience description' (you always focus on describing the user's interaction with the technology solution), 'Combined moderator, observer and note taker' (you are always in all three roles during a test), and 'Professional notetaker' (it is a standard thing to have a professional that makes a full transcription). Besides the four standard parts of a usability test, two more parts varied with different contexts. The 'Choice of usability evaluation method' could vary for intranet, web search portals and government web pages "...a few methods like expert review can be used...", but also for cross cultural contexts. For example, 'Choice of usability evaluation method' was about fitting the method to user's personality "...this kind of user is more talkative, maybe more useful in some kind of tests...", or to user's cultural background "...to only country or religion, but education, different people can give different feedback, like the IT person gives totally different feedback from the general user ... " and to the users' lifestyle and family background "...products like sports, select the natural observation method ... ". The 'Choice of task scenario or task list' varied both with technology solutions as a matter of fitting topic with methodology, and would accordingly as part of data consolidation and design recommendations be written in the final report.



Figure 3. Culturally specific paradigm for tests in Beijing.

The technology solutions to be tested were important contexts for the standard parts of a usability test. 'Verbalization' was related to all kinds of technology solution "...but only through the methodology, sometimes you need more qualitative data...". 'Reading the user' was related to who would be the observers of that technology "...if hot topic, the marketing should hear directly from the users...[if intranet or other internet technology] the designer has no need to hear it directly from user...[if mobile phone interfaces] usually the designer will join...".

In Mumbai, in addition to the cross cultural usability test parts there are a number of other parts of a usability test, see Figure 4. The task scenario is a property of the kind of formative tests done, and is described into the final report. It is also dependent contexts, specifically mentioned by the Indian informant, related to where the test takes place.

There are four distinct parts related to dealing the user as a person, and these vary in different contexts. For example, when recruiting the user "...we think about what kind of compensation to be given...to a certain extent we ask them if they are willing to come here...nothing in writing but we have the consent...we are asking the permission [from family]...", and when greeting the user "...in US, for example, even if he is an older or younger person, the greeting will be the same. Here the elderly will feel good if I bow...". Specific contexts for the Mumbai usability test include gender "...I may not have a handshake with a lady...", government websites "...in US if your client is government agency you cannot give them compensation...[actually] I don't know if it is the case in India...".


Figure 4. Culturally specific paradigm for usability tests in Mumbai.

The moderator skill level is related to user's personality "...if he [the user] is an introvert, you [the moderator] may need to ... ", user's cultural background "... You may need to know the nuances of the culture and understanding of that..." , test methodology "...for formative tests it would be good to have an experienced moderator...summative is fairly straight forward....", writing the final report "...it is part of the contract that we have experienced moderators...also an experienced moderator is involved in creating the final report...very closely...various models here, he could be writing it, he could be overseeing [parts of] of the final report..' consolidating the data "...the notetaker in consolidation with moderator, usually the moderator is much senior than the notetaker ... ". For the moderator skill level there are also specific contexts such as user's motivation "...in the sense that you have to realize that when a person is not motivated, he is probably not giving you the real feedback...the moderator has to realize that .. and he has to do some twists...", the kind of technology solution "...if it is a complex application we would need experienced moderators...", and remote testing "...it is good to have someone who has done some remote testing, because the technology issues...making a phone, call, the supporting things, you should be aware of the things that can go wrong during the test, ...it be phone line, internet connection, web example, accent...". The use of test documents such as formal test protocols and notes about usability problems are important parts of the usability test, and has to be visible in the final report and data

consolidation "...if you have not been able to conduct all the tasks as per the protocol, you have missed out something...you do mention what data will be captured...in remote testing you will not be able to capture body language and facial expressions...". Getting other insight about the user interacting with the technology



Figure 5. Culturally specific paradigm for usability tests in Copenhagen.

solution is also a standard part of a usability test, in particular in formative tests "[the data are] much richer here than in summative, things can strike you here...". The time of test session is a standard part of the test that is considered during recruitment of test users "I just mention to the user that it will take one hour...".

The Mumbai-specific contexts are also relevant for the four cross cultural parts of a usability tests. For example, 'Verbalization' depends on user's motivation "...[if low] very strongly, lot more probing would be required, give more reminders, also correlation to assists.." and is considered during test protocol development when interacting with the client "...sometimes the clients are saying that we really need you to get more information ....then we identify were more probing is required...", and 'Overall user-evaluator relationship' is related to the user's motivation and considered during test protocol development "You have to spend extra efforts if that person is not motivated... one of the reasons for using [specific kind of] scenarios is to make the user comfortable...".

Figure 5 shows the findings from Copenhagen. Contextual influence on a usability test mentioned by the Danish informant included the user's gender: "...females over 40 years are less talkative..." ('Verbalization'), and "...usually we select both male and female users because their context of use can be different" ('Reading the user'); educational background "...you would like to express yourself slightly different..." ('Instructions and tasks'), "...higher education gives more verbalization and better verbalization, people with low education has a tendency to apologize not being able to do the test correctly..." ('Verbalization'), and different expectations to task performance ('Reading the user'); user's employment situation (role and length) "...there will be different tasks to managers and employees, there will be something

that employees cannot answer, it is not part of their job ... " ('Reading the user'); users' language skills "the problem can be that you cannot be sure to understand what they are saying..." ('Instructions and tasks'), and "...if their English is so bad that they cannot read the task instructions..." ('Reading the user'); users' experience with the technology to be tested, use frequency and motivation "...if it is a super user, I must say 'tell me about you knowledge' ... " ('Verbalization') and expectation to task performance ('Reading the user'); intranet webpages "...in a test of intranet you have to make a point to the user that he or she is anonymous, try to explain to them that in the report it will not be written who they are...in such a test you often speak about use and frequency of use...the boss might not like to hear that ... " ('Instructions and tasks'), "...[in intranet tests] you are the stranger coming from outside and has to try to figure out how much you know the concept and tools that are there...can you be part of that organizational culture ... " ('Verbalization'), and "... there is no observation room because the test [of an intranet] will be done in the field, not in the lab..." ('Reading the user'); mobile technology "sometimes there are no observation room, because we move around [during test of mobile units] in town, in traffic... ('Reading the user'); online computer gaming "...you may go to the user's home to watch them gaming in their environment ... " ('Reading the user'); remote usability testing "...you have to explain a bit technical how the test will proceed, how you as a user get access, that you at the end of the test will be disconnected..." ('Instructions and tasks'), and "usually there are no observation room, if there are one, the observer has also logged on with a separate screen..." ('Reading the user'); contract negotiation "...we write about method in the contract..." ('Verbalization'), "...we always write [in the contract] that we have an observation room customers like that we are open and trust them, that they may come and learn about their users by observing them..." ('Reading the user'); questionnaire guide "...then there will be a script that tells us how to talk to these users..." ('Verbalization'); and, furthermore, in-house usability work "clearly explain the technology solution is not my design, so I will not be offended [by the user's critique]" ('Instructions and tasks'). Finally, the context of success criteria (increased sale, interested community users, number of users seeing the advice given, etc.) is relevant for a part of usability test that only the Danish informant mention, the moderator's experience "...there is not sufficient focus on that [client's success criteria] if you have taken the way through usability in your education – instead you need to have experience working with clients, you need to know what makes your clients pay attention to this and to be persuaded that this is necessary...it is important for your design recommendations that you reflect on what are the business goals for the use of this technology solution...".

Besides the moderator's experience with clients, the Danish informant mentions clickable prototypes as a part of usability testing that is always there, no matter the different contexts.

## 4 Discussion and conclusion

The ethnographic interviews with the taxonomic and paradigm analysis indicate that a standard usability test across countries has some clear similarities, with four main parts and eight important contexts to consider when doing the test.

In each country there are specific parts of a usability test and specific contexts for a usability test, which are not found everywhere. In Mumbai, most parts of the usability test are not related to the interactive application that is tested, but to differences in user characteristics, test preparation, method, and location. In Copenhagen, considerations about the client's needs are part of a usability test. In Beijing, the only varying factor is the communication pattern and relation to the user.

Compared to the current popular grounded theory approach, the real strength of the ethnographic approach is that the terms revealed are the informant's own terms. Thus idiosyncrasies and tacit knowledge developed in the particular company can be revealed by our study. On the other hand, the informant may do his best to conform to some international standard or what believes that he has learned during his formal education, i.e. he violate the interviewer's need for a "non-analytic informant" [17, p52]. Another methodological challenge, which has been met with some success in this study, is to compare ethnographic studies from three sites distributed globally.

The results of this study needs more discussion to reveal the true cross cultural similarities and subtle differences in what are parts of a usability test, how the test is practiced in different contexts, and what are the significance and implications of such findings. This kind of knowledge from the field may provide a conceptual basis for interpreting the results of studies of usability test methods in laboratories.

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# Online Banking in India: User Behaviours and Design Principles

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**Abstract.** This paper documents online banking trends, behaviours and expectations of Indian consumers and banks. It is based on excerpts of a large study of users from 4 leading banks. While banks view it essentially as a technology solution, online banking is not yet completely self-supporting and a relatively recent area for Indian consumers. Being a savings based culture still, consumers are also cautious about their financial assets. Design of these systems must therefore be based on this understanding of users' outlook and priorities through task centric, security assured and service oriented solutions minus technological challenges. Design lessons suggest a focus beyond just convenience in order to create satisfied online banking customers and therefore profitability for the bank.

Keywords. Banking, online banking, user perception of banking, banking in India

# 1 Introduction

Internet banking arrived in India in the late 1990s [1]. ICICI was the first bank to champion its usage and introduce it in 1996. After internet costs lowered and awareness about electronic media increased, online banking established itself in 1999. Other banks followed suit, including HDFC, Citibank, and the now redundant Times Bank. Nationalized banks were initially hesitant but eventually they too jumped on the bandwagon [2]. The motivation to introduce it included new business potential, additional funds, expansion in geographical reach, image as a tech-savvy bank especially if targeting the youth and the threat of customers shifting loyalty if they did not introduce it [3]. Internet banking has seen an exponential rise in users since its advent [4]. But oftentimes the user has minimal place in this evolution.

# 2 User research study

## 2.1 Objectives

User research studies of users from 4 banks were conducted to understand users' current relations with their bank, their perceptions of its services and to offer recommendations for more customer-focused services (See Table 1).

# 2.2 Methodology

The methodology involved recruiting and studying users from the banks' customer database, categorized on the basis of usage and transactional behaviours:

- Non-users who do not bank online
- Users who bank online but only check account status, do not perform transactions
- Users who perform extensive online transactions via their bank account

	<b>Objective of Study</b>	Method and Techniques	No of Users	Cities
1.	Offline and online expectations and association with the brand	Quantitative research Qualitative research	800 96	Mumbai, Ahmedabad, Delhi, Jaipur
2.	Homepage as touch point for encouraging online banking	Usability Test and One-on-one Interview	48	Mumbai, Pune
3.	Identify customer engagement barriers in online banking	Usability Test and One-on-one Interview	48	Mumbai, Pune
4.	Concept Testing for new online services	Focus Group Discussion	48	Bangalore, Mumbai, Delhi

 Table 1 Classification of studies conducted and methodology applied

# **3** Findings on user perceptions and attitudes to online banking

While users do adapt to online banking, they often do so because they view it as better than standing in line. However users with accounts in 2 banks often choose the one that offers a simpler online experience for online banking.

In response to queries about their online banking experience, expectations and concerns by user segment have been generalized and detailed in Table 2.

Non-users	Non-transactors	Transactors
Inhibited about security of sensitive information	Felt lost in content jungle	Looked for error-free transaction experience
Found the entire process complex	Concerned about online security	Valued advanced options that saved time
Absence of an online demo for initiation is a roadblock	Did not find clear directions & action points	Wanted online, the entire spectrum of services of the bank

 Table 2 Issues of different types of users with online banking

Table 3 elaborates and categorizes criteria considered important by these users.

Simplicity	Security	Service
Better link label clarity to ensure transaction completion	Lack of 100% assurance on security of banking information	More services available online, e.g. Printable DD
Better information find-ability, presented & highlighted in context	Unpredictability of online banking operation creates confusion and anxiety	Real time customer support channels, e.g. online chat
More efficient content organization as per popularity and priority	Absence of an additional layer of security	More direct interface for smooth switching between frequent functions

Table 3 Criteria considered important by users categorized into: simplicity, security, service.

# 4 Banking industry approach to users

Based on our client interactions before and after the studies, we found banks to view online banking as an important medium of servicing its customer base. They however do not yet view it as a 'person-less service counter' and hence do not give it the attention of customer service at the branch. A very simple example is recognizing the impact of banking terminology like 'E-monies National Funds Transfer' that leaves an average customer baffled. Changing it to 'Funds transfer' reduces confusion and allows the customer to complete their transaction. Marketing gimmicks like 'InstaAlert' where all other banks use 'SMS Alert' is another example of creating hurdles for the user.

Many banks have now understood that Internet banking is here to stay and that they need to upgrade and enhance their offerings for simple solutions and desired security to retain and attract customers [5]. They also need to recognize that customers expect the same convenience and service online as at the branch as well as in other areas of their life like online shopping [1]. The transition of a new user into an advanced one can only happen by encouraging users to explore confidently and therefore they need to offer them intuitive processes and user-friendly designs. Banks are yet to accept that established user-centric rather than technology-centric methodologies will increase usage of online banking and satisfied customers. This will automatically increase sales opportunities and revenue potential for the bank.

# **5** Design Lessons and Recommendations

Banking is a focused activity and also deals with people's money. Ease of use and psychological comfort of the user are critical fundamental requirements for both, for example, giving feedback of 'your money will be transferred in 24 hours.' Specialized banking for the Islamic community is an example of customer focused online banking, where banks must understand and design for specialized user behaviour, expectations and critical aspects of these cultures. [6]. There is wide variety and large

numbers of novice users among Indian online banking customers today. Their view goes beyond the novelty of online banking. They expect their experience to be a selfservice counter and are ready to accept it as a sales channel. Banks need to view and reflect this through thoughtful designs of their offerings. While banks have clarity of their market segmentation, they must progress to behaviour-based segmentation and user-centred methods and beyond predesigned technology solutions. Online banking design must create a 'quick in and out' experience, ensure success in transactions users undertake, arouse curiosity and attract the customer to explore. Studying users, benchmarking designs and testing for ease of use after defining user types are critical for this. Specific needs are: clear task flows, brevity and clarity of language and terms, basic functions made obvious to average users and support available at all times. Besides short-term solutions, the long-term strategy needed is to not just create but also measure designs to be self-evident and transactions to be self-controlled.

# 6 Conclusions

It is clearly in the interest of banks to encourage use of online banking. User-centred design methods can achieve this. Internet, phone, paper, ATM and visit to the branch all need to appear as one holistic experience for the customer who is 'anybody. In India, banking still continues to be relation-based and in need of human assurance and intervention, technology notwithstanding, hence this is particularly significant. True benefits will be seen when banks use this technology to offload customer service costs and increase sales by maximizing self-service. As 21<sup>st</sup> century banking users entrust the care of one of their most important assets to cyber space, a seamless, stress free and successful experience is essential. Design with users' success as focus, content understandable by 'anybody' supported with demos and help to reduce intimidation, will justify investment in online through increased usage by satisfied customers.

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# **Cultural Factors Influencing Elements of Interface Design for Indian Youth: Study and Guidelines**

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**Abstract.** Indian cultural integrity and cross cultural influences infuse a selective approach to browsing, particularly among the youth. Our user study revealed that Indian youth are influenced by customs, nature, music, festivals, making & keeping relationships. We found that Indian youth is specifically stimulated by cricket, matrimony, bollywood, astrology, and finance. The reactions to these domains were found culturally conditioned.

This paper intends to look at the factors which influence interface design for Indian youth. The paper gives a brief overview of selecting basic elements on the interface i.e. color, language, icons, images, content, page layout while designing customized interfaces for Indian youth.

Applications of findings can be extended to interfaces of websites, mobiles phones and touch screens.

Keywords: Cultural Factors, Interface Design, Indian Youth

# 1 Introduction

The recent studies carried out to understand the Internet users in India have revealed insightful findings. The report "India Online 2007" released by Juxtconsult recently [1] revealed that only 37% of Indian Internet users come from top 10 cities of India. Only 41% prefer to read English on websites that means more than half of Indian people do not like reading English when on the internet. 51% of users accessed dating / friendship sites and 77% of users accessing from homes use a broadband or superior connection.

In the same survey it was mentioned that 19 to 35 years age groups account for 67% of the internet users in India. On the demography front, as per the Census of India – 2001, the current proportion of population under 25 years in India is 51% and the proportion under 35 is about 66%. This predominance of youth in the population

is expected to last until 2050. And the average age of an Indian in 2020 is expected to be 29 years [2]

With internet usage in India increasing at tremendous speed there is a need to address the Indian population in terms of interface designed specially for them. There has been a growth in usage by 912% in 2005 as compared to 2000 [3]. Also, the population of youth in India which is presently 540 million [4] is increasing with time, but very few efforts have been made to study the elements which make an interface web page appropriate for youth. This paper is an attempt to answer this need by taking account of the elements of an interface and then molding these elements to best suit the youth. We recognized the basic elements of any interface as colors, text & language, images, icons, layout and flow.

While text and formats, are elements that designers commonly think of while customizing interfaces for a target group, the remaining elements however, are generally overlooked [5].

## 2 Research Methodology

54 people (age group 18-30) from all parts of India were approached and were encouraged to fill up the online questionnaire. We received replies from youth belonging to varied parts of India; to name them, Western, Eastern, Northern, Southern and Central India. Among these maximum (24%) subjects belonged western India.

Questionnaire was balanced with both objective as well as free text questions. The questionnaire was designed to judge the cultural influence on participants, to test academic and personal dimension of participant, to get information about their areas of interest and to understand the internet usage habits of youth.

Before taking cues for culturally inspired mode of interaction, it is very important to know how much a participant is culturally influenced. In this particular study the focus was to note whether the subject is more influenced by Indian culture or by western culture, to test this, information was gathered about how many years have has the participant been out of India, how many years of the life have they spent with their grandparents. Questions were framed to know participant's aim in life, their academic qualifications, their openness to discuss sex related matters with parents and friends. This information helped us to get an overview of personal and academic side of subject. Hobbies, type of music they like to listen, favorite color, food, sport, finance and astrology based questions were asked to know their areas of interest. To know about their current browsing habits, information was gathered on whether they access local language site, if yes, do they find them effective? Are they required? Do they participate in online competition, E-business? What type of sites do they access?

# **3** Observations

Based on the above methodology, in this paper we ascertain the important elements responsible for an interface to be friendly for the Indian youth and the cultural factors influencing these elements. Most of the findings of the paper deals with the conceptions of the Indian youth but can be generalized to certain extent in order to find a solution to interface design for Indians as a whole. The findings are categorized as colors, language and text, background music, images, icons and other factors. These findings are as below.

## 3.1 Colors

Color can form the basis of a universal system of symbolism that goes beyond the narrow confines of language. According to Murch, a well-known human factors researcher, "Color can be a powerful tool to improve the usefulness of an information display in a wide variety of areas if color is used properly. Conversely, the inappropriate use of color seriously reduces the functionality of a display system." [6]

Culture	Red	Blue	Green	Yellow	White
United States	Danger	Masculinity	Safety	Cowardice	Purity
France	Aristocracy	Freedom, Peace	Criminality	Temporary	Neutrality
Egypt	Death	Virtue, Faith, Truth	Fertility, Strength	Happiness, Prosperity	Joy
India	Life, Creativity	Cool	Prosperity, Fertility	Success	Death, Purity
Japan	Anger, Danger	Villainy	Future, Youth, Energy	Grace, Nobility	Death
China	Happiness	Heavens, Clouds	Ming Dynasty	Birth, Wealth, Power	Death, Purity
Indian Youth	Love	Coolness	Nature	Brightness	Peace, Purity

 Table 1. Meanings of colors in different cultures.

Some effective suggestions regarding usage of color made by Marcus [7] which should be incorporated while designing an interface are:

1. Use blue as background (same as the favorite color of Indian youth)

2. Use spectral color sequence (red, orange, yellow, green, blue, indigo, violet)

3. Keep the number of colors small

4. Avoid using adjacent colors that differ only in amount of pure blues

5. Use bright colors for alarming or for getting the user's attention. We suggest the use of yellow background with foreground as red for this purpose.

The conducted survey pointed blue as the favorite color of about 55% of the subjects. Therefore considering the inclination of youth towards blue, a page with blue background will be most suited. As far as the color of the text and other foreground colors are concerned white, yellow, gray are the best suited ones while black is the worst suited [8]. Consistency is vital when assigning meanings to colors. There are also certain restrictions which should be followed while using some colors together for e.g. one has to be careful while using saffron, white and green (the colors in Indian flag) together in an interface made for Indians.

#### 3.2 Language and Text

Language is the simplest mode of interaction but this interaction will become complicated if the interface is designed without taking cultural factors into consideration. An important issue is the use of local languages. According to the conducted survey about 33% of the subjects have already used sites with local language out of which 83% feel that the sites were not effective. Main reasons being

1. At a higher level translation fails because the language idioms and the cultural contexts of target cultures are not being considered. This often had to do with local differences and specialized terminology [5].

2. It is important to note that it is viewed more as a spoken than standardized written language.

3. Users may not be as 'picky' about the representation of written text, as long as it matches their expectations phonetically.

4. Using Hindi equivalents for common English terms used in computer interfaces (or using transliterations of English computer interface terms into Hindi), such as "Cancel" or "Delete," produces confusion [9].

The most optimum solution to these problems is the use of 'Hinglish' in Indian interfaces. Hinglish, a portmanteau of the words Hindi and English, is the usage of Hindi and English, combining both, in one sentence This highly popular mixing of both the languages in most parts of northern and central India has grown from the fact that English is a popular language of choice amongst the urbane youth who finds itself comfortable in its lexicon. Another factor contributing to the spread of Hinglish is the popularity of Bollywood films [10]. Professor David Crystal [11], says 350 million Indians speak Hinglish as a second language, exceeding the number of native English speakers in Britain and the US. He also states that Indian expertise in writing computer software also means that Hinglish will spread via the internet. The words like cool, dude, funky, rocks are generally used in youth lingo, this lingo if used in the interfaces specifically designed for youth, can make them more interesting and catching.

While taking consideration of text size it is valuable to note the study completed by Jakob Nielsen, a principal at the Nielsen Norman Group, which states that the font size should not be kept too small while designing web sites for youth because they lean backward while working on computers [12].

#### 3.2 Background Music

Music up till now has not been considered as an important factor in interface design but it can act as a catalyst in situations where attention gets diverted, especially in case of youth. (e.g. e-learning) Existing research seems to support the hypothesis that certain types of instrumental music, especially slow- to medium-paced, nonpercussive music, is beneficial in improving concentration and several other learning situations [13].

This finding is also supported by our survey which reveals that 69% of the subjects said that their efficiency is enhanced by music. In India, meditation which has been used as a tool for enhancing concentration uses music as a supplement. While Indian youth enjoys almost all genres of music, soft instrumental music is preferred by most of them. This finding is supported by our survey in which 76% of subjects clearly stated soft music as their favorite and so can be used as background music.

#### 3.4 Images

#### **Image Selection**

Images are the visual language of a culture. Like words, images don't always translate. What we recognize in our culture may have little or no meaning in another. Designers must be sufficiently aware of differences among cultures to recognize images that are culturally specific, especially considering the dynamic mind-set of youth.



Fig. 1. Raksha Bandhan festival in India

For example, in India the band shown in the picture above is called *Rakhi* which signifies the relation of brother and sister but for western cultures it signifies friendship band.

#### **Image Acceptability**

There is a difference between what is comprehensible to a culture and what is acceptable. Because social norms vary greatly between cultures, what is acceptable in one culture can be objectionable in another. In particular, we need to be careful when designing images that contain religious symbols (e.g., swastika, crosses and stars), the human body, women and hand gestures [5].

There are also levels of how well an image creates an impression on the target. Images which match the preferences are bound to create an impact than non relevant images [14]. A study of the survey points out that Indian youth prefers images related to nature and bollywood films. Using images related to these areas can draw the youth attention.

## 3.5 Icons

Commonly used icons may also be subject to misinterpretation across cultures. When icons are used to convey information to the user, it is very important to understand influencing factors which have already created an impression on brain for their recognition. For example, when the Indian temple used in maps was shown to users in United States, they referred it to school. When asked about sports, Indian youth was found to be more interested in cricket than any other sport and they recognized Fig. 2. as more appropriate icon for sports than Fig. 3.



Fig. 2. Cricket ball

Fig. 3. Rugby ball

Designers should take account of interest areas of user while designing icons so as to make them more expressive and communicative.

#### 3.5 Other factors

Often the text and graphical components of an interface will be arranged on the screen in a way that depicts the logical flow of information. In India icons, Tab panels should be arranged from left to right and top to bottom.

Important issue of content arises while designing web site for youth. After study we found need of certain information on web pages. Our survey revealed that only 13% of subjects feel free to discuss sex related issues with their parents so to obtain correct information about sex, a web page dedicated for youth should have a sex education section. The need for sections on career counseling, social networking was also found. Indian youth preferred matrimonial over dating which is supported by the fact that 80% of matrimonial sites are Indian. Our study also demonstrated the fallacy of myth that Indians follow astrology, Indian youth is not much into astrology and predictions. So the content should be fabricated taking the above factors into consideration.

## 4 Conclusion

The feedback we received from participants, the observations we made, personal interviews of subjects made us to decide the way in which interface should be designed for Indian youth. Blue is best suited as background color with foreground colors as white, yellow and red. Designers should minimize the use of saffron, white and green color together because they create a model of Indian flag when placed near to each other and inappropriate usage might be misleading. Using pure Hindi in Indian interfaces should be avoided instead a portmanteau of Hindi and English called "Hinglish", the most popular language among youth should be used. We found that in most of the cases background music increases work efficiency thus if used properly can yield better results in e-learning. Though we have raised the issue of background music, we think a more in depth study of this area is required. Cricket, Bollywood movies are the most favorite interest areas of youth, though they don't have direct application in interface design, they should be taken into consideration while designing icons on the interface or populating content.

Findings that we have reported can be used extensively in the field of HCI while designing interfaces not only for Indian youth but for Indians as whole. The results can also be used to compare influencing elements between India and rest of the world.

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# Development of an intuitive user-centric font selection menu for Devanagari

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Abstract. The font selection menu in most application software's is arranged alphabetically; in recent years one can also see the split menu approach being used. An alphabetical arrangement presupposes that the users are aware of the font characteristics and usage scenario through its name. Unless the font name specifies it; the scheme does not in any which way indicate the morphological features or the usage scenarios of a given font. In order to address these issues, a set of systematic experiments was conducted to capture the typeface classification strategies of users with a modified card sorting technique. The collected data was subjected to hierarchical clustering algorithms to come up with a collective user-centric classification system for Devanagari fonts. The classes created by this method appears to address the problems raised by alphabetical orderings by allowing the groupings to be more intuitive (and realistic) while retaining statistical validity over large user sets.

Keywords: Devanagari, Font Classification, Card Sorting, Menu Organization.

## 1 Introduction

The font selection menu is one of the most frequently used user interface components in today's software applications. Designing the structure of this selection menu hence becomes an important activity in the user interface design. A considerable amount of research has already been done on the design and evaluation of general menu driven systems. Lee and Raymond [1] have consolidated a considerable number of research findings in this area. Unfortunately there is no direct research on font selection menus and it is practically difficult to transfer these findings to the on to the creation of a type selection scheme.

It is nonetheless essential to look at the significant features of research in generalized menu design. Menu navigation is generally classified as broad (many options on one level) and narrow (less options). The number of options available at a level is called the 'breadth' of a level, and the amount of sublevels available is referred to as the 'depth' of the menu. In deep menu structures, users usually have to take many decisions before making a choice; this increases the risk of users losing their way within the menu hierarchies. In broad menu systems, users have too many options to choose from, which increases their search time. Hence, formulating the optimal balance between the depth and breadth of a menu structure becomes and an important factor in menu design. Earlier studies suggest that in terms of both time and

errors, users perform better in boarder hierarchies as against narrow (deep) hierarchies.

#### 1.1 Menu Organization

Previous research has also focused on evaluation of organizational techniques for menu driven systems. Three popularly studied menu organizational techniques are alphabetical, frequency based and categorization. The organization of menus is largely determined by the users' search strategy. Some of the search strategies are: random (where users scan a given set of items randomly), redundant (one or more items are scanned more than once), sequential (items are scanned sequentially), exhaustive (items are scanned exactly once) etc. Empirical as well as eye-movement research strongly suggests that most searches are systematic with a certain amount randomness in them. Searching seems to be knowledge driven, knowledge allows users to focus search to a narrower region of the menu after which search is random or non-systematic [2] [3] [4].

Earlier studies have shown alphabetical ordering to be initially superior for nonexperts; however its advantages deteriorate rapidly with practice [5]. In general search tasks, alphabetical organization performs slightly better than random organization, but is quite inferior when compared with any form of categorization. A study using two organizations—alphabetical and (functionally) categorized menus; suggests that a functional menu is more effective than an alphabetical menu, and users make fewer errors with the functionally organized menu [6]. Within categories alphabetical organization has been found equivalent to random ordering, however its efficiency is much worse than that of categorization within categories [5] [7].

Eleanor Rosch proposed, categories created by mapping the perceived world structures are the most efficient ones [8]. This suggests that menu categories should reflect the cognitive structure of non-expert users, as they are the ones who use the applications. There is strong evidence that suggests categories created by non-experts perform better than the ones created by experts [9] [10] [11]. The reliability of the created categories increases when consolidated with the judgements of many users. Search performance can also be ameliorated by using improved categorization techniques [5] [9] [12]. It is also not surprising note, that users have performed better with categorized menus than with randomly organized menus [5] [7] [12] [13].

It is evident from the stated studies that broad menus generally perform better than narrow ones; and (functionally organized) categorized menus are more efficient than alphabetically or randomly organized menus. In categorized menus itself, categories created by non-experts (novices) are more efficient than the ones created by experts.

#### 1.2 Card Sorting

Card sorting is a common generative technique used by researchers to capture how users arrange a set of objects. The captured information can then be used to create an information structure for the given group of items. Largely two variations of card sorting are used: Open card sorting, where participants are asked to create classes from a given set of items and closed card sorting where participants are given a set of items and a set of classes. Open card sorting is used to generate classes whereas closed card sorting is used more to verify classes created by open sorting. Authors [14] [15] have written introductions to card sorting and the differences between open and closed card sorts. However, within these two techniques if the given data contains many connections amongst its elements, participants often express the need to place a single item in two or more classes. In order to incorporate this need; in this study participants were allowed to place a single item into more than one category if they so wished, so as to create fuzzy classes.

Card sorting data can be analyzed by a variety of methods; the selection of the method depends upon the goal or intent of the study. If the intent of the study is to create a highly structured setting, cluster analysis has at times used to statistically analyze card sorting data and to visualize its results. Factor analysis has also been used [16] to analyze card sort data where the intent of the study was to identify attributes or properties used by participants to assess categories. Visual examination or "eyeballing" [17] has also been used to gauge the overall organizational structure of card sorts. One of the goals of this study was to create a menu structure for application software's (a more intuitive typeface selection scheme); cluster analysis was hence used to come up with distinct clusters for Devanagari typefaces.

# 2 Goals of the Research

The overall aim of this research was to examine how various individuals classify a set of Devanagari fonts. An experiment was designed to capture the different Devanagari font classification strategies used by people through a modified card sorting methodology. The primary objectives of this experiment were:

- 1. To understand the overall strategies that participants use to classify Devanagari fonts.
- 2. To identify the significant parameters used to classify Devanagari fonts.
- 3. To record the nomenclature given by participants to various font classes as well as parameters.
- 4. To discover which are the parameters that are given preference while creating classes and which are overlooked.
- 5. To create a user-friendly classification system for menu structures for software applications.

The first four objectives listed above are part of a larger study and hence have not been discussed in detail in this paper. This paper focuses mainly on the accomplishment of the fifth objective viz. creation of a user-friendly classification system for software menu structures.

# 3 Experiment

## 3.1 Stimulus

The stimulus size for the experiment was a 25cm x 4cm cardboard sheet (see Fig.1) with one line of non-sense Devanagari text set at 72 point size (normalized kana height 1.25cm). Thirty font samples were used for the study. Sampling of the font samples was partially random (from a list of typefaces published by CDAC) and partially purposive (fonts in popular use and distribution were selected). The sample card sheets were randomly numbered, with the number being placed on the lower right corner of the sample sheet.

फुद्धी बुठ्ठमीश किट्रेर्न आंग्ररे बुठूभीश् किट्रेर्न आंग्ररै िछर्द 2 फुद्धी बुठूभीश् किट्रेर्न आंग्ररै 3 आंग्र बुठुभौश किटेने 4

Fig. 1. The above figure shows four sample stimulus cards used in the experiment.

# **3.2 Participants**

The exercise was administered on thirty-eight participants (twenty males and eighteen females). Their age ranged from 21 years to 42 years, with an average of 25 years (S.D. = 2 Years). All the participants had completed a minimum level of education and had formally studied Hindi, Marathi or Sanskrit languages till the  $10^{th}$  grade.

#### **3.3 Experimental Procedure**

The main procedure of the experiment was conducted after a warm up exercise. Participants were given thirty cardboard mounted font sample cards. They were then asked to classify them according to any logic that they pleased; with no restriction on the number of categories that they could make. It was also stated that they could have as many sub-categories as they wanted within the main categories that they created. The classification procedure took around 30 to 120 minutes to complete. After they had completed classifying, participants were asked to give names to each of the classes which had been created; and elucidate the basis on which each of the groups was made. They were also asked to state all the properties of the classes that they had created. When the participants had completed classifying and naming the groups they were asked to reconfirm their classification scheme, and see if they wanted to make any changes (to see if their classification was consistent with the applied logic). Once the classification scheme was confirmed, the categories and the properties attributed to them were recorded on a data collection sheet.

It was essential here that user's were given the option of placing one element into two or more classes. There is sufficient proof [8] [18] that mental categorization is a graded and fuzzy phenomenon. In fonts, a particular font can be categorized considering several properties, and a typical mental model can have multiple rationales, towards its grouping. Many users combined multiple viewpoints for font classification; this necessarily demands most of the fonts to be placed in two or more groups. For example it was common to see users grouping fonts partially based on formal elements (such as written with a traditional Devanagari pen) and partially on the basis of usage (like decorative text or headline text) or even subjective keywords (such as energetic text, professional text etc.).

#### 3.4 Data Recording

Data was recorded in a tabular fashion, with the categories and subcategories being written in a top to bottom fashion. After the participants had completed classifying the given samples, the groups were recorded with the help of the numbers assigned to each of the samples. The top most categories were recorded first in a tabular fashion; the name and the description provided by the participants was then recorded besides the recorded numbers along with the associated properties of each class.

#### 3.5 Treatment of Data

Clustering algorithms require data to be specifically formatted before it can be processed. Converting card sort data into these formats is not an obvious process and is not usually discussed in literature on card sorts [16]. Capra has discussed one such method for the preparation of card sort data for factor analysis.

In this study the recorded data was used to create a proximity matrix for the thirty samples. The matrix here is a similarity matrix rather than a dissimilarity matrix. The proximity matrix p is an m by m matrix (m is sample size and is thirty in our case)

containing all the pair wise similarities between the samples considered. If  $x_i$  and  $x_j$  are the  $i^{th}$  and  $j^{th}$  objects respectively, then the entry at  $i^{th}$  row and  $j^{th}$  column of the proximity matrix is the similarity  $s_{ij}$  between  $x_i$  and  $x_j$ . Here in our case, the number of times a typeface sample was grouped together at any level by the participant increments the similarity in the proximity matrix. Such an operation was carried out for each category created by the participants. The resulting matrix was then used as an input for the cluster analysis algorithm.

# 4 Experimental analysis

#### 4.1 Cluster Analysis:

Cluster analysis groups objects based on information found in the data describing the objects or their relationships [19]. The goal is that the objects in a group should be similar to one another and different or dissimilar from the objects in the other groups. The greater the similarity within the group and the greater the dissimilarity between the outside groups, the better the clustering. Since the objective of this study was to create distinct typographic categories for practical use; hierarchical cluster analysis was used.

#### Hierarchical Methods:

A hierarchical clustering method works by grouping data elements into a tree of clusters. Hierarchical clustering methods are of two kinds: agglomerative clustering where the hierarchical decomposition is formed in a bottom up merging manner and divisive clustering where the hierarchical decomposition is formed in a top-down (splitting) fashion. In agglomerative hierarchical clustering [20] the bottom-up scheme is initiated by placing each element in its own cluster and then merging these atomic clusters into larger clusters, until all of the elements part of a single cluster. We used Ward's minimum-variance to calculate the distance between two clusters added up over all the variables [21]. While creating each cluster the within cluster sum of squares is minimized over all partitions obtainable by combining two clusters from the previous creation. Ward's method tends to join clusters with a small number of observations, and strongly tends towards producing clusters with the same shape and with roughly the same number of observations.

For the  $i^{th}$  cluster, the Error Sum of Squares is defined as  $ESS_i = sum$  of squared deviations from the cluster centroid. If there are C clusters, the Total Error Sum of Squares is defined as:

$$ESS(C_i) = \sum_{a=1}^{n_i} |x_a - \frac{1}{n_i} \sum_{b=1}^{n_i} x_b|^2$$

Consider the union of every possible pair of clusters. The two clusters would then be combined whose combination results in the smallest increase in ESS. The distance between clusters can hence be calculated as:

$$d_{ward}(C_i, C_j) = ESS(C_i, C_j) - [ESS(C_i) + ESS(C_j)]$$

For this study Ward's minimum variance method was chosen over the others, because:

- 1. It is good at recovering cluster structure, and yields unique and exact hierarchy [22].
- 2. It does not leave any "loose ends". No clusters with only one or a few elements. All data is grouped in bite size chunks, which can be studied further [23].
- 3. Aberrant points are also grouped together, which might not have anything in common with each other except for the fact that they are dissimilar from the other objects.

The clusters generated (dendrogram) by using Ward's method on the generated proximity matrix, are shown in figure 2.



Fig. 2. Resulting tree, cutoff, and final clusters.

## 4.2 Cluster Validation

Validating the results of cluster analysis requires subjective decision making [24]. Besides primary validity, which measures how valid the cluster analysis is overall, there are a few measures of secondary validity which assess whether the clusters have certain desirable properties. The following cluster validation technique was used to evaluate this study.

Agreement of Classifications Based on Split Samples of Data: Sinha [25] has suggested that the objects of the original data matrix be randomly split into two subsamples and separate cluster analyses be run on each to produce two separate classifications. To be judged valid, the two classifications should agree: the number of classes should be the same and their defining attributes should be the same. As part of the cluster validation scheme, the resulting clusters were validated incrementally, first on a set of twelve participants then on a set of twenty-four participants and then on the final set of thirty eight participants. During each of these stages the clusters remained fairly stable and only one or two members changed their position within the lowest sub-categories.

# 5 Results

The resulting dendrogram was subjected to the cutoff line (shown by the dashed line in fig 2.). The cut-off line was chosen by looking at the major (graphical) groups within the clusters, since "the cut-off points to identify clusters ... are a matter of subjective judgment by the researchers" [26]. After the cut-off point the resulting clusters can be seen in Fig 2.

Hierarchical cluster analysis yielded five stable and distinct clusters.

Fonts from the first cluster from the left (Fig.2 (1)) have been labelled by many participants as "Traditional text", "Standard Text", "Textbook or Newspaper Text". The formal properties of the whole group indicate that all of them have been drawn with the help of a canted pen (8 right canted, 1 left canted), due to which one sees canted vertical terminals, at inclined axis and high contrast among its letters. This group is further classified into three subgroups; based on their visual characteristics one can notice that the first two groups have been differentiated according to their counters (open vs. closed).

The second cluster (Fig.2 (2)) in the resulting set is that of the "scripts", the only common visual feature that all the elements share is that their vertical terminals have a "swoosh" which either goes to the right or to the left in a smooth manner. Two of them have an inclination towards the right. They are further bifurcated in to two other subgroups, the first one seems to be the one where the fonts have a darker grey value and have a narrower appearance than the regular fonts. The second group contains fonts which are wider in their appearance and have a lighter grey value. Two fonts in this group have an inclination towards the right. One font instead of having a "swoosh" as the vertical terminal has a rounded (felt-tip pen) terminal.

In the third group of clusters (Fig.2 (3)), the significant common visual feature seems to be the serif. These are fonts influenced by Latin typefaces. There is a considerable amount of variation in the serifs of the fonts; from single sided to two sided, thin, thick and inclined. There also is a considerable difference in the width of the fonts; two narrow fonts form a sub group, while three broad fonts form the other sub group. There is further differentiation in this group as fonts with medium grey value and fonts with dark grey value.

In the fourth cluster (Fig.2 (4)) the prominent visual feature of this group is the fact that all the fonts in this group are mono-linear i.e. the strokes are of uniform

thickness. All the elements have a horizontal vertical terminal except in one font sample which has a traditional Devanagari inclined terminal. This group is further subdivided into two categories based on the typographic colour; the medium weights form one group while the darker weights form the other group.

The fifth cluster and final cluster (Fig.2 (5)) contains typefaces which are either dark in their grey value, and/or are very broad or tall. The description that some of the participants have given is that of "display typefaces" or typefaces that one would use for headlines. They are again sub grouped according to their weights; the first subgroup is that of the thick, dark or bold fonts; while the other is group of varying widths i.e. narrow and broad fonts.

# 6 Conclusion

Earlier research has shown categorized menus to be more efficient than alphabetical or randomly organized menus. Within categorized menus categories created by non-experts (novices) have yielded better results than the ones created by experts. We have carried out a thorough empirical experiment where the Devanagari font classification schemes created by a group of non-experts were captured. The captured data was then analysed by cluster analysis to create five broad categories.

The five broad categories with the most popular titles are:

- 1. Traditional Text Fonts
- 2. Script Fonts
- 3. Serif Fonts
- 4. Equal Stroke Fonts and
- 5. Headline Fonts

Understanding how people perceive a set of objects and the relationships that they associate between those objects is a complex phenomenon which cannot be addressed by quantitative analysis alone. In order to have a complete understanding of the users' mental model a combination of qualitative and quantitative techniques must be used. Our study has produced a large amount of data—in this paper we have presented the initial results and analysis. Further tests on the usability of the created categories and on the given titles in an application environment will be needed to come up with conclusive solutions. This method nonetheless can be used to generate categorized menu structures for usability evaluation.

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# Developing a mobile phone based GUI for users in the construction industry: a case study

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**Abstract.** This paper reports work done in conceptualizing, developing and testing of a mobile phone based Graphical user interface (GUI) package targeted at users from the construction industry. System analysis and information design principles were adopted during the development processes. Starting from user requirements based on field studies the development of graphic icons and their testing has been outlined. In addition to integrating individual icons into a GUI, coding and loading the application on a mobile phone has been done to enable testing of the GUI prototype. Users from the construction trade (sample size = 29), randomly selected, were asked to evaluate the designed icons in terms of their acceptance, adaptability and learnability aspects. It was found that learnability of the new GUI was more dependent on age and education level of the user rather than on the length of prior experience they had with mobile phones in general. The length of experience of using mobiles may not be an indicator of learnability in new applications for such user segments due to rapid rise in 'digital literacy' levels amongst semi literate users.

**Keywords:** Information system, Mobile Phone usage, GUI, Icon, Useability Testing.

# 1 Introduction

Information on job vacancies, especially availability of work on daily payment basis in the construction industry, is often done through word of mouth of the laborers. Though there is a sense of kinship and bonding, such word of mouth information is open to misuse by middlemen and cartels. Low literacy levels of the workers results in a dependency factor for finding work on a continuous basis [17]. The industry itself operates on 'job work' basis or 'hire & fire as required' basis. Laborers have to commute long distances to work from the outer periphery of urban cities. Opportunities for work that exist on far side of a town therefore are not explored due to fear of loss of an earning day. Laborers who are organized under groups, working for individual contractors are better off being transported like cattle in open trucks across the city from one construction site to another [17]. However individual laborers not belonging to cartels or groups have to rely on word of mouth to know where their

next employment is likely to be. The population of unorganised labours who work in the Indian construction industry is about 1.76 crore [1]. A self managed information system on mobile phones, which will inform a worker of job openings, will be immensely beneficial.

#### 1.1 Mobile phone usage in India and trends of screen sizes

India has the third largest mobile subscribers' base of 225 million in the world [2]. A large part of this subscriber base is in semi urban and rural - village sectors. Mobile phone usages have cut across all spectrum and classes of users including construction trade workers and casual labarors as well as housemaids. The Center for Telecom Research in London has projected that the number of subscriber will rise to 600 million by 2011[3]. In 2005 wireless services have connected up to 4,000 towns and 2, 00,000 villages [4]. Mobile phone companies offering cheap handsets and lifetime prepaid service [4] are increasing the subscribers' base in every class. Even lower middle class (laborers & petty vendors) with earnings of up to Rs.5000 per month have bought mobile phones [5] and are happy with connecting to their people across distances. Providing employment information to construction labours using mobile technology is the most viable option available to connect them directly with the contractor employers as well as to share information on job availability amongst themselves.

There is a wide range of screen sizes available. Phone models with bigger screen sizes are more expensive (above Rs 10,000 range) and may seem out of reach of the lower classes as of now. Given the rapid downhill pricing of handsets due to competition, it is safe to assume that in due course, low cost handsets too will sport larger screen sizes with finer resolutions as demanded by new 3G services. The mobile phone screen size of 240 x 320 pixels, which is expected to become the baseline for the mobile screen size [6], has been considered while designing icons and textual information in the case study being presented in this paper.

# 2 User Survey

This survey was conducted to understand the employment problems of the laborers in the construction industry. In addition, the usage characteristics and importance of mobile phone in their daily lives were also studied. The sample sizes are indicated in the table below. Some of the findings have been reported in the following paragraphs.

City	State	Country	No. of construction Site	No. of contractors + Supervisors	No. of Labours
Guwahati	Assam	India	1	1+ Supervisor	9
Solapur	Maharashtra	India	2	2 + Supervisor	16

Table 1Survey Regions

### 2.1 Employment related problems of the un-organized construction sector

The following issues and problems were observed after conversing with the laborers, supervisors and contractors.

- Employment information is not easily accessed due to lack of contacts and constant change / rotation amongst team members.
- Loss of job due to late reporting to work resulting from dense traffic condition in the city. Majority of laborers use bicycles or city bus transport to commute.
- Unpredictability of losing jobs due to sudden discontinuance by contractor for reasons best known to the contractor. It would be too late in the day to search for another construction site for a job.
- Laborer may want to shift from one site to another because of wage differential one contractor offering marginally higher wages.
- When the work at one site gets completed; finding another new job may take anywhere between 1-2 weeks, resulting in loss of earnings.
- Workers cannot plan their employment sites / employers to follow in a sequence. Gap of unemployed periods are interspersed with gainfully employed periods.
- Laborers may borrow advance money for survival from contractors thereby bonding them in obligation to that contractor. This could prevent gainful employment elsewhere even if available.

## 2.2 Mobile usage scenario

The following two tables shows the interaction parameters used to elicit information regarding the types of works, behaviors of laborers on the construction site and their interaction with mobile phones. This is done with the purpose of understanding the experiential issues of mobile phone interface and their usability characteristics by this segment of users.

It was observed (table 3) that this segment has taken to usages of mobiles like any other segment in terms of the frequency of use as well as purpose.

Interaction parameters	Findings
Language Known	Marathi, Hindi and Assamese
Types of work (Categories of	12-13 Different types of works / activities are
works)	identifiable.
Types of Labour	Skilled (Mistari) and unskilled labour (kamgar)

Table 2 User survey findings in brief

The usage is not different from a non laborer segment. It was found that this segment has taken to mobile usage both qualitatively as well as quantitatively

Table 3User survey findings

Interaction Parameters	Usage patterns
Use of Mobile	<ul> <li>For communication between friends, Listening to music, Playing games, calling, Messaging</li> <li>Mobile phone price range - Rs.1500- 3000</li> <li>10-15 % of labours are using mobile.</li> </ul>
Importance of mobile	• Very essential. Quick communication device for job as well as for any other personal communication.
Interaction with mobile	<ul> <li>Navigates through mobile interfaces.</li> <li>Existing icon identifications (All laborers identified icons), Receiving calls, Making calls.</li> <li>Reading Messages, finding out 'missed' call.</li> <li>The most known words are Menu, ok, Exit, MP3, SMS, FM.</li> <li>Illiterate users only receive calls, avoid other functions.</li> </ul>

#### 2.3 Context Diagram

The context diagram depicts the entities involved in system on the field.



Fig.1 Context Diagram: LES - Labor Employment System

## **3** Conceptualisation

To facilitate exchange of employment related communications and information between the entities (Fig 1) an attempt was made to conceptualise a new set of GUIs for a new system with improved information architecture.

Three wire-frames have been conceptualised in view of user-survey findings. The following are the features proposed to be included: (a) screen size of 240x320 pixels, (b) icon based graphics; (c) textual information window, (d) local language labels for navigational keys. The three concepts are briefly explained in 3.1, 3.2 & 3.3.

**3.1. Concept 1** is based on popular interfaces used in low cost phone models. The square block (Fig.2) has positions for icons representing type of construction work with additional labels and the voice over icon.



Fig. 2 Concept 1

**3. 2 Concept 2,** the following wire-frame shows the use of 'post office box' as a metaphor for the interface. The red coloured vertical rectangle is symbolic of the postbox. The postbox continues to be associated with 'Messages & Communicating information' by the lower middle class of users in India especially in the rural setting.



Fig. 3 Concept 2

**3. 3 Concept 3** incorporates a drop down menu based on the contemporary GUI widget models, which is widely adopted in Interfaces. While economizing on the amount of information displayable given the small screen size, it was assumed that it is intuitive enough for interacting with by semiskilled users.



Fig. 4 Concept 3

#### 3.4 Heuristic Analysis and evaluation of concepts

The above three concepts were evaluated against standard useability parameters. For example - for a particular information configuration in a concept how many minimum numbers of clicks the user will have to perform/to achieve his/her goalgiven a task - was of interest. How easily and quickly the user will 'learn' to operate (Learnability). How S(he) will be able to become familiar / remember the operations of the system (long term memory reinforcement) How easily the user will be able to move/navigate from one layer to another within the information architecture of a given concept. How the past experience (handling mobile device and their interactivity) of the user is used to learn and memorize so as to achieve his/her goals easily. The results of the heuristic evaluation done by the authors are shown in the table 4 below.

Sr.No.	Evaluation Parameter	Concept 1	Concept 2	Concept 3
1.	Information Architecture	6	5	5
2.	Learnability	6	4	4
3.	Memorability	5	5	5
4.	Navigation	6	5	5
5.	User experience used	6	4	3
	TOTAL MARKS	29	23	22

 Table 4 Concept Evaluation

On the basis of evaluation Concept 1 was finalized to proceed with detail designing and integrating at the system level through the software development process.

# 4 System Modeling & development

The modeling of the system for design detailing of the final concept was done by using Unified Modeling language comprising Use Case diagram, Activity, Sequence

and Relationship diagrams amongst others. This stage was under taken to model the complexity involved in designing the interface in relationship to the overall system. One of the, Use case diagrams and sequence diagrams is shown in Fig 5.



Fig 5 Use case diagram (top); Sequence Diagram (bottom)

#### 4.1 Information Architecture

The information architecture adopted was such that it should not increase the memory loads on the semi literate & semi skilled user. All tasks in the finalized GUI were to be accomplished within 3 - 4 clicks. It was assumed that 3-4 clicks would constitute maximum permissible limits to operate without mental & physical fatigue given the small sizes & dense configuration of mobile phone buttons. (Fig 6)



Fig 6 Example of Information Architecture for one of the screens.

## 4.2 Detailing of Graphics - Final Concept

With nature & type of construction work as a basis of catagorisation, eleven icons depicting different types of work (digging, brick laying, plastering, painting etc) were individually designed (size: 32x32 pixels, 48x48 pixels) keeping in view the screen resolution of  $240 \times 320$  pixels. The icons in monochrome and colour are shown in Figure 7. They were then tested for their learnability, legibility, identity and association to work type. The test subjects were laborers & semi skilled workers on the field.



Fig 7 Developed Graphic: User Interface icons

## 5 Final Mobile User Interface prototype development

The prototype was developed by using Flash software. The specifications of UI are as listed below,

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Language Used: Hindi, Assamese Voice Over: Hindi (As Hindi is the mostly used language) Number of Icons: 9 icons on the first screen Color used: Color and Black and white both Screen Size: 240x320 pixels Navigational Instruction: ok, Exit, to go back (previous UI) press '4' Site details: Site Address, Vacancies, Duration of work, Contractor's Name, Thumbnail view of site location. Extras: Calling option to other worker on the selected site Software used for prototyping: Adobe Flash Lite Emulator: Adobe Central Device. Therefore, Mobile used for testing the prototype. : NOKIA N73

## 5.1 Features of the new mobile UI

- Iconic Interface
- Usable Information Architecture
- Easy navigation
- Request refilling facility
- Voice over

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## **Additional Features:**

- Tickers for Government announced messages
  - Laborer-Laborer connectivity, to contact laborers on the selected site by providing laborers photos and their contact numbers, in case if any difficulties like unknown site location or to know another work related information of the selected site.

# 5.2 Final GUI on mobile

Some of the screen shots of the final Graphical User Interface designed is as shown in Fig.8.


# 6 Testing

To start with testing was done to understand the 'learnability' at the systems level of proposed new GUI. Test Location was at: Guwahati, Assam, India. The Number of users tested was 29. The tests were carried out at the Laborers' Quarters, on the construction site located at IITG Campus. The User Age group range was between 17 to 34 years. Education level of the user Illiterate, Semiliterate, and Literate. Mobile Used Experience of the users ranged from 0 months to 144 months, Hindi and Assamese language was used during testing.

There were two tasks has been given to be complete by the respondents.

- Task 1: To select the job availability by his/her own logic of navigation.
- Task 2: To select the job by discussing with other members already working on the site. This task was designed to connect people who did not know assigned job location as well as contractor's information

Testing Tools used:

- Mobile Phone: N73: Prototype in both languages Hindi, Assamese
- Stop watch used to check the time taken to complete the given task

#### 6.1 Testing Methodology

The test was patterned on Coaching methods [16]. Hindi language was used for giving instructions and clearing doubts of the testing users. Mobile Phone was provided to the user to operate. Time taken to complete the given task by the user was noted using stopwatch and Graphs were generated by using the data (see table 5)

The new GUI and various screens configurations were explained, shown and demonstrated to the subjects. The time taken to do the assigned tasks was expected to indicate how easily and how quickly the subjects could operate the GUI. Learnability of the new GUI by the user was under testing.

# 7 Results

The following table 5 depicts the data gathered during testing of the application.

Sr. No.	Education	Mobile Usage Experience In months	Age In years	Time for T1in Seconds	Time for T2 in Seconds	Actual Time for T2 in Seconds
1	8	12	22	7	30	150
2	7	36	20	8	45	165
3	12	48	23	9	33	153
4	12	18	22	10	32	152
5	0	24	21	14	53	173
6	10	18	20	15	23	143
7	10	24	26	18	43	163
8	9	24	20	20	40	160
9	8	24	22	20	100	220
10	4	12	20	22	58	178
11	13	60	19	22	22	142
12	1	36	20	24	30	150
13	0	18	30	30	48	168
14	12	18	22	32	70	190
15	9	36	34	31	43	163
16	9	12	18	34	57	177
17	8	24	17	34	34	154
18	10	24	27	34	40	160
19	5	24	30	36	137	257
20	12	24	23	36	106	226
21	12	72	32	38	40	160
22	12	12	25	47	60	180
23	10	36	27	53	84	204
24	0	12	22	59	83	203
25	6	144	27	60	89	209
26	10	0	20	65	78	198
27	12	72	27	67	116	236
28	10	24	18	84	100	220
29	3	6	22	114	236	356

Table 5. Test data

(T1- Time taken for task 1, T2- Time taken for task 2, Actual Time taken for task 2 = T2 + 2 minutes(Approximate time taken for calling), Education-  $1^{st}$  standard to  $13^{th}$  standard ( $1^{st}$  year in Graduation))

The following graphs were generated on the basis of gathered experimental testing data. Closest fitting linear graph for education level, mobile experience and age respectively, was computed through software.

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Graph 1 Education, Mobile Experience, Age of the User Vs Time taken for Task 1



Graph 2 Education, Mobile Experience, Age of the User Vs Time taken for Task 2

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From the graphs it is inferred that

- Learning ability of such new products /GUIs correlates with the age and education level of the user.
- Learnability of such application may not depend upon prior mobile phone usage experience the user may have. Meaning even if the user has had less usage experience with mobiles, it did not affect the ability to quickly learn to operate the new GUI and navigate through its information architecture.
- The voice over feature used in the GUI is not as helpful for the illiterate user as it was presumed.
- Illiterate users prefer GUIs that incorporate one or two click operations to complete their tasks.

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# Identifying the Cognitive Needs of Visitors and Content Selection Parameters for Designing the Interactive Kiosk Software for Museums

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**Abstract.** This research presents the findings of contextual interviews, visitor survey and behavioural study that were carried out in Indian museums. It originates from the hypothesis that the museum exhibits are unable to express their relevance, historical significance and related knowledge to satisfy the curiosity of visitors. Our objective is to identify the cognitive needs of museum visitors and the content selection parameters for designing the interactive kiosk software, which is expected to be set up in every thematic gallery of the museum. The kiosk software is intended to offer higher level of engaging and learnable experience to the museum visitors. The research involved participation of 100+ visitors in Indian museums. The access restrictions and constraints of museums cause cognitive deprivation of visitors and compromise the quality of experience. Therefore, the interactivity, animations and multimedia capabilities of kiosk software must be focused on overcoming these limitations.

**Keywords:** Visitor-centred design approach, Museums, Interactive kiosk software, Contextual interviews, Survey, Questionnaire, Social behavior, Cognitive needs, Content selection parameters, Visitor / user experience

## 1 Introduction

This research is carried out for an ongoing project, which involves design and development of touch screen based kiosk software, which is to be hosted in each thematic gallery of Prince of Wales Museum, Mumbai, India. The potential users of the proposed kiosk software are basically the museum visitors that include school children, tourists and other diverse categories of people. Therefore, it is quite difficult to define the attributes of museum visitors.

#### 1.1 Scope

As per the scope defined for this project, each kiosk software has to present interesting information about the theme of gallery, highlight the historical significance of artefacts, provide interactive games and animations to make it an engaging and learnable experience for the visitors. On the whole, the kiosk software should provoke the interest of visitors about history and motivate them to explore historical exhibits displayed in each gallery. It should also raise the level of their appreciation of historical artefacts. It is decided to present the information in Hindi, Marathi and English languages to address the communication requirements of regional, national and international visitors. Each interactive application is desired to be not more than 20 mnts in run-time duration, if one was to go through all the information, so as to avoid crowding before the kiosk.

#### **1.2 Research questions**

Museums are *free-choice learning* or *informal educational environments*. Enormous variability in both the environment and the audience makes it very challenging for the researchers to make sense of what visitors learn [1]. Therefore, before starting to design the interactive kiosk software, it was essential for us to seek certain design directions from the museum visitors.

We had following questions in our mind, which are based on our hypothesis that the museum exhibits are unable to express their relevance, historical significance and related knowledge to satisfy the curiosity of visitors.

- Considering the existing non-interactive exhibits and supplementary information displayed in museums in the form of labels and posters, what new things 'interactive kiosk software' should offer?
- What are the *cognitive needs* of museum visitors which must be addressed for developing proper understanding of the historical artefacts?
- What parameters should be applied for selecting the content for inclusion in the kiosk software?

Our primary goal behind this project is to create an engaging and learnable visitor / user experience through the interactive kiosk software.

#### 1.3 Related work

We have referred the existing research on usability of public access systems like kiosks and environmental psychology both. The brief overview of this study is presented below.

The key design principles for kiosk based public access systems like *immediate attraction, immediate learning, immediate engagement and immediate disengagement* are very relevant and useful in our project [10]. The proposed touch screen kiosk is a midway approach if compared with the *tangible interactive installations* [7] and *low tech interactive option* already explored in the context of museums [11]. The case study of conversational *familial collaboration and relationships* through handheld device in the context of museums are also found useful for our study of social behavior of museum visitors [8]. Advanced

technological experiments involving *augmented reality* [6] with *mobile multimedia guide* and *personalization* of visitor experience provide broad guidelines that are relevant to our project [5].

The doctoral study on "visitor behavior, interrelationships of adult visitors' view of learning experience" in the museums provides the 5P model of museum learning which includes Person, Purpose, Process, People and Place as its main aspects [9]. Cognitive processes of attention involved in the interpretation of labels [3], the exhaustive study on environmental psychology in museums and the methodology for visitor study has been extremely helpful to us in the current research [4].

V1	Visitor Name 26 yrs			Visitor	Condor	A.c.o.	Erom	Qualification
				бyrs по.		Age	From	Qualification
	Jaipur Degree: Law / taxation			1	Male	26 yrs	Jaipur	Degree in Law/taxation
				2	Male	33 yrs	Thailand	Energy scientist
V1-1	I came to the museum to see and compare today's lifestyle	Visitor High statement	High	3	Female	23 yrs	Pune	Hardware professional
	with the olden days			4	Female	20 yrs	Nagpur	Engineering student
V1-2	To know what food, clothing etc. our forefathers had 1000	Visitor statement	High	5	Male	25 yrs	Mumbai	PG student
V1-3	Visitor has been exposed to a	Observation	Hiah	6	Male	27 yrs	Pune	PG student
	lot of historical monuments and stories by virtue of his native		5	7	Male	30 yrs	Ahmedabad	Tablaplayer
	place (Jaipur, Rajasthan which			8	Female	28 yrs	Germany	Museum staff
	has a lot of historical background			9	Female	41 yrs	Germany	Museum staff

Fig 1. Documentation template used for contextual interviews and brief profiles of visitors

# 2 Methodology

Considering the vast number of visitors that visit the museum every day, we decided to adopt three pronged methodology (Visitor Centred Design approach) as under-

#### Contextual interviews of museum visitors (Reasoning and explanation)

We carried out contextual interviews [2] of visitors belonging to different age groups, genders and geographic locations and nationalities to understand their perception of the museum, informal learning outcomes and the reasons behind their response to the exhibits in terms of why they skipped certain objects or what intrigued them most.

#### Visitor survey through questionnaire (Prominent trends)

Our objective of visitor survey was to get large sample of self-reports on common set of questions and collect statistical data. This was intended to help in analyzing the prominent trends of actual visitor experience.

#### Visitor behavior study (Social behavioral patterns)

Study of visitor behavior in museums was intended to observe their spontaneous reactions to antiquities and the museum environment. We also intended to notice the social behavioral pattern of visitors and the interactions between groups.

Above activities were not carried out in an exact sequential order but it overlapped sometimes and gave us the opportunity of improvisation wherever applicable based on the incoming insights. This research was primarily carried out at Raja Dinkar Kelkar Museum, Pune, India and some observations were also made at Prince of Wales Museum, Mumbai, India. Overall, about 100+ museum visitors participated in our study.

# **3** Contextual Interview

A total of 12 contextual interviews were conducted to find out the various layers of visitors' experience. The interviews were conducted like a talk while moving across the museum galleries. A typical interview lasted for about 25 minutes to 100 minutes. 9 of these interviews were good enough and were interpreted thoroughly. The interpretation was done on the same day after finishing the interview.

An age group of roughly about 15 to 30 years was chosen because it was observed that majority of the youth is comparatively less interested in visiting a museum as against going to movies, hanging out or having fun with friends. The youth have had fair enough exposure to the world and can form their opinions; they are more critical in their approach and hence a lot of problems could be identified.

The visitors' responses were classified as visitor statements, observations, cultural influences, breakdowns, design ideas and insights. These responses were rated as high, medium or low as per the interview focus. All interviews were compared and affinity found across the age group.

#### **3** Survey of visitors



Fig 2. A. Survey forms designed in English and Marathi languages

IFIP HWID2009 Working Conference on Usability in Social, Cultural and Organizational Contexts, Oct. 7-8, Pune, India. Questionnaires in English and Marathi languages (the museums have significant amount of regional visitors) were kept at the exit lobby of the museum and the visitors were requested to fill them. The questionnaire was designed to gather specific data from the visitors. Help was given to those who did not know either of these languages. The main focus of the survey was to find out the-

- Demographic and basic information about visitors
- Appreciation levels of different visitors
- Crucial aspects in the presentation of artefacts
- Likings and interests of different visitor groups
- Value addition to the visitors
- Time spent by the visitors

Some of the survey findings are explained below.



Fig 3. A. Gender and agewise distribution of visitors B. Agewise distribution of visitors

#### 3.1 Visitor demographics

As shown in figure 3A, more number of female visitors in the 29-40 yrs age group indicates that more mothers (or more families) have accompanied their children to the museum. A large number of male visitors in the 14 to 21 years age group indicates groups of friends or travelers.

The number of children (1 to 13 yrs) and mostly parents (29 to 40 yrs) is almost the same throughout the total sample size of 91. This indicates the following possibilities:

- Only one of the parents (either father or mother) has filled up the form.
- There are probably visitor groups in majority like: child accompanied only by the mother / child accompanied only by the father.

Figure 3B shows that there is less number of visitors in the age groups of 14 to 28 years. It is perhaps due to lack of interest in museums or increased academic load on the students and professional commitments for those employed. There are greater number of visitors in the age groups of 29+ and below 13 years. It again confirms that these are mostly the children accompanied by parents or elderly persons.

#### 3.2 Value addition to the visitors

As shown in figure 4, the maximum 'NO' replies came from the 22 to 28 yrs age group. This indicates that special attention and strategies need to be developed to cater to this group. Also, more 'NO' responses were registered for the collection 'Provoked me to study...' & 'Made me more sensitive....'



Fig 4. Age wise distribution of 'NO' replies to the overall experience of 'The collection...'

#### 3.3 Time spent by visitors

Our statistical study shows that individuals in the 22 to 28 yrs age group spent significantly less time in the museum if compared with the visitors in other age groups. It indicates that the artefacts could not engage them for longer time.

## 4 Visitor behavior observations

The behavioral study of visitors in museum environment revealed certain patterns in terms of their response to the artefacts such as expressions, gestures and postures, interactions between the group members and social behavior. We were able to identify following prominent social groups among the museum visitors-

- Parents & children
- Grandparents, parents and children

- Friends (teenagers and youth mostly)
- Teachers and schoolchildren
- Families and their relatives or guests
- Domestic Tourists
- Foreigners
- Others (loners, people visiting from nearby places, etc...)

The visitors are further categorized based on their interest levels-

- Motivated those who visit museum out of interest e. g. tourists
- Initiated those who are guided by somebody e.g. children
- Non-initiated and non-motivated those who came to kill time

Relevant observations of visitor / social behavior are given in the deliberation on cognitive needs of visitors below.



Fig 5. Observations of visitor /social behavior in museums

# 5 Cognitive needs of visitors

The contextual interviews, visitor survey and behavioral observations together have put forth various cognitive needs of visitors that remain unaddressed in the present museum settings. The proposed interactive kiosk software must be designed to cater to the following cognitive needs of museum visitors. It is possible to develop functionalities, features, interaction templates and user interface design based on the cognitive needs of visitors.

#### Curiosity about the non-visible parts of artefacts

Most of the artefacts in the museum are kept in protected displays and restricted areas. The visitors are compelled to view the artefacts from certain distance with a fixed view point. Although these restrictions are essential for the safety of artefacts, they put major constrains on the visitors in developing full understanding of artefacts. Furthermore, some artefacts need to be seen from a closer distance using a magnifying glass; and some artefacts need to be opened for viewing the internal details. Due to restrictions, this curiosity about 'what is inside? or what is on the other side of object?' is never satisfied.

#### Multisensory perception of artefacts

Visitors have a great desire to hold the artefact in hand, to touch it or feel it or see it from closure distance or to try using it, which is never fulfilled due to restrictions. They need to experience the three dimensionality of certain objects. Raja Dinkar Kelkar Museum, Pune has a gallery of traditional 'Indian musical instruments'. Prince of Wales Museum, Mumbai has a gallery on 'Indian birds'. In such cases, hearing the sounds of musical instruments and birds can complete the understanding of these artefacts. In short, the visitors are deprived of multisensory perception of artefacts. Such type of arrangement makes a museum, very passive and non-interactive type of environment.

#### Comparison with old and modern lifestyle

Human mind is habitual to making comparisons and forming semantic associations and relationships between different things. Many times the artefacts are very culture specific that are very difficult to identify in terms of its purpose and use. We found that visitors appreciate more when they are able to form comparisons between the historical objects and modern objects. Figure 6 shows the prototype of an interactive application meant to trigger comparative thinking about *modern* and *Indus civilization* objects.

#### Visualization of oneself using the artefacts

Visitors are often noticed making gestures to imagine themselves holding the sword displayed in the exhibits or any other object for that matter. One desires to wear the costumes or ornaments from ancient period. One wants to try using the ancient artefacts. But such desire always remains unfulfilled due to the restricted museum environment.

#### One-click-one-toffee approach for narrow attention span

We have observed that most visitors have no patience to read elaborate historical information displayed as posters in museums. They tend to have a very limited attention span. Therefore, smaller nuggets of knowledge that can be absorbed in one glance should be presented in the kiosks. It will also reduce the chances of crowding over the kiosk. We would like to call this approach as '**one-click-one-toffee approach'**. It implies that we quickly provide a stimulating and memorable piece of information which can be understood quickly.



**Fig 6.** Prototype of an interactive game in which one can match the pairs of objects from 'Modern Times' and 'Indus Times'. It is meant to provoke comparison of lifestyles in the minds of museum visitors. The game presents shuffled examples of dice, toys, plough, spindle and needles, cup, bath, drainage system etc from the modern era and from the era of Indus civilization for comparison. The visitor has to find the matching pairs.

#### Stories associated with the artefacts

Visitors are rarely interested in the dates and historical descriptions of artefacts. What interest them most are stories, drama, performances and the thrill of being witness to certain historical events in their imagination. This is evident from the fact that although the museums are not so popular among the youth but the historical films are.

#### • Overall experience of objects, events, places and lifestyle

In summary, we can say that the museum visitors are deprived of the aspects essential to develop overall cognition of artefacts and the experience of it. They are unable to visualize as the artefacts are usually disconnected from its original environment and the context where they belonged. The descriptive posters and panels in museums fail to fill up the absence of experiential elements. The textual information needs to be read, interpreted and comprehended by visitors who have a very limited attention span.

#### Shared cognition between various social groups

We found that large number of museum visitors come in groups as mentioned in section 4. The group invokes significant social interaction in response to the museum artefacts. Visitors discuss, explain and share their point of views and knowledge while looking at the museum artefacts. Through collective efforts they try to develop greater understanding about the artefacts.

The interactive kiosk is conventionally assumed to be used by one user at a time. To further encourage the social interaction and shared cognition process simple games and puzzles could be designed that allow inputs from 3 to 4 persons in a group.

#### Inarticulate cognitive map of museum's architecture

During our contextual interviews, visitor surveys and behavioural study, we found that many visitors want to visit only the important artefacts or galleries due to time constraints. In such situation, they are unable to develop a proper cognitive map of the architectural layout of galleries in museums. The reference of their present location in the museum vis-à-vis the static maps displayed on walls do not help in understanding the navigational path to various galleries, especially when one wants to quickly visit only the selected galleries and artefacts.

We have been able to convert some of the cognitive needs of museum visitors into interactive games and features as shown in Table 1, to help in the visualization of Indus civilization. The demonstration of working prototypes of these possibilities has generated extremely positive feedback from visitors and museum officials both.

Table 1.	Interaction	design bas	ed on the c	ognitive	needs of	f museum	visitors
----------	-------------	------------	-------------	----------	----------	----------	----------

	Interaction design based on co	gnitive needs of museum visitors		
1	One-click-one-toffee approach	Visual index with layered information		
2	Comparison between old and modern lifestyles	Interactive Game: Match the pairs between modern and Indus lifestyle		
3	Visualization of oneself using the artefacts	Interactive animation of toy-cart from Indus valley		
4	Multisensory experience of places, environment and the context	3D Visualization of Indus townscape		
5	Visualization of oneself using the artefacts	Interactive re-construction of a broken vase		

# **6** Content Selection Parameters

As stated earlier, we have a constraint that each interactive application should engage the visitor for not more than 20 mnts if (s)he was to go through all the information, so as to avoid crowding before the kiosk. Each museum gallery displays hundreds of artifacts therefore we need to apply certain parameters to select the artifacts for inclusion in the interactive kiosk software. Following parameters are evolved based the cognitive needs of visitors –

Artefacts that -

- have interesting features which are not visible due to fixed view
- have significant multisensory attributes
- have potential for presenting comparisons between 'then' and 'now'
- visitors like to imagine themselves using it

- inspire one to visualize the lifestyle or which can be better understood with the context
- have interesting stories associated with them
- explain information useful in the educational context
- provoke group interaction / discussions
- are popular due to historical significance and other specialties like craftsmanship, aesthetic value, etc.

Artefacts complying with above parameters can be selected for inclusion in the kiosk software.

# 7 Conclusion

The contextual interviews, survey and behavioral observations of museum visitors have been extremely helpful in identifying their cognitive needs, which remain unaddressed in the present museum settings.

The interactivity, animations and multimedia capabilities of kiosk software must be focused on overcoming the access restrictions and constraints of museums. The content selection parameters are also largely based on the points where the visitor experience is compromised the most.

It is possible to develop functionalities, features, interaction templates and user interface design based on the cognitive needs of visitors. Therefore, proposed interactive kiosk software must be designed around the cognitive needs of museum visitors in order to offer higher level of learning and engaging user experience.

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# Usability Issues in developing an Intra Office Communication System.

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Abstract. This paper outlines the basis of incorporating functional features in a new GUI based software under development for addressing comprehensive communication and interaction needs within an office environment. Bench marking of features in existing communication software products such as Microsoft Outlook, IBM Lotusnotes, Office Communicator, Mozilla Thunderbird etc. was done by asking a set of questions related to the usage of these existing soft wares. Usability issues were identified through a user survey involving 30 subjects of varied profiles (domain, designation, age etc.) in a corporate office. It is posited that existing software office communication products that have been developed for a universal market may be highly underutilized or have redundant features especially for use as an intra office (within the same office) communication medium. Simultaneously they may not cater to some very contextual requirements of intra office communications. Based on the findings of the survey of usability of existing products, a simple 'person to person' communicating medium for intra office situations was visualized with a new interactive GUI. Issues in usability that need to be considered for a new intra-office product have been brought out.

Keywords: Intra Office Communications, Usability, Interface Design, Requirement Analysis

#### 1 Introduction

The key to a successful organization is the effective communication in between its employees. One can term this as *Intra Office Communication*. Technically, communication is the process of transfer of information between the communicating entities. Much of the work inefficiency in offices can be traced to poor and hurried communication. As a result of intra office miss communications important deadlines are missed with objectives not met. In all probability customers are not served and venders are not paid.

With the rapid growth of internet the IT market is suddenly flooded with a plethora of communication services and service providers. Email, List servers, Newsgroups, Web Conferencing, Internet Relay Chat (IRC, also termed as Instant Messaging (IM)), Internet Phone (Internet Protocol (IP) Calling), Internet Radio, Desktop Video Conferencing and File Transfer Protocol (FTP Client) are few of the large number of 'Web-Based Electronic Collaborative Tools'. After the advent of the Web 2.0, newer concepts of social interactions such as Social Networking (Face book, LinkedIn etc.), Blogging (Wordpress, Blogspot etc.), Micro Blogging (Twitter), RSS Feeds etc. have evolved [3]. Many of these are jostling for attention as personal as well as semi-official communication enabling products. This has turned out in making the communication a complex and an incoherent process. The basic dissimilarities at the structural and interfacial levels plummets the problem further. Nonetheless, there are always learnability and usability issues which remain largely unaddressed. All this adds to the confusion for someone who wants a non complicated intra-office product to communicate.

There is hence the need of investigating at a micro level, the actual essentiality of each of the features of existing software products and prioritize them according to their frequency and necessity of use. It is expected that unidentified and unmet requirements (opportunity gap) might pop up. It was hypothesized that many of the existing features might be classified as redundant, repetitive or unnecessary.

### 2 Identifying the typical intra office communication needs

The need to identify typical intra office communication requirements come from the extensively diverse ways of communication adopted in an office setting consciously as well as unconsciously. A threefold research strategy was adopted to accomplish this task. This involved a study of the existing products, a rigorous user study and finally prioritizing the features. This would be then succeeded by conceptualizing the GUI for a new utility that comprehensively accomplishes the conclusions of our research.

#### 2.1 Software Utility Analysis

A large number of serving software applications were found to be used by office workers. A list of 10 most popular office softwares and web services were shortlisted. Heuristic evaluation targeting the special features of each product was done. The applications shortlisted were Microsoft Outlook, IBM Lotus Notes, Mozilla Thunderbird, Office Communicator, Google Talk, SSH Client, Message Pal, Gmail (Web), LinkedIn (Web) and Facebook (Web). Some of the important and notable features and characteristics that were identified are as listed below:

*Emailing:* Email is the most common and preferred collaborative communication tool in use today. Besides its basic functionality of being an asynchronous communication tool [1], it is also being used increasingly for information systems' management, coordination and collaboration tasks in organizations (Ducheneuaut & Bellotti 2001). Email is a crucial tool because virtually everybody who has ever touched a computer knows about email. The interesting observation, however, is that most of the added

utilities like task managing, calendar, email flagging, email tracking, temporal information organization, time management etc. are redundant as compared to its basic functionality viz. manipulate individual messages and message threading. Compatibility issues of the email service with other software utilities are partially responsible for this (Gwizdka 2004).

- Instant Messaging (IM): A form of real time (synchronous) communication, instant messaging evolved as posterity to emailing. Communication is possible between two or more users and with one or many users simultaneously. Newer Instant Messengers also come up with features like file transferring, voice messaging, IP calling, video chatting and custom 'status message' settings. Instant messaging is preferred more for informal and quick conversations. IM language is one of the more noted features of instant messaging which involves extensively the use of evolved abbreviated forms, smiley faces and symbols (like\*(star) for spelling correction) for better interaction.
- *Social Networking:* This new wave of internet based social interactions catalyzed particularly after the advent of Web 2.0. In the past five years, it has rocketed from a niche activity into a phenomenon that engages tens of millions of internet users socially connected to each other. While networks like Facebook and Orkut are already popular for creating social groups, mutated versions of the same have evolved for office environments and professional work too in the form of services like LinkedIn. Structurally, a social network is made of nodes interdependent on each other on one or more parameters. The most unique feature of social networking is the concept of profile management on a personal and community level. With other add-ons like community forums, photo sharing, games, personal recommendations, social networking has revolutionized the world of internet based interactions.
- *File Sharing:* File sharing facility is actually dependent upon the type of network shared between the users (LAN, internet etc.) and the size of the file transferred. While typical email services provide file transfer facilities of about 10-15Mb space per email attachments, file transfer protocol (FTP) clients are standalone services specifically designed for file sharing and hosting. On an intra office level, FTP clients contextual to local intranet as often used to share official work related material. This is often practiced as a team activity rather than just person to person communication.
- *Voice over Internet Protocol (VoIP):* More frequently termed as IP calling, voice over internet protocol is one of the newer features found in modern internet based interaction services. It provides a unique telecommunication capability by exceeding the standards of traditional telephony. IP Phone is a technology in itself. Over half of the fortune 500 companies are deploying VoIP phones and over 10,000 organizations have deployed the technology with millions of IP phones acquired. VoIP is becoming a mainstream technology in the world of commerce and is likely to spill over beyond corporations. The most advantageous features of

VoIP are the reduced operational expenses and their unified messaging capabilities.

- *Video Conferencing (Vcon):* Vcon is a step next to VoIP which involves interactive telecommunications between two or more remote locations with visuals. However with some serious usability concerns like privacy and reciprocity, audio-video quality, audio localization gaze awareness and eye contact etc. Vcon has yet to take off on a big scale.
- RSS Feeds (Web Feeds): Really Simple Syndication Feed or Web Feeds is something that found popularity during the time 2005-06 and gained sudden momentum with blogging. RSS feeds are particularly relevant to offices and organizations due to their capability of rapid news capture and propagation. However, RSS feeds have often been found to score very low on usability standards, especially with the process of subscribing and unsubscribing them. Most office users are simply ignorant what RSS feeds are in spite of encountering the term and the popular logo time and again on the internet.
- *Other Features:* Other important observations were the usability aspects of performing various tasks like managing mails, searching content, previewing attachments prior downloading, drag and drop file sharing etc. Some miscellaneous information management features like Journal, Reminders, Meeting Fixtures, Calendar and Utility Widgets were also noteworthy.

#### 2.2 User Study

In the previous section we gave a brief overview of our findings about a few utility features of the existing systems. This section deals with the nest stage of our research viz. the User Study. We sampled a set of 30 different users of diverse profiles working in an internationally known Indian Information Technology company in Benguluru. Data gathering sessions composed of questionnaires and contextual inquiries through interviews. After an initial pilot test of the questionnaire amongst 5 selected users, the questionnaire was launched online to gather larger volumes of quantitative data. The questions targeted to explore the most used features and most preferred features by the users amongst different competitive softwares. Furthermore, a data about their working experience and expertise with different softwares was also collected. Users differentiated on the basis of their age groups, work experience, gender, designation and work type.

We conducted contextual inquiry sessions with the selected users for about 30 minutes each, which included responding to a printed questionnaire. Occasionally, users were also asked to perform a specific set of tasks on some of the previously mentioned softwares. Users often faced difficulty in handling a software they had not worked upon previously, but appreciated if they finally discovered the task executed using an unfamiliar software more easily than their own preferred software. Experienced users provided valuable inputs about a comparative study of different softwares they have worked with.

Following are reproductions of some selected questions and replies put forth during the contextual inquiry sessions:

- What are the different ways (physical/electronic/web based) in which you communicate with people in your office?

   A typical response: "E-mail is the most essential primary tool for communication. Intranet messenger is used for informal communication", "E-mail, IM, SMS, Phone", "E-mail, Phone, FAX, Video Conferencing", "IM, Email, Meeting(offline and online), document sharing, FTPs, Shared Folders, Scripts".
- 2. What all softwares are you acquainted with as communicating softwares? Please mention the time (in months) you have been using each of these. *The responses are compiled in table 1.*

	MS Outlook	Office Communicator	Gtalk	Mozilla Thunderbird	IBM Lotusnotes	Y!Messenger
Number of Users	30	21	18	12	10	8
Average Time since using	10.0	8.5	13.0	8.0	8.5	12.0

Table 1. Software usage pattern over time of acquaintance (in months).

3. Which is your preferred way (software/utility) of communicating to your office mates amongst those listed above? Please rank in order of preference. For a particular user we awarded 10 points for rank#1, 8 for rank#2 etc. Total points scored by the software averaged over the number of users who voted gave the Average points scored by each software. Average rank is the order of average points scored, 1 being the most preferred.

Table 2. Preferential list of Softwares. Ranks averaged over user preferences.

	MS Outlook	Office Communicator	Gtalk	Mozilla Thunderbird	IBM Lotusnotes	Y!Messenger
Average	1	2	3	4	5	6
гапк						

4. Do you depend on some specific ways (like email for example) to communicate to certain people in your office? Or you get along with whatever is the easiest or the quickest?

Typical responses were as follows: "Formal messages, without any choice have to be corresponded as e-mails. I prefer IM for general communication", "Of course! Like you have to use an FTP client for transferring large files or working on shared folders", "I hesitate using IM to communicate with my project manager, or other senior officials", "I really don't like typing mails or even IMs, I prefer the office phone at most times".

- 5. How do you rate Microsoft Outlook? Any particular problems that you have faced while using it? Any suggestions about the same? *Typical responses: "I am not aware of many features like Journal, RSS, Labels etc. I am really not keen to explore much of these", "Outlook 2003 does not support previewing attachments and that's really annoying", "I don't know how to make a signature, but I've seen mails bearing the same", "Search is not powerful enough, like these days we have searches that show suggestions instantly for every word. Then, I can't search IDs for typing names"*
- 6. Would you prefer having one integrated system (if it were to exist) for total communication requirements? Or are you comfortable and happy with the state of art facilities?



Fig. 1. User response to the proposal for a posited system which address their complete communication needs in an office environment.

7. Following is a set of features that we proposed to incorporate in designing an integrated futuristic communication application. On a scale of 1 to 10, with 10 indicating highest degree of preference, rate the features.



**Fig. 2.** Chart showing the average ratings for recommended features in modern intra office communication softwares, essentially 'Outlook' by the users. Some of these features may or may not be already present in other software services under consideration.

Contextual inquiries often resulted in open ended qualitative questions and discussions when the user would precisely point on the screen, the feature he/she failed to understand or the problem faced. This provided valuable inputs to understand the lower levels of interactivity existing between the user and the software.

#### **Results of the User Study**

The results of the User Study conducted in numerous contextual inquiry sessions, online questionnaires and heuristic evaluations of various softwares were interpreted on both qualitative and quantitative levels. An Attribute List of the recommended features for a new office communication system was then prepared. It also threw light on the unmet needs.

The primary communication needs identified (in decreasing order of priority) were as follows: (1) Emailing (2) Instant Messaging (3) Phone Calls (4) SMS (5) FAX (6) Video Conferencing. The most common softwares products in use (decreasing order of usage) were Microsoft Outlook, Microsoft Office Communicator, GTalk Client, Mozilla Thunderbird, IBM Lotus Notes and Yahoo Messenger.

It was observed that Instant Messaging topped the list of unmet needs and users often had to resort to separate softwares like Skype and Google Talk to serve this purpose. More interestingly, unlike other features, instant messaging was backed by almost all types of personas be it consultants, managers, coders (developers) or designers.etc. We now have a look at some of our significant qualitative observation: A majority of users preferred using a single application that could cater to complete communication needs rather than operate numerous softwares for different communication requirements. Although the above ratings show the priority of features on a cumulative scale, users differentiated in their preferences on a individual level. For example someone like a manager rated News Feeds quite higher than a software engineer. Preferences varied significantly over users with different age groups. While younger people rated rather non functional features like skins/custom colors higher (perhaps to keep the ambience more lively and enjoyable), experienced people almost discarded it. Tailorability (Customizability) was one important unmet need noticed which remained unaddressed by any software so far.

Social Networking, initially speculated to be one of the major trends of contemporary communication systems was totally discarded by all types of users. When probed, they accounted this for the unnecessary expenses of time and over indulgence in social network activities. People did want their web based social networks to remain intact in place, however disapproved the recommendation of introducing an intra office social network system by discarding any of its special utility.

Microsoft Outlook was although the most prevalent software system used, but this was only because of the company's policy to use it in their offices and not the users' choice. As a result, majority of users who complained about several critical usability problems in handling Outlook, had no other choice but to cope up with it. New recruits especially faced this problem time and again and had to consult their co workers to help them out in different situations. More about this is reported in detail in the next section.

#### 2.2.2 The special case of Microsoft Outlook

Taking a deeper look into Outlook, since it was found to be the most used communication software, we probed some major difficulties that users faced while using it. 'Searching' (both content and contacts) was one of the major concerns repoted. There were also issues like 'Archiving', managing and using 'Journal', Color Coding, Sorting and managing Folders, download attachments, making 'links' in signatures and a general 'clumsiness' in the user interface. Furthermore, the most used features in Outlook were also identified. Email being obviously the leading one followed by Contacts, Calendar, Meeting Fixtures, File Transfer (essentially mail attachments), Remainders, Archiving, Tasks and lastly recovering deleted items.

It is interesting to note that 'Contacts' (searching, managing, using) is one feature that falls under the most used features and also highlights usability concerns. We can argue a number of technical reasons for this problem - dynamic searching being the most fundamental.

#### 2.3 Inferences and the Attribution List

A number of interesting inferences could be drawn from the above discussion. We discovered that what users require is an application affording all-round - '360 degree communication and interaction within the office' without having to go out of their current working GUI screen. However, this does not imply to make a potpourri with

all possible flavors of softwares added to it . Rather we need to select the essential ones which the users actually want. Unnecessary repetition of redundant features offers no advantage. Adding to this, many crucial needs remain unaddressed and lead to the diversification of softwares.

We discussed in section 2.2.1 how preferences varied considerably with changing user profiles. It can be stated that a section of the users might be quite satisfied with the current state of art viz. the diverse ways of communications and their diverse utilities. There might be another large section of the users who are looking out for a radical change. Same could be posited for the various features. Age, domain and experience play a central role in dictating a person's preferences as reflected in our user testing.

#### 2.3.1 Tailorability: Lets the users design for themselves

One proposal could be to let the user define his/her own requirements and design his own system. We label this feature as *Tailorability* of the system. Software applications in recent times have been developed to be more flexible. Products like Eclipse and Mozilla Firefox are good examples of highly flexible and customizable systems. Therefore the user has the liberty to adapt the system according to his needs, work practices and environment.

We propose to extend the same concept as a new approach to intra office communication systems. Of the several features listed, only the basic or the most essential ones identified could be kept upfront, while the others provided for subjected to user's discretion. This can be achieved by introducing a user interface like a customizable *DockBar*. Different features like News Feeds, Journal, Remainders, Sticky Notes (Tasks) etc. can be docked on the DockBar as *Docklets* or simple widgets. This not only satisfies the user by giving him the freedom to tailor his/her own system, but also helps in reducing the general clumsiness of the interface and increase usability.

#### 2.3.2 Activity Analysis & the Attribution List

We discussed in section 2.2.2 how managing contacts in general was one of the most used and most 'complained about' feature while using a communication system, especially Outlook. While trying to figure out why this happened, we observed a very basic problem which rather goes unnoticed in the realm of the obvious. Every time when a user has to contact a person, he has to first make a choice about selecting the way of communication he needs to use to contact the person. However, communication is a user centered and not a task centered process.

This means that the interface should be so that the user does not have to bother first about selecting one out of the n ways of communication to connect to his contact, but selecting the contact itself. The same should be taken care of when the user wants to contact more than one simultaneously. This is something that can be addressed purely at an interaction design level of the User Interface. Table 3 depicts a list of features and requirements elicited from our study so far. This includes both the present and the proposed features listed in priority of their usage and requirement. Common file

formats like .doc, .xls, .pdf, .jpeg etc. are recommended to be *previewable* prior downloading them as attachments or repositories. This makes it easier to organize both mails and desktops. Other features include facilitating a single client to manage more than one mail addresses. Utility tools include features like Inbuilt PDF convertor, Sticky Notes (Tasks), Auto Answering Feature, Utility widgets like Live Stock Exchange News etc.

Table 3. Attribution list of essential features arranged in order of priority.

1.	Emailing
2.	Instant Messaging
3.	IP calling
4.	RSS Feeds
5.	File Sharing & Previewing
6.	Calendar
7.	Multiple mail login support
8.	Utility tools

# **3** Conceptualizing a New Intra Office Communication Utility product

Based upon our discussion and conclusions in the previous sections, we conceptualized wireframes of GUIs for a new Intra Office Communication Utility and called it Office 360. We started with making different iterations by paper prototyping for a new proposed communication system counting around 10 in number. We then tested each prototype on the parameters of our findings and conclusions. In this iterative process we also made an Information Architecture for the new system. Based on the information architecture we made the various screens and sections and classified the features. A final GUI was then wireframed which was based on the paper prototype that stood closest to our findings. Static and non functional dynamic prototypes of the screenshots were made (Fig 3). A screen shot simulation of the final wireframe is shown in Fig 4. Contacts are shown as large thumbnails with display images. A task bar at the top shows new updates, settings etc. Contacts can be searched dynamically and added to a recipient box where the user can then select the mode of communication. The DockBar shows the different docklets as per the user's preferences Contacts are selected as recipients and the action 'Send a Mail' is selected. Attachment's previewing can be noticed. The interface uses lesser buttons and actions up fronted on the screen thereby reducing its clumsiness in general.

Softwares like Adobe Illustrator, Photoshop and Flash were used for making the prototypes with screen shot in Fig 4.

Welcome	Piyush Jai Available	1 New Mail – Divyanshu 1 New meding request – Veniz 3 Scheduled Tasks	at Customize*	Settings   Help   Logout	
Add Recipients	My	Contacts	Search for Contacts	DockBar	
Devesh Anand Abhinav Singh Ganesh Iyer Venkat Vivek	Divyanshu V	International Abhiever	a Ansmay Ashdosh Ayush	Stock Exchange Live	
		Mails	Piyush Jain I New Mail _ Divyanstu 1 New meding request _ Variat 3 Scheduled Tacks	a Customize*	Settings   Help   Logout
Type to Search 🛥		Add Recipients	Send	Save Print Discard More >>	DockBar
Send a Mail	Available Ava	Abhinav Singh	Formattin	ig ToolBar1	
Start Carl Conference Send Monting Request Mart as Group Sand Reminder <u>Mails</u> <u>RSS Feeds</u> Calonadar	Prudvin kile Put	Venkat Vivek 7ype to Search ~	Subject: Date : Time Attachments:	g rootsarz	Exchange Live News Feeds & Subscribed Updates
Back to N	Vikram V Available A Main	Start Chat Conference Send Meeting Request Mark as Group Send Required			Wikipedia Search
		Home RSS Feeds Calendar	Aain		Sticky Notes

Fig. 3. Wireframes for various screenshots.



**Fig. 4.** A furnished GUI with a special 'dark' theme selected. A variety of such themes besides a basic plain one, manages to keep the interest of the user captured.

#### 4 Conclusions

The two most significant conclusions that we had derived from the user testing viz. the need for Tailorability of the system and the activity flow of performing a task without having to go out of the hierarchical level in the information architecture. Multiplicity of office products with communicating features embedded, resulted in unsatisfactory situation for users as far as need for intra-office communication was concerned. What they preferred, from the point of view of usability, is an independent dock-able plugin type solution that could be used regardless of the software they were currently using on the screen and could be customized as per their own specific contextual requirements. Simultaneously an attempt was made to embed a refreshing new aesthetics to the GUI configuration of a proposed prototype for such a dockable new intra-office communication product.

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# HCI and Usability Research in Indian Educational Institutions

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**Abstract.** HCI is an emerging area of great potential in India. While Design schools were already advocating it as part of Design education since a decade, it has yet to consolidate itself as an independent area of specilaisation in a learning institution. Computer science and Information technology institutions have started taking interest in HCI. There is urgency for training more researchers in this filed. This paper traces briefly the evolution of HCI in educational institutions in India. It highlights through samples of research work done in one or two institutions such as IITG.

Keywords: HCI education, Research, Design, Computer Science, Information Technology

# 1 Introduction

Long before the advent of Computer Science discipline on the Indian educational scene, Design schools in India were already teaching and practicing one or the other forms of User Centered Design that constitutes the core of today's HCI / User Experience (UX) /Usability Engineering (UE) /Interaction Design (ID). Else where in the world, HCI is more associated with Computer Science (CS) & Information Technology (IT) disciplines rather than Design. Indian Design schools have a lead over their Computer Sciences counterparts in HCI / UX / UE / ID. Eventually like it has happened else where in the world, in India too, HCI will be focused upon more by IT and CS institutions. CS & IT groups in India are now wakening up to the potential of HCI as a specialization. The Information Technology & Computer Science departments across the country are larger in number than Design departments / schools. However in India it is the Design Schools that have formed the foundation for skilled and trained human resources in this field. Will they be able to maintain the lead is an appropriate question to raise now.

Which of the two disciplines -CS & Design should this activity associate itself with - is the moot question we in India will soon be facing. The HCI community needs to be prepared with an answer and an action plan to avoid a confused

identity for this emerging discipline in India. International trends in published literature indicate that this activity is more a preserve of Computer Science and Information Sciences fields even though the contributors /authors themselves come from backgrounds as varied as Psychology, Ethnography and Engineering amongst others. Computer science seems to be more welcoming of other discipline than Design. Else where Usability professionals [1, 2, 3, 4, 5] have argued for a multidisciplinary approach to HCI citing reasons such as amalgamation of many disciplines . While the argument is valid, continuing to associate HCI as a lose knit coming together of disciplines (multidisciplinary) is probably preventing the field from emerging as a new discipline on its own right within Design. The propensity of the Indian educational environment to threateningly force fit a topic retrospectively into an existing discipline betrays a sense of ignorance of how new branches of knowledge evolve - led by Research activity. Design schools are no exception to such a belief. Design schools who are tying up their hands by teaching Design of the 1970s refuse to see the writing on the wall. Only those Design schools making paradigm shifts in their myopic vision will be the ones to collaborate with and lead the IT and CS professionals in forming a new discipline that has Humans at one end and machine computation at the other.

#### **2** The evolution of the HCI in Indian educational institutions

Academic activity surrounding HCI as a serious specialisation in Design can be traced back to work done, either in Ergonomics of products or in Graphic Interfaces, in three or four educational institutions. However the first dedicated Usability Engineering Research laboratory in an higher educational institution to admit research students was initiated in IITG in the year 2002. This laboratory accepted its first PhD scholar and started offering courses in HCI, UX, UCD & Interaction Design in 2003. Since then over Ninety (90) B.Des undergraduates, Ten (10) M.Des Postgraduates and one PhD have successfully specilised in this area from IITG which has a 100% placement record since 2002 for its Usability Engineers cum Design alumni. Many of them pursued higher studies in HCI at the Masters and PhD levels and are now working as Usability experts all over the world.

By 2004-06 other institutions like National Institute of Design (NID) & Industrial design Centre –IITB (IDC) started offering specific degree programs in New Media Design and Interaction Design. NID & IDC had been teaching in this area since a decade but as part of user focused studies in Design and not as a specilised HCI streams. Design schools prefer to use the term "Interaction Design" to label this area. Education efforts in HCI have therefore remained within the Design discipline. Apart from Design schools, institutions like Birla Institute of Technology and Science (BITS) Pilani were already encouraging research in HCI & usability with the support of Indian Information Technology Industry. The first awarded PhD in HCI to a Designer was by BITS in 2005 [6]. Besides the above mentioned institutions many Information Technology Institutions like IIITs, CDAC and Computer Science Departments have now initiated research activity in this area. Several engineering

institutions like VIT- Pune, IIIT - Hyderabad, ISIM - Mysore and many others through out India are now offering HCI related subjects in their curriculum. A large number of Indian students have also started acquiring Masters and PhDs in this area from institutions abroad since 2000 onwards.

## **3** Usability practice in industry

As a rich pool of HCI /UE /UX/UCD talent in a very niche area of IT starts growing in size, the Indian IT industry has been quick enough to spot it and offer service and expertise to IT companies the world over. The IT industry too has been actively practicing and evangelizing Usability as an important part of the product being delivered to the costumers. Every big corporate name from IBM to NOKIA to Honeywell to GOOGLE and many others have offices in India. Most of them by now have Usability teams working alongside Software teams. Along with the multinational corporations it is the medium and small firms that are pushing the Usability envelope by sheer enthusiasm and hoping for the business model to click. Professionals in HCI come from diverse backgrounds ranging from Design, Arts, Engineering, Information Science and Management. In 2006 the most comprehensive and useful survey [7] that was carried out gives an overall view of the usability profession in India. A whole range of job titles are used by the companies. However there is a dearth of PhD qualified professional researchers. Apart from educational institutions various associations managed by highly dedicated and enthusiastic usability professionals are active in India. Attempts are constantly being made by these associations to form an apex association for the Indian Usability professional as seen from active on line Usability discussion forums.

#### 4 Research in Usability: Areas and topics

India has just started its journey in this area. Institutions that are involved in serious research in Usability are few in number with IITG having taken the lead since 2002. IITG has over 60 publications in Journals / Refereed International and National conferences besides winning International awards for its research in HCI /UX/ID which it labels under a single nomenclature of 'Usability Engineering' (UE). Other institutions like CDAC and IIT Bombay too have a significant track record of research out put as measured by publications, industry interactions and international research collaborations. Institutions like NID, IIITs, CS departments of IITs & IISc hold tremendous potential to engage in research activity in Usability. There is a dearth of trained researchers. India probably has less than 10 researchers with a PhD actively researching in HCI/UE/UX/ID.

The first conference on HCI, Systems Usability, and User-Centered Design was held in Bangalore on December 6 and 7, 2004 under the aegis of the Indo-European Systems Usability Partnership (IESUP), in cooperation /association with the Computer Society of India, the British Computer Society / HCI Group, ACM / SIGCHI, and the International Federation for Information Processing (IFIP). [8] Since then more than 10 international and national conferences and events have taken place in a short span of 5 years mainly in Mumbai, Bangalore, Hyderabad, Guwahati and Pune. The second IEEE International conference on Intelligent Human Computer Interaction is scheduled in January 2010 at IIIT, Allahabad. [9] followed by another international event at Mumbai organised by IIT Bombay, IITG, NID, CDAC and others. International collaborations like the CULTUSAB project between Copenhagen Business School, IITG and Chinese Academy of Science as well as the IESUP have played a catalytic role for research activity in HCI in India. Similar collaborations are being planned between German institutions and IIT Madras which is setting up a new entity.

Based on a survey of information depicted in the institution websites and based on the list of publications the following categories / areas of research can be broadly identified as those that are currently being pursued in Usability in India. By no means is this list complete in its representation.

Multi Media Content Digital Conservation and Library Language tools E-Learning systems, content and Tools E- Governance Medical applications of ITC Culture Mental Models User personality, emotions, attitudes in HCI Usability testing of software and hardware products. Information Architecture and Graphic User Interfaces Mobiles & PDA Interfaces. Information Systems Graphic User Interfaces ICT in Social Systems Retail, Banking and Service industry Cognitive Models for Human Computer Interaction Signal and Vision Processing Language Processing Intelligent Methods & Interfaces **Computational Semantics** 

# 5. Illustrative list of some recent Research, Design & Development projects completed at IITG.

- Extending Mobile as a Networking Medium for Educational Campuses
- Study of hand gestures as a mode of interaction and its future application Scenarios

- A tangible product to enhance real time user experience of enjoying music using kinesthetic interactions.
- Speech Based Mobile Interface for the Textually Low Literate
- User Centered Design of a Collaborative Work Environment in an Educational Scenario using Multiple Mice Inputs
- An Artificially Intelligent Recommender for enhancing user's browsing experience.
- Role of Non-verbal communications in User Interactions and Demonstration through Gesture driven interfaces.
- Interactive Information Platform for Remote Health Care
- Study of Mobile as a future strategic advertising medium in India
- ICT in computer supported collaborative learning: some experiments at the school level
- Interactive Digital Signage system design for IITG campus
- An online aptitude testing system for admitting students in design program
- A multimedia repository for design projects A Knowledge Management approach
- A Graphical User Interface based Remote Public Bus Transport Management System for Guwahati city.
- An Indian Culture Sensitive Tangible Social networking System.
- Design & Development of a virtual counselor a Knowledge management approach

#### 5.1 Some of the upcoming research areas initiated at IITG are as follows:

- Multi lingual and pan cultural solutions for device interactivity Developing heuristics & norms for GUIs in Indian contexts
- Development of non-invasive, Gesture driven, interfaces is another potential area being planned in Ubiquitous computing under this research topic.
- Educational Technology & E -Learning systems: Mobile based e learning systems & Collaborative learning environments
- Knowledge Management
- Digitally enabled living and working environments: Energy and ecology issues in Building systems through the application of computers.

## 6. Conclusions

Vast unexplored potential exists in India for Usability Research. India offers a unique context for live research especially in Cultural issues. It also has the worlds largest pool of IT professionals. For Usability /HCI / UX /UE /ID - to evolve into an independent branch of study in educational institutions more graduates, postgraduates and PhDs are need to be produced. More national and international research collaborations need to happen.

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# Augmenting Usability: Cultural elicitation in HCI

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**Abstract.** This paper offers context and culture elicitation in inter-cultural and multi-disciplinary setting of ICT design. Localised usability evaluation (LUE) is augmented with a socio-technical evaluation tool (STEM) as a methodological approach to expose and address issues in collaborative ICT design within the Village e-Science for Life (VeSeL) project in rural Kenya. The paper argues that designers need to locally identify context and culture in situ and further explicate their implications through the design process and at global level. Stakeholders' context, culture, decisions, agendas, expectations and disciplines requirements need to be locally identified and globally evaluated to ensure a fit for purpose solution.

**Keywords:** Context and culture, usability evaluation, socio-technical evaluation, DUCE, STEM, face negotiation theory, inter-cultural, multi-disciplines

# 1 Introduction

Many techniques and frameworks offer different approaches to eliciting culture and context in Information and Communication Technologies (ICT) design [9, 10, 26]. These approaches have the merit of viably exploring elements of the problem domain within the complexity of collaborative design settings. However, making visible and integrating the cultural gaps between designers and users and translating these into socio-technical implications to assess design decisions at different stages of systems development still remain a challenge.

While socio-technical systems theory has been credited for identifying relevant social dimensions that should be considered in technology development, this theoretical framework has yet to offer a methodology or grounded approach usable by interaction designers [7]. Conversely, usability engineering benefits from many validated evaluation methodologies and frameworks, but these fail to effectively encompass these socio-technical issues involved in designing for culturally different users in multidisciplinary teams.

The impact of culture and context in technology design is well documented [1, 10, 15]. Nonetheless, it is demonstrated in this paper, that those issues are better exposed and richer while methodologies are localised and combined rather than doing one-off elicitations. This paper therefore, offers localised usability evaluation combined with
socio-technical evaluation in the context of an ongoing Village eScience for Life (VeSeL) project.

A background of the study along with a description of the two approaches and how they have been combined are presented. An outcome of the study highlighting its merits and limitations is also presented.

## 2 VeSeL: Background and Approach to Design

The VeSeL project, part of the Bridging the Global Digital Divide (BGDD1) network funded by the EPSRC2 in the UK, is an ICT research project for development that aims to enable rural communities in Kenya, Africa to use digital technology to improve their agricultural practices and literacy levels. VeSeL is a multi-disciplinary project involving five UK universities plus the University of Nairobi in Kenya, with specialists in education, HCI, power engineering, computing, communication technologies and agriculture.

Two rural communities (Kiangwaci and Kambu) had been previously identified by the University of Nairobi. These are both rural agricultural communities, but with vastly different economic and climatic conditions. The choice was made to work with both communities in order to facilitate comparisons across two very different sites and in case relationships with one community broke down.

Farming communities in Kenya tend to organise themselves into small self-help groups based on mutual interests (growing the same crops or herding similar livestock). This enables them to share experiences and form selling and buying power groups. The team therefore identified a self-help group in each community and a local primary school as direct target users for the research. The next step for VeSeL was an inquiry into the contexts and cultures of the user groups to elicit their ICT requirements and the identification of a suitable approach to propose and design a fit for purpose system.

The interaction between technology and its users has a profound and influential impact on both in that users influence technology as much as technology influences users [3, 27]. Thus, the VeSeL approach to context and culture of the rural communities had to be participative and inclusive of the social and technological context of its stakeholders (users, designers, government, institutions and third parties). Two complementary approaches were adopted: Localised Usability Evaluation (LUE) and Socio-Technical Evaluation (STE). Both of these approaches aimed at an ethnographic understanding and effective design rationale.

LUE in VeSeL is an important strand because the yet-to-be-developed-technology needs to be evaluated before being deployed to the farming communities. This is particularly true because users (rural African farming communities) and designers (Western) of the technology are of different cultures, technology expertise and use. While it is important to identify context and culture of the users (LUE), explicating the different assumptions of producers and users in the process of design and the inherent implications is a complementary perspective needed to effectively and

<sup>&</sup>lt;sup>1</sup>BGDD: <u>http://www.bgdd.org</u>

<sup>&</sup>lt;sup>2</sup> EPSRC: http://www.epsrc.ac.uk

efficiently produce a fit for purpose ICT. Socio-technical evaluation (STE) offers this perspective.

Through these two approaches the VeSeL research team prepared a "solution designers' resource kit" consisting of a variety of technologies and methods which could be combined, adapted and appropriated to support a participatory exploration of users' ethnography and requirements to inform possible technological solutions. The kit included a series of activities such as interviews, cultural probes, evaluations of portable technologies and websites, card sorting, observations, and some design 'sketches' for potential activities with primary schools.

Some of these activities or methods were loosely structured to simplify or initiate cultural discovery, or abandoned due to ethical considerations. Nonetheless, the findings have been very useful in informing the design processes as described in the two approaches below.

## **3 Localised Usability Evaluation for ICT Design**

As part of the VeSeL project, one of the farming community groups requested a blog site to promote their projects, such as the eradication of the Tsetse fly, in the hopes of attracting funding from globally distributed users. An early prototype was developed by researchers from the London Knowledge Laboratory. The usability of the blog site needed to be evaluated both with a sample of local (Kenyan) and global (British) audiences before it was launched.

Usability is the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context [16]. The DUCE method (Developer User Contextual Evaluation) was chosen. DUCE, [21] had been used successfully for many UK commercial developments but not yet for cross-cultural evaluation.

#### 3.1 Usability Results

Elicitation of information from UK users was relatively easy and the feedback obtained was quite detailed. In the case of the Kenya-based users, elicitation of information was more challenging. Furthermore, the Kenyan users were not comfortable with the probing questioning style of the DUCE method. Several of the Kenyan users expressed uneasiness or irritation with the DUCE summary questions. The users also commented that the evaluator was asking the same question in many different ways, and they were fed up by the end of the exercise. This was particularly aggravated because the users felt that the responses they were giving to the evaluator might be 'incorrect' and therefore with every 'repetition' of the summary questions, the users felt their 'failure' to be further exposed. In addition the evaluator felt that the users perceived the entire evaluation exercise as a 'test' and every task that was incomplete or incorrect was perceived to be a personal failure leading to 'loss of face'.

It is likely that the Kenyan users felt threatened during the DUCE exercise, which in turn affected their feedback. The challenge then for the VeSeL team was to come up with a means to carry out the usability evaluation without the users feeling threatened.

Although previous experience with ICT and task complexity had a significant effect on user feedback, 'loss of face' was also considered to be important.

#### 3.2 Face Negotiation Theory

'Face' is the public image of an individual or group, what their society sees and evaluates based on cultural norms and values. Conflict occurs when that group or individual feels threatened and fears a loss of face [6]. The Face Negotiation Theory was first proposed by Ting-Toomey [22]. 'Face' is a universal phenomenon because everyone would like to be respected just as everyone needs a sense of self-respect. However, how to manage strategies for maintaining, saving or honouring one's face differs across cultures, [23].

There are three key sets of cultural variables integrated into the face negotiation theory:

**Individualism and Collectivism:** Individualism is a cultural pattern that is found in most northern and western regions of Europe and North America. Collectivism refers to a cultural pattern that is more common in Asia, Africa, the Middle East, Central and South America and the Pacific, [13, 24]. Due to the importance of 'face', members of collectivistic cultures are highly sensitive to the effects of what they say on others. Directness and especially contradictions are much disliked. It is hard for speakers in this kind of culture to deliver a blunt "no" [6].

**Low-context and High-context communication:** Low-context communication [11] refers to the communication patterns of the linear logic interaction approach, direct verbal interaction style, overt intention expressions and sender-oriented values [22]. High-context communication refers to communication patterns of a spiral logic interaction approach, indirect verbal negotiation mode, subtle nonverbal nuances, responsive intention inferences and interpreter-sensitive values [22]. Low-context (LC) communication patterns have been typically found in individualistic cultures and high-context (HC) communication patterns are more prevalent in collectivistic cultures.

**Power distance:** Hofstede [13] defines power distance as the extent to which the less powerful members of institutions accept that power is distributed unequally. For small power distance cultures, defending and asserting one's personal rights is reflective of self-worth esteeming behaviour. For large power distance cultures, playing one's role optimally and carrying out one's ascribed duties responsibly and asymmetrically constitute appropriate face work interaction, [23].

These key sets of variables as integrated into the Face Negotiation Theory framework, [23] posit 8 assumptions and 32 proposals. Propositions 5, 6, 9, 10, 11, 12, 13 and 14 address the role of cultural variability in the Face Management process

and are used to guide the choice of a usability evaluation method suited for collectivistic cultures.

At VeSeL, we need a usability method that suits a collectivistic culture. According to the Face Negotiation Theory framework, this would be a method that reduces the extent to which the users feel the effect of power distances and in which interaction with the evaluator is reduced or removed. It would be useful to have little or no probing of the users and a means whereby the users provide their feedback indirectly.

The Co-discovery Usability Method has been adopted to suit the collectivistic culture. For comparison purposes, the Retrospective Protocol has been used too. Usability testing took place in April-August 2009 with a sample of Kenyan and British users. Users with at least one year of technology experience were chosen and the tasks simplified. An initial 'quick and dirty' analysis of the collected data indicates that the data collected from the Kenyan users using the Co-discovery Method is much richer as compared to that collected using the Retrospective Protocol Method.

Evaluations such as the ones described above help in understanding how to design for targeted users since they are adapted (localised) to yield culturally valid requirements. However, cultural understanding needs to expand further for three main reasons: (1) a technological solution (blog, mobile phone, application) may not have yet been identified; (2) technology design more or less follows iterative and interdependent patterns: requirements -> scenarios -> prototypes -> development -> etc.; (3) stakeholders' decisions and participation are fluctuating and conflicting variables at times. Therefore, an approach is needed to augment not only the understanding of the users, but also to explicate the cultural and technological gaps across stakeholders and the resulting impacts on design processes. An STE approach is proposed here to address these gaps.

#### **4** Socio-Technical Evaluation for ICT Design

A socio-technical evaluation of a technology design helps to focus on the centrality of research and design of the technology - "the functions of the system" and "the functions of human cooperation" - in order to find a manageable combination [20]. As Keller [17] sums up, the usefulness of a socio-technical approach lies in the cognitive process of analysis and design. But its "adequacy and expedience" are completely dependent upon the context in situ. Within a global setting like VeSeL, where multiple disciplines, geographical locations, cultures, stakeholders and technology are part of the context, the implications can embody complexities to the design processes and team dynamics.

To effectively capture and manage stakeholders' assumptions, sensitivities, knowledge, expectations and agendas *vis-a-vis* a system design process requires an understanding of the inherent socio-technical issues deriving from the difference between what is required socially and what can be done technically. This is what Ackerman identifies as a socio-technical gap, [2]. He argues that "[h]uman activity is highly nuanced and contextualised." It is therefore in the designers' best interest to make those gaps visible and harmonised for a dependable and fit for purpose system.

The VeSeL team has addressed these gaps by designing an online artefact for collaboration called Socio-Technical Evaluation Matrices (STEM) to complement knowledge obtained through localised usability evaluation. For more details on how this has been implemented see [5].

#### 4.1 Socio-Technical Evaluation Matrices (STEM)

The tool is an online form-based system where all stakeholders evaluate social and technical requirements or decisions against pre-defined criteria (dimensions and attributes) to highlight dependability issues for both the technology and the users within their own cultural sensibilities. See extract of matrix interface below.

Figure 1: Extract of a matrix display interface

■: New idea or issue S:	Supporting idea or issue	2: Conflicting idea or issue
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		Discussion of Implications or Issues		
sions	Attributes	For Users	For the Technology	
		(KW) Users are required to consult, analyse, interpret and use the data for farming.	(KW) Tech is required to collect data relevant to users and visualise it in a useful and understandable way.	
		<ul> <li>☑ (Cecilia Oyugi) Agriculture is part of the curriculum in the schools we are working in, so the techno- shamba will valable support this.</li> <li>☑ (JA) I donty think thats right</li> </ul>	(Milan P) Using RFID for example on water cans to identify who and when water is being taken from pumps, at least as an initial implementation.	
		<ul> <li>(Jafaar) Communities could cycle through sensor network to automatically capture soil conditions.</li> <li>(SC) This will need to be clarified. Communities do not have a common shamba like in school. Also, it is not easy to cycle within the field as the soil is either too soft or planted all over. It is much easier to walk through then to cycle. The bicycle maybe used to carry but then the kit could be mobile to carry in hand. [edit]</li> </ul>	<ul> <li>(Jafaar) Communication protocols TBD but almost certain is Bluetooth (for communicating with mobile phones); possibly ZigBee for intra-network comms, GPRS for inter. When the 'wired bicycle' rides through/near a sensor network kit could automatically capture data</li> <li>(Kevin Walker) I have some RFID hardware which could be used for initial testing.</li> <li>(Advisory Group) plans for shamba sensor network and weather monitoring agenda must be driven by</li> </ul>	

The tool allows stakeholders/partners to enter comments/views and other data such as results of the LUE (of website, mobile phone, iPod, digital camera) against the dimensions and attributes so that each partner can measure impacts against their culture, practice and ability. When an issue is relevant or requires a partner's input, s/he selects the issue and makes a comment (in support, in conflict or new) accordingly. These comments become available to other partners for comments. The tool then organises comments according to their inter-dependency to one another.

Figure 2: Extract of a matrix data entry form

Discuss Implications or Issues for Users	Disccus Implications or Issues for Technology
11 users	
In Support 💿 In Conflict 💿 with: 222 🗸	In Support 💿 In Conflict 💿 with: 223 🗸
[Look up Implications/Issues]	[Look up Implications/Issues]
None (It's a new implication/issue)	None (It's a new implication/issue)
116 de marine la contribució	n an habelf of sources)
(If discussing/contributor Are you the contributor? Yes  No  Contri	ibutor's Name:
Contribute	Reset

Initially two matrices were dedicated to ethnographic data, one for each village. Once the matrices were populated, face-to-face and technology mediated meetings (emails, Skype, telephone) were used to agree on feasible user requirements and scenarios. This was the first iteration of the matrices. Subsequently, a matrix was created for each scenario of the design process. A moderator is also assigned to each matrix to invite, regulate and report on contributions/participations. Previous studies reported the contextual and cultural characteristics of these communities along with the identified requirements through STEM [4, 18].

As VeSeL moves from scenarios to prototyping, matrices are once again iterated for each scenario bringing about previously identified issues and agreements. This iteration process helps VeSeL to deal with the challenges posed by inter-culturality and multi-disciplinarity by consistently exposing them to all partners.

#### 4.3 The Design Setting as Inter-cultural

Interactive systems are subject to interpretations grounded in the cultural spaces of both producers and users [1, 14, 19]. In VeSeL, STEM exposes these intercultural gaps by allowing the different stakeholders to explicate their own interpretive frames and reflect on their own cultural positions. E.g. while Western partners believe that a minimal trial set of resources should be sent to the communities, local partners see this as an expression of how limited the project will be, thus painting a negative image of VeSeL.

#### 4.4 The Design Setting as an Iterative Socio-Technical Complex

Research on the dichotomy between tacit and explicit knowledge, group psychodynamics and the cognitive shows that while explicit knowledge can be shared or represented using information technology, tacit knowledge is more difficult to represent [8, 12]. In STEM design decisions for both users and technology are

negotiated against pre-defined criteria forcing the elicitation of otherwise tacit knowledge. This knowledge in the form of design decision/proposal is in turn evaluated in its multidisciplinary and cultural context by other members of the team, e.g. in VeSeL, the cost of a technology is often understood as the responsibility of a specified partner or third party. Conversely in rural Kenya, this is culturally a collective effort.

The lack of such iterated cultural understanding across partners would result in many subsequent issues. STEM thus augments cultural usability requirements identified in LUE to address these issues.

# 5. Conclusion

LUE helps to expose valid cultural usability requirements. However, the impact of context and culture poses many challenges that cannot be exposed as a one-off evaluation in technology design. As the design progresses through the different stages, decisions and actions often result in the emergence of cultural and socio-technical implications. There is a need for a constant socio-technical evaluation of those requirements to explicate their implications for the development, acceptance, adoption and use of the envisaged technology. The VeSeL team has proposed a combination of LUE and STE as two evaluation approaches in the early identification of these inherent issues.

#### Has LUE been Effective in Informing Socio-Technical Design?

Assumptions embedded in standard usability evaluation techniques did not necessarily match users' interpretations. This is probably because they saw the activities as a measure of their abilities or limitations. LUE has been a valuable instrument to learn the meaning of technology in this context and the perceived usefulness of existing ICT. Engaging with users and getting them to reveal their sensibilities or preferred approaches to technology have been instrumental in informing our design process. Most importantly, the findings obtained with LUE are more valid than those obtained without any previous cultural assessment of suitability. However, LUE did not give us visibility of the multiple perspectives involved in designing a solution nor did it indicate how certain cultural requirements interacted with other aspects of the evolving socio-technical setting.

#### Has STEM Addressed the Inter-Cultural Gap in VeSeL?

The use of STEM in VeSeL has been positive but it has also led to a number of new challenges. On the positive side, using STEM highlighted the many different cultural positions of the members of the team, which in turn clarified which key metaphors and cultural practices should be recognised and included in the user interfaces for Kenya; matrices exposed differences across the expectations of the different stakeholders in the project, e.g. engineers, users, designers, educators, agricultural experts, etc., thus helping to overcome the multi-disciplinary challenge. Without matching the socio-cultural factors to the technological factors in one frame of

understanding, the solutions would very likely have been abandoned or face serious setbacks.

For the work of the interaction designers, the value of STEM is immediately recognisable. They require further elaboration on how decisions made at implementation level have a direct impact on technology acceptance, perceived usefulness and usability, e.g. avoiding text heavy screens, collective learning, etc. This is only possible with early usability evaluation that then informs the STEM.

The combination of LUE methods with an STE facilitated by a collaborative tool has greatly augmented and facilitated cultural discovery as design progresses.

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# A comparative study of handwriting based solutions using keypad for Hindi text entry

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**Abstract.** Mobile phones have crossed the price threshold benefiting wider range of users including the hitherto technologically and economically underrepresented segments. Indian users are a gigantic consumer base for mobile phones. With Hindi being one of the most widely spoken languages in the country and the primary tool of communication for about a third of its population, an effective solution for Hindi text entry in mobile devices is immensely useful to the non English speaking users. This paper proposes a mobile phone handwriting based text entry solution for Hindi language.

Keywords: Keypad based entry, Hindi text entry, mobile phones, usability evaluation.

## 1 Introduction

Mobile phones are fast emerging as the primary mode of communication for increasingly large sections of population with diverse needs, resulting in the creation of several distinct user groups with vastly different needs. Ample opportunities are available to the mobile service providers to increase their market share by catering to the specific needs of each segment of these diversified user groups. New services need to be designed and tested for the specific target group with a common cultural base, in order to be able to capture the market. Researchers like Rose [1] have found that the earlier the factors of localization are considered, the better the acceptance ratio of the service and hence the device.

India has emerged as the second largest mobile phone market in the world after China in April 2008 with the subscriber base already crossing the 250-million mark [2]. The increasing mobile penetration in India and particularly in the semi-urban and rural parts has resulted in a large user base for mobile interface in regional languages; Hindi being one of the most widely spoken amongst them. The Hindi speaking user base constitutes 41% of the Indian population, with a major percentage of it not being proficient in the use of English language. The focus of this paper is to find the limitations of the existing solutions for Hindi text input in mobile phones, and propose an alternative handwriting based input solution.

# 2 Hindi letterforms

Hindi is written in a script called Nagari or Devanagari. Hindi is spoken using a combination of 52 sounds. These sounds are represented in the Devanagari script by 52 symbols: for 10 vowels, 2 vowel modifiers and 40 consonants. Vowels and consonants together are called *Akshars*. Along with pure consonants the language consists of partial consonants which are called *ardha-akshar*. Besides, for every vowel, there is a corresponding *Matra* which is combined with consonants to impart the sound of that vowel.

Structurally, the letters in the Hindi alphabet can be said to be spatially composed of nine parts. The main component of each letter or the principal character (characters in case of conjuncts) occupies the central position while the Matras can occupy space either above, below or to the sides of the principal character. The Matras usually take up a smaller proportion of the space as compared to the principal character. Therefore writing hindi script is a result of combination of strokes.

# **3** Existing Hindi text input solutions in mobile phones

Mapping the Hindi alphabet to a mobile keypad is difficult due to the sheer number of letters (52) in the alphabet. Moreover, the existence of Matras that occupy space above or bellow the alphabet and the partial consonants make the problem of mapping existing key boards, all the more complex. The current mobile keypads mapping Hindi letters can broadly be classified into the following schemes [3]:

- 1) Multi-keystroke
- 2) Single stroke followed by navigation
- 3) Two key-strokes

For the purpose of this study, we refer only to the multi-keystroke scheme as implemented by Nokia 1100.

The multiple mappings result in more number of keystrokes per key than the user can keep track of. Each key is mapped to 2-5 characters, resulting in high error rate [3]. It also requires users to remember the sequence of letters in the alphabet, resulting in higher cognitive load. In addition to all this, a vast majority of the users in emerging markets are yet to adopt fully to the usage of keypads and typing from the conventional pen – paper writing. It follows that for a user base accustomed to handwritten message, transmission stylus or pen based text input is more suited.

# 4 Handwriting Recognition and its Limitations

Handwriting based text entry solution for mobile devices, has been extensively researched in recent times, some of the areas of focus being recognition algorithms [6] and interface issues [4] [6].

Bharath and Madhavanath [7] propose a solution for continuous handwriting based input in small writing surfaces using pen or finger. The technique used is allowing over-writing in the writing area in a continuous manner rather than enter one character at a time. Usability issues concerning text input in small surface are discussed. These which include requiring the user's attention to the characters being written and switching focus between the writing surface and the screen. A gesture-recognition based quick text entry solution called SHARK (shorthand aided rapid keyboarding) [7], is proposed in which uses shorthand gesturing in order to speed up stylus based keyboard entry. The results indicate that users were able to learn to write correct, recognizable gestures. It can be deduced that learning a slightly modified form of writing as required by our proposed design is not likely to be too difficult.

In the field of text input in Indian Languages, Aparna, K. et al [4] presents a method for online recognition mechanism in the case of hand-written Tamil text. It describes character recognition as recognizing the constituent strokes and matching them against a pre-defined database. The developments of similar systems for other Indian languages as outlined have been used as assumptions for proposed template.

In MacKenzie et al. [8] the tradeoff between the recognition accuracy of handwriting, memory requirement of the device and forcing constrained writing to ease recognition is discussed. Allowing natural handwriting requires a very advanced recognizer with larger memory, which may be a problem for handheld devices. An interface that forces some constraints to make recognition easy without adversely affecting the usability of the device is therefore a necessity. From the users' useability point of view simplified inputs methods with minimum strokes become imperative.

#### 4.1 Hindi script and handwriting recognition

Handwriting recognition is defined as the ability of a computer to translate human writing into displayed text. The image of the written text may be sensed "off line" from a piece of paper by optical scanning (optical character recognition) or intelligent word recognition. Alternatively, the movements of the pen tip may be sensed "on line", for example by a pen-based screen surface.

Online pen based surface recognition is what we are proposing as a potential solution for Hindi text input in mobile phones. This method supports the familiar act of writing which our target user groups are used to. It also reduces the burden of high learnability required in the existing keypad based solutions, hence minimizing the barrier of familiarity to the solution being proposed.

The major issue here is the low accuracy of handwriting recognition for Hindi, especially for free form writing. Poor accuracy level severely hampers usability of this technology.

Character recognition is done in the following steps [4]:

- 1) Stroke identification- where the input stroke is compared with the database of existing defined strokes
- Character recognition- grouping already identified stroke labels and converting them to suitable character codes. For Indian alphabet, the ISCII (Indian Script Code for Information Interchange) is used. ISCII is a phonetic code, which represents composite characters in terms of component consonants and vowels.

Stroke recognition has been identified as the crucial factor that determines the accuracy of the handwriting recognition algorithm.

The ideal input conditions for high recognition accuracy include:

- 1. Consistent size of the hand written strokes constituting the letters
- 2. Constant orientation of the letters

#### 5 Proposed Handwriting based Solution

The solution we are proposing combines handwriting (stylus or pen) based input with intelligent suggestion. To improve the recognition accuracy we conceived the notion of providing the users with a template to write on . The template would facilitate the written strokes to be closer to the ideal condition as practiced by habit of the user. We discuss the two key components of our solution; the template and the intelligent suggestion in the following two subsections.

#### 5.1 The Template

Our literature review shows that recognition accuracy for hand-written text improves considerably if the size of the letterform (glyph) remains consistent and the orientation vertical [4].

In order to constrain the hand-written input text in this manner, we propose a writing template (figure 2). This template is a square block that is partitioned into nine sub-divisions as shown in figure 1. The users are required to constraint their letters in such a way that the *Akshara* (main component of the letter) fits within the inner block and the *Matras* in one or two of the side blocks depending on the case. Further, users are encouraged to take up as much space as possible within each block without moving out of them. This ensures both a lower and an upper limit on the size of each component and yet provide wide margin of freedom to the users finger action. By separating the regions for the *akshara* and the *matras*, the template allows for *region specific coding*. That is, anything written within the central square is necessarily an *akshara* whereas anything written in the rectangles at the sides is necessarily a *matra*. This helps in using separate database for the identification of the written letter-form depending on the location.



Fig. 1. Image showing the format of the template



Fig. 2. Image showing the dimensions of the template used

To allow natural writing to the extent possible, we designed our interface to consist of two rows of touch-pad based writing space with eight templates each (Figure 3).

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Fig. 3. Image showing the mapping of template on a touch based mobile phone.

# 5.2 Intelligent Suggestion

While the template is likely to have a significant positive impact on recognition accuracy, it is also likely to reduce the speed of writing as the users have to be mindful about where they are placing each stroke. To counteract this, we have incorporated Intelligent Suggestion of the most probable letters. As the user writes the glyphs, the system tries to guess what letter it corresponds to. Once the system is reasonably confident of its guesses, it suggests the three most probable letters that the user is trying to write. The user can then disambiguate by choosing on the correct option or simply ignore the suggestions and continue to write.

This feature makes sure that the user does not need to write each letter to completion. Once a written glyph is specified enough for the system to suggest it as one of the three possible letters, the user can simply click on the right suggestion to select it. This feature is thus expected to increase the overall speed of input especially if the suggestions are accurate most of the time.

## 6 Evaluation of the Proposed Solution

Our purpose behind designing the writing template was to ensure consistency in the written letterforms in order to facilitate an enhanced recognition precision rate. However, it is important to ensure that while doing so we are not constraining the users to write in a specific way which they need to learn. We are also interested in comparing the speed of input using our template with the current state of the art solution with keypad entry. To ensure that our template allows for a text entry rate higher than existing Hindi keypads, and that it is easy to work with, we conducted a usability test.

The metrics we were interested in are:

- 1) Effectiveness of our template (if users can complete a task correctly)
- 2) Ease compared to keypad entry (number of errors made)
- 3) Text entry rate as compared to keypad

We first conducted a benchmark usability test with the Nokia 1100 Hindi keypad. This model represents one of the three most prominent mapping schemes for Hindi keypads.

**Description of Mapping Scheme in Nokia 1100** The Nokia 1100 keypad is based on the multi-keystroke model. Multiple letters are mapped onto each key and are disambiguated by the number of times the key is pressed in quick succession. The mappings follow the sequence of the letters in the Hindi alphabet. Each key has a set of consecutive letters mapped onto it. This scheme is not made explicit by the interface. Only the first and the last letters mapped onto a key are displayed and the user is expected to know the range of letters covered.

The number of letters mapped onto each key varies between 2 and 5 characters.

#### 6.1 The Benchmark Usability Testing

We conducted a task analysis involving on ten subjects.. The subjects were divided into two groups of six and four. To one group the mapping was explained and to the other group it was not. This was done to "artificially" create a mix of expert and novice users since we had no access to actual expert users of Hindi keypad based text entry.

The participant users were in the age range of 18 to 22, tech savvy and frequent users of mobile phone. They were conversant with the Hindi (Devanagari) alphabet and the language. However, they had little or no experience with Hindi keypads. Though we could not access users from the emerging user base of mobile phones due

to limited resources, we ensured that the chosen participant's familiarity with Hindi keypads and expertise in typing Hindi letters were comparable to our target user segment. Since these are the two predominant factors in this study, we expect to see similar results with a more representative sample.

The task assigned to them was to type in the following sentence in Hindi:

# मैं दीपावली पर घर आ रहा हूँ

The sentence comprises 26 characters. Conjunct letters were excluded from the task to avoid making it too complex. The observations from the test are enlisted in Tables 1 and 2.

S.No	Task	Number	Total time taken	Time per character
	Completed	of errors		(in sec)
1	Yes	1	240	9.23
2	Yes	1	117	4.5
3	Yes	4	215	8.27
4	Yes	0	109	4.19
5	Yes	1	180	6.92
6	Yes	3	160	6.15
Mean		1.66	170.17	6.54

Table 1. Observations for the group to whom the mapping scheme was explained

 Table 2. Observations for the group to whom the mapping scheme was not explained

S.No	Task	Number of	Total time taken	Time per character
	Completed	errors		(in sec)
1	Yes	1	210	8.08
2	Yes	5	320	12.31
3	No	4		
4	Yes	3	315	12.11
Mean		3.25	281.67	10.83

#### 6.2 Usability Testing of the Proposed Template

To measure the speed and ease of handwriting based text input, we asked five users to write the same Hindi sentence on a paper with our template printed on it. They were explained the specifications of writing within the template and asked to adhere to them.

This test was conducted with the assumption that speed and overall ease of handwriting will not vary significantly between pen-paper and stylus.

The profile of the participants used was kept the same as the benchmark test to be able to make valid comparisons. We were interested in the overall time and the number of errors made as a measure of ease. The results are enumerated in table 3.

Sr.No	Task Completed	Number of errors	Time to write in free handwriting (in see)	Time to write the sentence	Time per character (in sec)
1	Yes	2	11	(III SEC) 80	3.4
2	Yes	0	15	58	2.23
3	Yes	Õ	16	47	1.8
4	Yes	0	21	51	1.91
5	Yes	1	17	46	1.77
Mean		0.6	16	58.2	2.24

Table 3. Results of usability testing of our template

# 7 Discussion

Our task analysis results show that handwriting based input for Hindi using our proposed template is about 3 times faster than keypad entry when the keypad mapping scheme is explained to the users and 5 times faster when it is not.

All the participants got used to the template with some basic instructions and were not seen to have any difficulty with following the specifications. It did not require them to alter the order in which they wrote the strokes; however it did require them to consciously control the proportions of the component strokes of each letter, which slowed them down. They reported to not have any problem doing this once they got used to it after writing the first few letters.

The fact that all participants could complete the task and made very few errors show that writing in the template is easy to learn. The error rate is a considerable improvement over the keypad mode of entry. The proposed template thus provides a structure to handwritten letterforms in order to improve recognition accuracy while scoring over current keypad based solutions in terms of speed and ease (lower error rate) of input.

Constraining users to write within the structure of the template slows down their writing to a large extent (Table 3) which can impact the overall experience of writing. However, using intelligent prediction and allowing users to choose from the most probable options is likely to improve speed considerably.

#### 7.1 Effectiveness of the Proposed Solution

The template addresses the key issue of recognition accuracy by enforcing consistency of orientation and size of the various components of Hindi letters. It does so by reducing variation in the spatial composition of the letterforms. If a hand-writing recognition based system is trained using samples of letters written using this template, the recognition system can learn the specific inter-relationships (or size and orientation) of the components of the letterforms as enforced by the template. Since these inter-relationships remain consistent for all letters written using the template, they can act as cues for recognition and afford higher accuracy.

While it structures written letters, it does not make the act of writing strenuous nor does it require considerable amount of learning as indicated by the results of task analysis. Since it leverages on the act of writing and not requiring searching for letters in a set of keys, it is suitable for the non-tech savvy emerging user base of mobile phones. Although the template slows down the speed of writing considerably it is still an improvement over key-pad based solutions currently available. It attains higher speed by not requiring users to search for letters or remember their sequence in order to enter text.

#### 7.2 Limitations of the study and future work

While the results of our task analysis are promising, we should keep in mind its shortcomings which could have affected the results. The tasks were tested on a small sample of users and hence should not be over-generalized. Moreover, the sample users did not include users with low expertise with technology, who are an important target user base for our solution.

Lastly, the evaluation of the template was done on a paper simulation and requires validation with an actual hand-writing recognition system. The most important step is to validate that the template actually improves the accuracy of hand-writing recognition. Besides, it needs to be tested with a larger set of users, adequately representing the emerging user base to get statistically significant results.

#### **8** Conclusions

The proposed template in conjugation with an adequately trained hand-writing recognition system is likely to be an effective solution to the problem of Hindi text entry in mobile devices by improving the recognition accuracy and allowing a reasonable speed of input. Results from this study show that it is easy to learn and quicker than keypad based solutions. For novice users who belongs to the emerging new segments it is not likely to put strain on the user in terms of use ability and learning ability.

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# An overview of 1998-2008 journal publications on Culture and Human-Computer Interaction (HCI)

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**Abstract.** In this paper, we analyze the concept of human-computer interaction in cultural and national contexts. Building and extending upon the framework for understanding research in usability and culture by Honold [3], we give an overview of publications in culture and HCI after 1998, with a narrow focus on high-level journal publications only. The purpose is to review current practice in how cultural HCI issues are studied, and to analyse problems with the measures and interpretation of this studies. We find that Hofstede's cultural dimensions has been the dominating model of culture, participants have been picked because they could speak English, and most studies have been large scale quantitative studies. In order to balance this situation, we recommend that more researchers and practitioners do qualitative, empirical work studies.

**Keywords:** Cultural usability, Culture, Human-Computer Interaction, Literature review.

# 1. Introduction

During the recent years the interest in the correlation between culture aspects and Human-Computer-Interaction has grown up significantly. Different terms are used in the HCI community to describe the phenomenon; started with Cultural Computing [7] to International Usability [6] and cross-cultural User Interfaces [1]. Many more terms are found. In this paper, we analyze the concept of usability in cultural and national contexts. Analyzing usability in context is important for connecting empirical work analysis and interaction design. The globalization has changed the task for system developer of information technology products. Nowadays they have to consider more and more international user requirements and culture-influenced taboos or local application specifics. Therefore the interest on cultural related HCI topics and knowledge may possible have been increasing during the last decades, making it timely to do a review of the research. System developers and HCI Researchers are interested in knowing more about user specifics in other cultures, e.g. differences in navigation behaviour. They are also interested in knowing more about relevant differences in system design, e.g. icon design or colour coding, and any other HCI relevant characteristics influenced by the user culture.

## 1.1 Framework

Researchers and practitioners in the HCI Community are interested in the state of art in the field of culture and HCI. A first study about publications related to culture and HCI was published by Honold [3]. She looked on any kind of publication in the field of cross-cultural usability engineering up to 1998 and identified three main phases:

- 1975-88: Classical ergonomic research is applied to non-Western countries
   1990-95: Practical solutions of UI-design for non-Western markets become a necessity
- 3. 1996-98: The need for a theoretical foundation of cross-cultural usability engineering is recognized

With this paper, we aim to continue Honold's work. We want to give an overview of publications in culture and HCI after 1998, with a narrow focus on journal publications only. Due to the emergent nature of the research topic, we would expect many publications about culture and HCI to be in conference proceedings, and not in the major journals. However, as Hornbæk ([4], p 81) stated: "journals might be more representative of carefully conducted and thoroughly reviewed studies". With our study we focus on journal papers. We give a general overview of the last 10 years journal papers related to culture and HCI, analyze the characteristics of the papers published in journals and give some inspirations as how to publish the cultural usability papers in HCI journals. The purpose of this paper is to review current practice in how cultural HCI issues are studied, and to analyze problems with the measures and interpretation of these studies. Other objects of interest are the used approaches and models to plan data gathering and interpretation, and the way of data collection itself. This also includes the involved testers and participants in these studies and the focused topics and research questions. On that basis, we discuss quality aspects of the studies and challenges to improve the preparation and implementation of international usability studies.

Analyzing the studies in journals for culture and HCI has three motivations. First, we like to evaluate our own impression of an increase in number of publications in this field, and if possible, identify the development trend of phases or topics. Second, most text books describe western-oriented method to measure usability and to analyse user requirements. We like to find out what kind of methods researchers use in the context of international usability research. For example, are ethnographic methods preferred, or is standard usability methods the researchers' preferred choice? Here we are looking for the criteria that determine what to apply and what to avoid regarding

the use of specific methods. Third, we are interested in an overview of the used models and approaches in this field. Hofstede's Cultural Dimensions [2] appears to be a dominant model for explanation cultural influence on websites, and for the categorization of a user culture [6]. But there are also other interesting approaches in the HCI community with a relevance to this topic of culture (e.g. activity theory).

The present paper reviews current practice in conducting international usability studies, and gives a high quality basis to discuss how to realize international studies. Part 2 presents the hypothesis of our analysis and method used for reviewing a selection of studies from high-quality HCI journals. Part 3 summarizes and discusses the analyzed data. Part 4 discusses and concludes on the challenges identified.

#### 1.1. Hypotheses

Before we started the analysis of journal paper we defined a framework and a number of hypotheses in order to do a structured analysis. The framework consisted of a matrix with journal papers as rows and common literature review topics inspired by the work by Honold [3] as the columns. To define the final hypothesis we carried out several workshop-meetings. These workshop-meetings started with brain storming about the general field of Culture and HCI and interesting research topics. It finalized in iterative loops of relevant questions for the HCI Community from a 'state of art' perspective with the general question: what can we learn from the published studies for our future work in this field? As result of all the discussions we formulated the following 10 hypothesis for the paper analysis.

- 1. The number of publications should be higher during the last 5 years. The HCI community has noticed the relevance of the topic and the sub-community for this topic grow up during the last five years.
- 2. There are more quantitative instead of qualitative studies. In the context of international studies it is easier to realize a quantitative data gathering. For qualitative methods are local experts needed and this increase the costs of a study.
- 3. Studies using foreign students to get information about cultural specifics. To realize an international usability study a good budget is needed to hire local experts, pay for participants and pay travel expenses. The most studies are realized in a university context (e.g. PhD work or Master thesis) and have only a very limited budget. Therefore foreign students participate on these studies and used as representatives of their culture.
- 4. Hofstede's cultural dimension framework is only cultural model used. Over many years researcher using the Hofstede model to explain and predict cultural differences. With more knowledge about culture and HCI in the last years the number of models should also increase.
- 5. There are more experimental instead of conceptual papers. The work in this research field has just started. It is a field oriented research and to start with concepts the field data are needed.
- 6. Most studies will focus on the Asian market. The Asian market becomes more interesting for the industry during the last years. The cultural differences between US/ Europe and Asia are non discussable, but HCI people know less about the user requirements in Asia.
- 7. There are more cross-cultural than cultural studies. To explain the differences in user cultures it is easier to compare cultures; often in comparison to the own culture.
- 8. Test material is localized. To get better information, especially in the context of a user requirement analysis, the studies using local moderator and/or local test material.

- 9. Most studies are using country as a cultural variable. Countries are seemingly the way to separate between cultures because they are existing official separations. Sub-cultural and regional specialties, especially in big countries, are often ignored.
- 10.All relevant HCI journals have published articles about Culture and HCI. This topic is highly relevant and therefore all journals should be publishing something from this field.

These hypotheses guided our analysis of the selected journal papers. Next is a description of the analysing method. It describes the criteria for the paper selection and the collected information from the papers.

# 2. Method

The aim of the present study is to categorize and analyze the HCI papers related to culture and usability or design in the last 10 years in the current major HCI journals. Culture here means country boundaries, language, cultural conventions, race and religious, not including the papers of organizational culture or other group cultures, such as different virtual environments or customer groups. We used meta-analysis to analyze the papers. Meta-analysis is a commonly employed systematic reviewing strategy for addressing research or scientific questions [8]. It includes any methodology for combining information across sources. Nowadays, meta-analysis has become the most commonly used quantitative method in the social and behavioural sciences [5, p 741]. Meta-analysis can be used as a statistical literature synthesis method that combines and analyzes the results of several studies and investigates a set of related research issues [5]. It is a "rigorous alternative to qualitative and narrative literature reviews" [5, p 741].

#### 2.1. Selection of studies

This study focuses on analyzing journal publications of the last 10 years related to culture and HCI. There were four main criteria of selecting the papers.

- 1. Cross-cultural studies or studies in a specific culture;
- All the papers are related to HCI area, but limited to methodologies and processes for designing interfaces, such as usability, interface design and evaluation methods, excluding the studies which only focus on using the general concept of computers or products to measure or investigate people's personality, attitudes, or feelings towards something or some social issues;
- 3. The papers in this study are all full journal papers, not editorials published in journals or conference papers.
- 4. As long as the paper accords with the requirements which are related to culture and HCI issues described above, it will be included, no matter it is empirical or theoretical paper or literature review. Hence, the papers in this study not only include empirical studies of experimental or field studies, but also theoretical studies which discussing cultural issues in HCI area.

We selected 9 major HCI journals from 1998 to 2007. Two of them ("Human-Computer Interaction" and "Transaction on HCI") were not found any paper relevant with culture and HCI issues described above. Hence, 7 journals are included in this study finally. In total we found XX papers in these journals. 27 papers are selected by our criteria.

#### 2.2. Information recording of the studies in the selected paper

For each paper, we collected information about the cultural issues, methodology and HCI issues. We recorded the following information of each study if it is involved:

- 1. The type of the study (theoretical, experimental or field study paper);
- 2. Techniques used in the study (such as interview, questionnaire, observation, usability testing);
- 3. The studied design method or development process (such as thinking aloud usability test, interview, or some new design techniques or design/ development process);
- 4. Research approach (quantitative or qualitative);
- 5. Interface design issues (such as structure, icon design, etc);
- 6. Application area/work domain/business area (such as medical, education, entertainment, etc);
- 7. Approach to culture (cross-cultural study or a specific cultural study) and whether the study cares about user subgroups in the country/cultural setting;
- 8. Country(ies) of focus for the study;
- 9. Local test setting (including whether using local moderator, local language, etc);
- 10.Used models for study/ paper (such as whether using Hofstede's cultural model or some other research models);
- 11.Number of participants, using students as participants or not and what the paper is about also recorded.

Three researchers (with expertise in the field Culture and HCI) read the papers and fill in the information to Excel spreadsheet. When we finished the recording of all the studies according to the categories, we discussed the information and got the overview of all the papers. We examined each category and tried to get the trends of the information in each category and relations between the categories.

# 3. Result section

**Papers and topics.** If the HCI community has noticed the relevance of the topic and the sub-community for this topic has grown up during the last five years, we would expect more papers to be published recently. The trend in publications can best be characterized by pointing to the peaks in number of publications coming from special issues culture in 2004 (IwC) and 2006 (IwC), Figure 1. The figure shows that there is small, but continuous stream of cultural usability HCI journal papers published during the recent 10 years.



Figure 1. H1: The number of publications has been higher during the last 5 years

**Participants and research type.** In the context of international studies it seems easier to realize a quantitative data gathering, but on average the number of participants in the studies was higher than would be expected had the studies been qualitative studies. Figure 2. Of the 27 studies, 20 reported doing quantitative research, while 5 reported doing qualitative research. A possible explanation is that for qualitative methods local experts are needed and this increases the costs of a study.



Figure 2. H2: There are more quantitative instead of qualitative studies.

**Characteristics of participants.** As is common in quantitative research, the participants were mostly university students, Table 1, – though there were notable exceptions such as the study 2001 study with 324 'typical computer users' – but in more than 60% of the studies with human participants, these were students.

Table 1. H3: Most studies use foreign students to get information about cultural specifics

Studies	Total
Did not mention where to find the participants	5
n/a (studies with no participants)	4
Not students	4
Students	14
Grand Total	27

**Models and Method/technique use.** More than to 50% of the studies used questionnaires. Interview and observations were each used in 20% of the studies and think aloud usability testing in 10% of the studies. The preference towards questionnaires was probably not due to use of a specific theory of culture; e.g. only 3 of the 14 questionnaire studies used Hofstede's culture theory. Hofstede's theory was used by 7 of the 27 studies. Other models were used in different studies, Table 2. So

even if over many years researchers have been using the Hofstede model to explain and predict cultural differences, it is clear that also other models have been used. It remains a problem that a large proportion of the studies do not use any model at all.

Table 2. H4: Hofstede is only one cultural model

	Hofstede	Other models	No models	
Studies	9	6	12	

**Research approach.** The work in this research field has just started, and we expected that most research would be field oriented research in order to explore which concepts are relevant. However, cultural usability is an experimental science judged from the 2/3 (19 of 27) of the studies that are experimental, while only 1/6 (4 of 27) of the studies, Table 3. In particular this is surprising in a science studying culture. The four field studies took place in Botswana (1), China (1) and India (2).

Table 3. H5: There are more experimental than conceptual papers

Year	Theoretical papers	Experiment papers	Field study papers
1998	1	2	
1999		2	
2000	1	2	1
2001	1	2	1
2003	1		
2004	1	3	2
2005		3	
2006		5	
2007		2	
Total	5	21	4

**Country in focus of study.** The Asian market becomes more interesting for the industry during the last years. The cultural differences between US/ Europe and Asia are non discussable. But HCI people know less about the user requirements in Asia. Studies of cultural usability focus on relatively few different countries, with China (32%) or US (33%) as the anchor country in most of the studies (China and US together 54%, 11% are combined US/China studies), Table 4, which also shows that 67% of the studies focused on countries with English as official language.

Table 4. H6: Most studies will focus on the Asian market

Botswana1China3China (Hong Kong)2
China3China (Hong Kong)2
China (Hong Kong) 2
China, China (Taiwan) & India 1
India 3
Korea, Japan and Finland 1
Netherlands & Turkey 1
United Kingdom 2
US & Bulgaria 1
US & China 3
US & Sweden 1

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US & Thailand 1	
US & Turkey 1	
US, Japan & Sri Lanka 1	
US, United Kingdom & Hong Kong 1	
(blank) 4	
Total 27	

**Cross cultural or mono cultural study?** Most of the studies are cross-cultural. Questionnaires are used most frequent in cross cultural studies. When categorizing studies as cultural, i.e. the purpose of the study is cultural specific/all users are from same context, or cross-cultural, i.e. the purpose of the study is to compare different cultures/users from different contexts, a good case to discuss is the study by Shen (2006) about the road towards culture-centred design. This study aims specifically to develop a metaphor for one culture, but does evaluate this one culture metaphor by cross cultural comparison. Does this make the study mono or cross cultural? To explain the differences in user cultures it is easier to compare cultures; often in comparison to the own culture. In 1/3 (9 of 27) of the studies had as their topic the cultural (the purpose of the study is cultural specific/all users are from same context) while 2/3 (18 of 27) had as their topic the cross-cultural (the purpose of the study is to compare different cultures/users from different contexts).

Table 5. H7: There are more cross-cultural than cultural studies

Count of papers main topic	cultural	cross-cultural	total
Interview	2	2	4
Think aloud usability test	2	1	3
Usability test	2	6	8
Questionnaire	4	9	13
Observation	2	3	5
Association test	2		2
Break down analysis		2	2
Heuristic evaluation	1		1
Reading time, preferences	1		1
Review of ten books		1	1
Survey	1		1
Grand Total	17	24	41

Language of study. To get better information, especially in the context of a user requirement analysis, the studies could be expected to use local moderator and/or local test material. However, local moderators are used in only one third of the studies. This could be due to that most of the studies take place in English speaking countries. Other possible explanations for the no-use of local moderators could be that the researchers use students with foreign background as test participants, or that the researcher is multilingual and able to speak the language of the locals. More probable, however, is that the test participants are selected partly because they are able to speak English, since less than one third of the studies, distributed across countries and years, report that the test participants were allowed to use their local language. Besides the oral communication, other communication could also be done in local language. For example, was the software in English or local language? In few of the studies, the test

participants were instructed in local language or the test material (e.g. software) was in local language, Table 6. The language of the study is a complicated issue. How to prepare and report an ideal localized test? For example, with online surveys, we believe that it is important that the paper report the country in which the respondents are residing - this is not always the case with the papers that we reviewed.

Table 6. H8: Test material is localized

Country(ies) of focus for study	Local moderator, evaluator/t leader	/ est	Local	language		Local m	aterial
	Yes	No	Some	All	No	Yes	No
English official language in all the countries:							
Botswana	1				1		1
China (Hong Kong)	2			2			2
India	3		1		2		3
United Kingdom		1			1		1
US, UK & Hong Kong		1			1		1
English official language in one of the countries:							
United Kingdom		1			1		1
US & Bulgaria		1			1	1	
US & China	1	2		2	1	1	2
US & Sweden		1			1		1
US & Thailand		1		1		1	
US & Turkey	1				1		1
US, Japan & Sri Lanka		1	1				1
China, Taiwan & India		1			1		1
Other official language in all the countries:							
China	2	1		1	2		3
Korea, Japan and Finland	1			1			1
Netherlands & Turkey		1			1	1	
(blank) & (blank)		4			4		4
Grand Total	11	16	2	7	18	4	23

**Test participants' cultural subgroup.** Countries are the easiest way to separate between cultures because they are existing official separations. Sub-cultural and regional speciality, in particular in big countries seems to be ignored. Most studies used national groups as cultural groups, **Table 7**.

Table 7. H9:	Studies	using	Country	as cultural	Dimensions
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Country(ies) of focus for study	Did the study care abou in the country/cultural s	Total	
	Yes	(blank)	
Botswana	1		1
China	1	2	3
China (Hong Kong)	1	1	2
China, China (Taiwan) & India		1	1
India		3	3
Korea, Japan and Finland		1	1
Netherlands & Turkey		1	1
United Kingdom	1	1	2
US & Bulgaria		1	1
US & China	1	2	3
US & Sweden		1	1
US & Thailand		1	1
US & Turkey		1	1
US, Japan & Sri Lanka		1	1
US, United Kingdom & Hong Kong		1	1
(blank)		4	4
Total	5	22	27

**Publication outlets.** This topic is highly relevant and therefore all journals should be publishing something from this field. However, two major journals have not published any papers on this topic, while IwC seems to be a candidate to the prize, Table 8.

Journal name (official abbreviation)	Total
B&IT	2
Computers in Human Behavior	2
IJHCS	2
IJE	1
IJoHCI	4
IJoHCS	1
IJoIE	2
IwC	12
Journal of usability studies	1
ToCHI	0
HCI	0

# 4. Discussion and Conclusion

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The three most important findings of this study were:

1. Hofstede was the dominating model of culture; however most papers did not have any model of culture, just used the word culture.

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- 2. Most of studies were quantitative studies with more than 20 participants.
- 3. In most of the studies, a major consideration in the choice of participants was if they could speak English.

We have organized the 27 papers chronologically and labelled themes or periods in time in Table 9 in the appendix. The first theme from 1998-2000 is 'frameworks for understanding culture' with 9 papers. The second theme occurring in 2001 is 'display design' with 4 papers. The third theme from 2003-2006 is 'effect of culture' with 10 papers, and finally the fourth theme from 2006-2007 is 'localized interfaces' with 4 papers.

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# Appendix

# Table 9. Four periods in Culture and HCI research

199	8-2000: Overall culture-HCI frameworks	
	culture as meaning of representation	3
	culture as globalization fo software	2
	national cultural differences	3
	culture as (english) language	1
200	1 - 2002: Display design	
	Local symbols and icons	2
	Current phrases in menus	1
	Color association	1
200	3-2006: Effect of culture	
	individuals culturally linked reactions to applications	4
	behaviour and attitudes of participants from idfferent culturles in tests	2
	cultural influence on design process abstractions	1
	reliagion and IT	1
	cultural and CSCW	1
	culture and ecommerce	1
200	6-2007: Localised interfaces	
	mobile data services	1
	affective avatars	1
	СМС	1
	Other	1
total		27

# **Personas in Cross-Cultural Projects**

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**Abstract.** Personas are considered a method to communicate data on users and to aid in the perception of users. Instead of project participants having individual images, the method creates a shared perception of the users that is not built on preconceived ideas, but on field data. Research shows that culturally different readers fill the narrative gaps that occur in every text differently. This paper looks at how culturally different readers interpret a persona description. Findings are that there is a need for having personas verified by locals as readers interpret the descriptions locally.

Keywords: Personas, Scenarios, Culture

# 1 Introduction

Personas are considered a method to aid the perception of users and to communicate data on users. Instead of project participants having individual images, the method creates a shared perception of the users that is not built on preconceived ideas, but on field data. There is consensus on that a persona is presented as a text with an accompanying illustration of the persona either as a photo or a drawing [1]. This paper investigates how different users from different cultures perceive the same textual description of a persona and builds on an earlier study [2].

Personas presentations have commonalities with stories. It applies to stories, that a story can never be told in its entirety and the reader will, when trying to make meaning of the story, fill in the gaps in the text, known as narrative gaps [3]. This goes for the persona description as well. The description is not able to present all information about the persona and the reader infers the missing information. The information that is not received as direct story elements, the reader infers from expectations, knowledge of the depicted area, and own cultural background [4]. Storytelling is a common experience, but the reception is individual and each reader creates his or her individual story. In connection to personas descriptions the question becomes: do culturally different readers fill the narrative gaps differently?

In the following I will report from two studies of how people from different cultures perceive a persona description. The first study [2] involved six participants from India, China and Denmark, most of whom were young and students. This study was followed by a second study with eight participants from Japan, Brazil, France,

Holland, Russia, New Zealand, Germany and USA. All were familiar with the persona method and all were usability professionals. The persona portrayed a person working with marketing. The description was written in such a way that there were no cues in the text regarding age, gender or culture. In both studies the participants were asked to: 1) read a persona description; 2) find a photo on the internet that resembled the persona; 3) write a short comment on why they had chosen this particular photo; 4) mail both the photo and comment to me.

**Fig. 1** The two photos below illustrate suggestions for the persona from the first and second study, respectively.



When the descriptions and photos arrived, the texts were analyzed in order to investigate the connection between the photo and the description of why the participant had chosen the particular photo as well as the relation to the persona description. The analysis focused on strategies, explanations, and visual appearances.

## 2 Strategies for finding photos

In both studies there seemed to be two strategies at play choosing the photo; either interpreting or looking for clues in the description.

The participant interpreted the text and used the interpretation as an explanation for the choice of photo 'I don't know why but I tend to associate obesity with reluctance to new technology mindset. Don't ask me why!'(Indian informant 3). 'Information Technology means he would earn more money than average' (Chinese informant 1).

The participant found a specific description in the text that served as explanation for the choice of photo. 'She has young children and therefore she could not be old' (Danish informant 2). 'He has no time to do much exercise, so he may be a little fat' (Chinese informant 2).

#### 2.1 The first study

In the first study it was observed that most participants picked a photo of a person in a business suit, even the only photo of a female. Three out of four participants from India and China chose photos of western looking business men, the last two of the participants chose photos of locals. There seemed to be a shared and stereotypical comprehension of how a business person looks – despite culture. Most participants chose a photo of a person with a non local appearance.

The Danes had slightly different choices. The two Danish participants chose photos of people younger than those chosen by the other participants from other countries. The photos chosen by the male Danish participants showed persons with typical Danish looks, while the female participant chose a person with a non-Danish appearance.

#### 2.2 The second study

The second study had slightly different observations. The photos were more mixed in appearance and in general they portrayed older persons. There was no unambiguous choice of photos. Few chose a photo of a business stereotype (except one who had earlier on worked with personas). All participants chose photos of people with a local appearance.

#### 2.3 Commonalities in the two studies

Analysis of both studies show that the participants chose the age of the persona based on their own age.

- In the first experiment: the photos depicted younger persons. Among the participant were several students.
- In the second experiment: the photos depicted older personas. All participants were usability professionals.

The experienced usability professionals had a greater tendency to choose photos of locals than the younger and not so experienced group.

- First experiment: several chose non-local appearance.
- Second experiment: all chose local appearance.

The experienced participants used interpretation of the text as a strategy for finding photos while most of the participants in the first experiment chose to find cues in the text, when they argued for their choice.

There seems to be gender stereotypes at play. When men are depicted they are more often shown in surroundings with their children as the persona is described as one who cares for the family. When women are depicted they are more often shown in business surroundings.

# 3. Conclusion

The two studies have several outcomes concerning cross cultural projects. When reading a description the readers use two different strategies when depicting the persona; either interpreting or looking for clues in the description. Especially the interpretation strategy and the use of known persons might create unintended results in cross-cultural projects and points to, how crucial it is to get the descriptions verified by locals.

The studies showed that it is quite easy for the writer to incorporate unintended information in the persona description. In the first study, the author of the persona description had given the persona children of a certain age (3 and 7). Comparing this with the age of the persona (42), this pointed to a westerner. An Indian reader caught this information immediately as it did not fit with the cultural experience for India, where it is most common for men at 42 to have older children.

The studies showed that the readers used their own background when trying to understand the persona description and they used persons in their intimate surroundings in order to relate to the persona description. 'I assume I know the person, because of my previous career and involvement in advertising. I, from the get go, had an idea of how I presumed this person to look, since to me we all looked alike at the agency after a while. I took inspiration from my former superiors and my general ideas of how people in his position dress and tend to appear physically.'(Danish Informant). 'He has a French look (he looks like my brother in law who has similar position in a company).' (French Informant). 'Based on some elements in the text I might be more inclined to make it a male, but then again (being the son of a working mother), there is nothing that will not make it possible in the Netherlands to let this persona be a woman.' (Dutch informant).

Consensus is that personas are based on field studies, but often the designers will have little or no access to the studies. The interpretation of the description is local and rests on the readers own background and experiences. Further studies could look into if more information would support the perception, and the relevant kind of information to add when the persona description are to be read by designers with no or few experiences of the project area. To determine the impact on cross-cultural persona projects, further and more detailed studies need to be conducted.

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# Moment of Truth (MoT) – A Deeper Insight into User's Culture

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**Abstract.** The World Wide Web (WWW), since its inception has changed the way business is done. Digitization possibilities have transformed the way product and services are delivered and consumed. Everybody is going online and customers no longer depend on a single website to achieve their goals. This necessitates websites to offer a satisfactory and memorable interaction experience for attracting/ retaining new customers. Today, when the world seems to have flattened, cultural differences still pose significant challenges to businesses. A website is effective only when it understands the cultural needs and expectations of its customers. Cultural norms, if hurt, injures the brand image and deforms user experience. Hence, culturally neutral user experience is very important. In this paper we intend to understand importance of software enculturation along with the technique to capture the actual 'Moments of Truth'; the critical moments where users establish your brand image – much on which your business depends!

Keywords: Moment of Truth, MoT, Culture, Usability

# 1 Introduction

Concepts of usability and methods to evaluate it have been known for years, but notion of usability has evolved over a period of time. Inception and proliferation of internet, wireless and mobile technologies have created unprecedented interaction possibilities, but too often these technological changes suffer from poor user interfaces. As a consequence, focus of usability engineering has moved from improving user performance to enriching user experiences [1]. User experience emphasizes the emotional aspects of interacting with a product. It measures how much the product appeals to the needs of user. Simply meeting user expectation does not guarantee smooth user experience; however it forms first step towards building user trust for the product [2]. Strong user trust results in long term customer relationship and improved bottom-lines. As per the estimates published in the Research and Markets report, an average retailer can uplift his sales by 33%-54% by improving user experience. Businesses can cut their contact centre's service costs by up to 70%. [3].

A product that's easy to use – and fun to use—creates satisfaction and loyalty in its users. These "passionate users" are invaluable assets for any company. Not only do they

exemplify ongoing customer relationships, they can act as brand advocates or evangelists, contributing to positive word-of- mouth with significant long-term value.

"The redesign of Wal-Mart's online sales channel resulted in a 214% increase in the number of visitors... The new release moved Wal-Mart ahead of its competitors and scored particularly well in ease of use and in stimulating consumer confidence." (Karat & Lund 2005, p. 298)[4]

Since the site redesign, conversion rates increased 59% for new customers and 43% for repeat customers, Chivari says, adding that Spiegel.com represents about 50% of Spiegel's revenue [5].

Hence for any business to run successfully, providing smooth user experience to the end customer is very important.

This smooth user experience can be guaranteed by meeting users' explicit and implicit demands. The explicit demands are often easy to identify and meet by adhering to guidelines in the requirement specifications document of the product. However the other implicit demands of customer go undocumented. A detailed customer oriented study needs to be done to gather these requirements. Culture plays a vital role in shaping user expectations and hence fair understanding of the cultural backgrounds of the target audience is essential for designing a usable product [6]. This paper attempts to analyze how strong the hold of culture on user's minds is and how far it influences their habits, likes or dislikes and implicit user expectations. It proposes a 'Moment of Truth (MoT)' approach to understand implicit user requirements that have the potential to attract or repel your visitors, at the first hit itself!

### 2 Culture and its co-relation with Usability

Culture is a set of behavioral qualities and standard beliefs which distinguish one group of humans from another [6]. It is a multidimensional phenomenon, not determined by the geographic location or ethnic background alone but also by user's financial health, educational status and exposure to technology. Factors like gender, marital status and age also significantly influence the cultural values and beliefs cherished by user. It operates at cognitive, perceptual and motivational levels. Culture provides us with a set of rules to predict and perceive our interactions with the unpredictable world [7]. It largely defines individual's way of thinking and responding to different situations.

Same things convey different meanings to different groups of people. Something that is considered holy by one group can be seriously offensive to another group. The 'Swastika' has very negative connotations in western world but in Hindu culture the symbol conveys goodness and good luck [8]. While in India red color is perceived as purity, fertility and prosperity, in South Africa it is the color of mourning. Sometimes culture translates into generic norms, for example in USA blue color is for baby boys and pink for baby girls [9].

When applied to Web design, color may impact the user's expectations about navigation, links, and content, for example, as well as overall satisfaction. For example, an American bank using a web site to promote services for French investors may want to avoid the use of the color green, which some French may associate with criminality. On the other hand, the American bank may want to use green to attract Egyptian and Middle Eastern investors, as green have a positive connotation for them [10].

People get habituated to the connotations and learn to act as well as react accordingly. Many of the user habits and preferences are determined by their culture. Habits drive users, most of the user expectations stem from the habits possessed by users [11].

### 3 Why Software enculturation is necessary?

According to Hofstede (1991), when using any given computer system, culturally specific influences are important context variables. It is not possible to interact with any given technical system without these culturally specific influences being part of the interaction. Hence, the attitude towards the technical product is influenced by the cultural background of the user. In case of computer systems, the attitude towards the product can be described as its perceived usability. Thus enculturation of software products and websites is a necessity and not an option [12].

The first step towards understanding customer culture is identifying all the touch points where cultural norms intersect with the interaction experience. Customers interface with the business in multiple ways. They watch your advertisements, they visit your web site, they buy your products and services and they communicate their grievances and also seek help. These touch points are the first and sometimes the last opportunity to create important brand impressions. We tend to view this world through a glass of culture which profoundly controls our perceptions. Culture essentially makes us assume certain interaction patterns. When we do not receive the response to which we are habituated to, it seriously impacts our trust and the interest to interact and explore further. These are the most important moments where customer decides whether to keep the transaction going or to look for better alternative. These are the real Moments of Truth.

### 4 What is MoT?

Jan Carlzon, who coined the term 'Moment of Truth' (MoT), describes it as moments in which important brand impressions are formed and where there is a significant opportunity for good or bad impressions to be made [13]. Moments of truth often surface when they are least expected to occur. First impressions are last impressions and hence very critical. They can turn out to be a beginning of a long term customer relationship or end the relationship even before it begins! These moments have huge make and break potential. Thus intelligent prediction of these points of interaction and its careful handling is significantly important to improve brand loyalty, increase user trust and most important your own revenue. For years, businesses have been using Moment of Truth for understanding the customer behavior and to explore possibilities of providing superior

products and services; but application of moment of truth principles to software and website design is not evident.

### 5 MoT in context of a Website

In context of this paper, we define MoTs as every possible point of interaction with the website or the software that compels user to validate her interaction experience with the cultural norms and respective expectations she has. In every MoT, user will form a profound impression about the system, which generally comes as a spontaneous reaction when the user interacts with the system. Reactions - especially spontaneous ones uncover the real feelings or a feedback which would be useful in capturing the intersection points where the cultural norm is being violated. It would be interesting to note that real user experience often remains at subconscious level and users are seldom aware of the real cause behind it. Therefore what user answers through a survey questionnaire does not reveal the real cause of feelings [14]. Hence capturing these Moments of Truth can help discovering the route cause for customer reactions.

It is evident from previous research that, 120 milli secs are enough to create an impression [15]. Whenever user visits your website, in no time she starts forming impressions about your website and essentially about your brand. In the case of a website the stimuli to form an impression could be fonts, the used colors schemes, logos, the prominent usage of certain symbols having cultural and historic backgrounds, language of the content, choice of words etc. If these components are designed and presented in a manner congruent to user's culture, it creates positive experience for the user [16].

Focusing on creating positive user experiences as a central part of the development process contributes directly to business success, whether it is increased sales, higher site traffic, improved feature use, better user performance, or increased customer satisfaction (Nielsen/Norman Group 2003). Some of these relationships are direct: Donoghue found that "For every 1% increase in the customer experience quality, there was a 1.66% increase in traffic to the site and a 0.84% increase in revenues" (2004, 10).

"The redesign of the United Airlines site... began by the teams' developing a deep understanding of travelers and modeling the traveler's experience to inform a new design. The result was a 200% increase in online ticketing and an increase in the satisfaction of United's most profitable customers. The new site design doubled the number of daily sessions, and the number of users going deeper into the site increased to roughly 65%." (Karat & Lund 2005, p. 298) [4]

### 6 A more Systematic MoT Analysis Approach

In the world of internet, the customer base is not restricted to a particular geographical location or a handful of people. If you are online, you may sometimes, to cater to customers from all over the globe on the same website at the same time. Your website is one and sometimes the only one point of interaction with your customers. MoT is

extremely important in this context which if not handled appropriately will drive visitors away from your website. However usable the site may be it has to successfully pass the test of cultural neutrality to be explored by the visitors. MoT aims at testing the cultural neutrality of the site.

As the look and feel of the website is the first aspect to be noticed by the visitors, it is imperative to clearly identify the UI elements which would surface during the first interaction. The six basic components of any website are [16]:

- Colours,
- Icons,
- Pictures,
- Sounds,
- Text information and
- Instruction

MoT analysis aims to capture these important parameters of user preferences that influence and evaluate user experience.

MoT Analysis can be carried out as follows:

1. Form a diverse user group

Select users from diverse geographies, different financial and marital status, varied educational backgrounds and literacy levels, different genders and age groups. Capture the demographic, psychographic data about the each participant.

2. Let them run through the system independently

Present every participant with the running prototype of the website. It is important for every participant to be exposed to the user interface individually and not in group.

3. Observe them interacting with the system

Ask the individual to think aloud while interacting with the system. The verbalization should be recorded and screen should be captured for future reference or for replaying the interaction in slow motion.

4. Record their spontaneous reactions

For understanding MOTs, it is important to capture the first and most spontaneous reactions of the user. The reactions can be in form of verbal remarks, facial expressions and body language. All these responses need to be captured in form of audio visuals. Eye tracking mechanism can be used to discover screen components causing the reactions.

#### 5. Conduct post interaction interview

Conduct one to one interviews with each participant. The interview would be based on observations made during interaction as well inputs from eye tracking analysis. Probe to discover the real cause of discomfort, anger, anxiety users may have experienced. Also note down the cultural notions which are getting violated or hurt during the interaction with the user interface. All the observations will be necessarily mapped to one or more of the experience parameters. MoT analysis thus conducted will clearly indicate a correlation between experience parameters and the cultural norms of the user. This analysis will also help designers to go beyond the functional requirements and will empower them to address implicit user expectations.

# 7 Implementing MoT Analysis Approach:

To validate our MoT Analysis approach, we conducted MoT analysis with users with different cultural backgrounds. All of them were asked to interact with three most popular websites in India namely, one English Newspaper website (W1) and two Political websites (W2, W3). Post interaction interviews were conducted to understand moments of truth users experienced during the interaction with the web sites.

User	Language	Age	Religion	Political View	Gender	Marital Status	Occupation
А	Marathi	25- 30	Hindu	NA	Female	Single	Software Professional
В	Marathi	55- 60	Hindu	NA	Female	Married	House Wife
С	Tamil	25- 30	Hindu	NA	Male	Single	Software Professional
D	Malyalam	25- 30	Christian	NA	Female	Single	Software Professional
Е	Marathi	35- 40	Hindu	NA	Male	Married	Software Professional

#### **Table 1. Participant Profile**

### Table 2. Feedback for website W1

User	Remark	Stimulus	Related Cultural Norm
А	Ok for browsing; but will not read in detail during office	Flashy and bold pictures	Concepts of beauty and fashion
В	Insane pictures, doesn't seem to be a mature news paper	Advertisements and pictures of scantily clad women	Concept of decency
С	Quality news, but some content is unacceptable	Increased focus on Page3/Spicy content	Concept of news paper
D	Will surely read the news; but some sections are unacceptable to a girl	Pictures of scantily clad women	Concept of decency

Е	It is no longer a news paper	Increased focus on	Concept of news paper
		Page3/Spicy content	

### Table 3. Feedback for website W2

User	Remark	Stimulus	Related Cultural Norm
А	This seems to be for small group of people	Color schemes	Perception of saffron color
В	Good one	Photographs	Political affiliation
С	No good no bad	General look and feel	Political affiliation
D	Doesn't appear to be a site for all Indians. Seems to be a one way communication channel.	Color schemes and text	Concept of freedom of thought
Е	Seems closer to me	Photographs	Political affiliation

## Table 4. Feedback for website W3

User	Remark	Stimulus	Related Cultural Norm
А	Good	Color schemes	Perception of saffron color
В	No good no bad	Photographs	Political affiliation
С	No good no bad	General look and feel	Political affiliation
D	This is for all Indians. Tricolor/Tiranga helps me connecting with the site.	Color schemes and text	Nationality
E	No good no bad	General look and feel	Political affiliation

Though the experiment was conducted with smaller sample size, it was helpful in confirming the understandings of MoT. It clearly indicated that visitors concluded on the nature of website in few seconds. They judged the quality of content by their first impressions about the site. These moments during first interaction turned out to be *"Moments of Truth"* for the website. Interviews of participants revealed that the reason for the impressions they formed was connected to cultural values they uphold.

This MOT exercise can be done on a larger scale on wider base of B2C, C2C types of business websites to validate importance of MoT and its impact on the commercial value of product for any company.

# 8 Conclusion:

In this flat world, culture still holds strong influence on the minds of people. Cultural notions accompany individuals during human to human and human to machine interaction. Therefore it is important for businesses to carefully watch for all *Moments of Truth* customers can potentially face during interaction with your website. However usable the site may be it has to successfully pass the test of cultural neutrality to be explored by the visitors. Therefore the web user interface has to be sensitive to diverse cultures. Application of MoT principles to website design can be useful in enculturation of the website.

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# **Promoting Usability in Large Enterprises**

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**Abstract.** Usability engineering techniques have been used by academia, research institutes, and independent consultants for many years. However, the acceptance of related best practices and added value of usability is continuously overlooked by most corporations. As a result, many products fail to meet end-users requirements, while businesses lose time-to-market and competitive advantage. In large corporations, how can user experience methodologies and practitioners survive dynamically changing organizations, business goals, or organizational silos? How to deal with a collective misunderstanding of usability? From a large enterprise viewpoint, this paper overviews the barriers, tools, practices, and adopted steps towards a wider acceptance of usability.

Keywords: usability, strategic usability, usability practices, usability barriers

# 1 Introduction

A few decades ago, users did not have many product alternatives to choose from. Nowadays, however, they have access to a wider variety of products and product versions, within flexible price ranges. As a result, end-users decide which products sell and which are bound for failure. Undeniably, in addition to functionality, cost, and performance, usability is a key factor for success of any interactive system [6]. Although many corporations recognize this and are aware of today's competitive market, most products fail to meet core usability principles. Usability cannot be seen as an external service; instead, it must be part of the organization.

Adopting best practices in usability engineering is a process of continuous learning and improvement. Several members of the human-computer interaction (HCI) community have contributed with strategies, methodologies, models, and approaches to increase corporate usability [e.g. 4, 9, 11]. Some focused on analyzing the barriers [5], some presented recommendations on how to demonstrate return on investment (ROI) [1] while others questioned its value [10], and a few showed how to match user experience and business goals [2]. Without a doubt, usability has yet to gain a wide acceptance across most organizations, each being unique in its own way.

Our corporation, Nokia Siemens Networks, is one of the largest and leading telecommunications companies in the world. It employs over 60,000 workers in more than 150 countries world-wide - offering a wide range of products, services, and solutions in the design, deployment, maintenance, and network management.

Our work began 4 years ago within an organization with more than 180 employees. At that time, the awareness of usability was low. Although there were some initiatives in small groups and projects, most developers and managers were not familiarized with usability engineering, its importance, and value to the organization. Our mission was quite simple and humble: help others to help themselves. Since then, we have contributed with our knowledge in raising usability awareness, corporation-wide, and improving the user experience (UX) of several products from different domains, such as: network management, network planning, network elements managers, interactive television, and service monitoring and reporting.

This paper presents how our enterprise has embraced usability over the past years, from our team's perspective. By sharing this story, we hope to help others to successfully bridge the gap between knowing, understanding, and practicing usability.

### 2 Challenges for practitioners

In our organization in Portugal, where we initially focused our work, mostly no one was aware of the key principles that distinguish a good from a bad design. Referring to Nielsen's corporate usability maturity state [8] we were between stages 2 and 3. At that time, most of the designs were based on developers' intuition, although there were some initiatives within other groups and projects – including the existence of a corporate laboratory dedicated to usability engineering. Nevertheless, even though the lab team produced high-quality inspections and analysis for several projects, they were unable to change the mentality of the organization – being viewed as an "external" service instead of a competence which was part of the teams and projects. Though many have strived to strategically place usability best practices within organizations, each is unique and there is no "one-size fits all" approach. This section describes the main barriers found at our organization.

All organizations vary in size and structure. In smaller ones, the process is usually facilitated by the reduced number of employees, roles, and proximity to the end-users. However, in large organizations, like ours, implementing usability practices is increasingly challenging. Organizations are often seen as an impediment for progress, as those with decision-making power are distant from the individuals that produce the actual work. In addition, to subsist in today's competitive markets, companies need to continuously update their strategy, structure, management, and even employees. As an example, our direct management has changed five times in the past three years, while the organization and structure have changed four times. From our experience, the only way to deal with dynamically changing organizations is through a continuous process of observation and adaption – without waiting for management support to start producing value work.

Most companies are focused on sales, cash flow, revenue, and ROI. These are the key terms and words that makeup the goals of most corporations. Although many have shown and proven the cost-effectiveness of usability [1], most corporations discard it as one of the key factors in products success. To increase the acceptance of usability we need a bottom-up approach.

Most common roles in research and development (R&D) include: developers, architects, system testers, technical writers, project managers, and so on. People with such roles come from different academic and professional backgrounds. As result, each has its own understanding of what and how valuable usability is to their work. To address this communication barrier, we need to speak "all languages" of the corporation and be part of the team.

Another characteristic in large organizations is global presence – induced by cost-benefit and market goals. Competences are usually scattered and, although less effective, many choose to run projects in multiples sites. Even though corporations are investing in more advanced means of telecommunication, these are still not accessible to the majority of the employees. One alternative to overcome this barrier is to increase social presence with intranet tools (such as web conferencing, online chats, and wikis). An additional outcome of regional organizations is the inherent need for inter-cultural communication. Each is distinct on how it perceives, produces, and conveys information, regardless of the selected corporate language. One approach is to understand these differences and adapt the way messages are shared.

Corporations still behave like "R&D factories". From one side they receive a set of business needs and requirements, while from the other they deliver a product to customers. How this is processed depends on the core functions of each company (such as processes, methodologies, technologies, and individuals). There is usually not much room for innovation or change. What to do? Just do it anyway.

Most companies employ highly-bureaucratic processes – defining what they can do, how, and when. Usually, processes are not open to changes or improvements, simply because they are in place and working for several years. For example, at our company a considerable amount of the projects still run with the traditional waterfall approach. Therefore, more time is spent producing documents than developing and testing code. Although this ineffective approach offers UX practitioners additional time to deepen their work, when development finally starts no one really cares about the documents that were produced. As a result, all the investment done researching, reviewing, and writing documentation is wasted. One way to address this problem is to motivate teams to develop and test prototypes simultaneously with the first documentation stages.

In large organizations, getting to know the final end-users is not accessible for everyone. Typically, only specific roles in the organization meet the customers and the users – and are responsible for conveying their requirements to engineering teams. Naturally, these employees are usually not educated or informed about usability engineering. Also, countries where products are developed are not necessarily the same as the customers. Therefore, the cost of sending individuals in the organization to customer sites is very expensive. To surmount this barrier we need to influence and change the organization towards the value of usability – only then will they invest in sending specialized employees to customer sites. Alternatively, applying agile methodologies can promote the involvement of customers and project teams.

Nowadays, more than ever, customers and end-users look for customized products. This is a challenge for corporations that seek recognition based on their brand and look and feel. To address it, we need to promote the development of products that are flexible enough to display a consistent brand, but are also customizable at a low cost.

### **3** Raising the awareness

Once we acknowledge the challenges, it is easy to foresee the inherent difficulties in achieving a common understanding and acceptance of usability. There is no ideal cookbook – just a set of strategies that must be adapted for each organization. Although we were familiar with the best practices, we feel that our implementation has been ad-hoc – in other words, we are continuously learning from a dynamically changing environment, while adapting and taking the best opportunities. We present here the main practices found useful within our organization.

UX practitioners enter a corporation with a goal: to change it. To infiltrate, we need to be part of the team. All of our team members came from different educational backgrounds, but mostly software engineering. We joined the company as software developers, technical writers, system testers, and so on. Some of us had a strong background on usability engineering; others were trained on the job. In addition, practitioners need to be familiar with the company and environment. What are the organizations and structures, business goals, processes, projects, customers, people involved, their roles and backgrounds, and so forth. While we keep aware of the changing environment, we most focus on producing high-quality and relevant work.

Acknowledging that organizations, individuals, and management will often change is crucial - we must adapt to these transformations, while we continue to explore opportunities. Others should not see UX practitioners as an outside group, but part of their own groups and teams. Ours has always been part of R&D and part of the projects. We cannot change anything by being against it (or apart from it).

Usability engineers need some strategy, even if for a short-term. Often we will hear statements such as: "no changes are needed in the user interface; our customers are happy". In these situations, we should monitor and "wait" for a chance to demonstrate how misguided they are with such assumptions. To achieve this, practitioners should not remain idle until management approval; we do the required studies anyway. Management will likely give support once they see the results. Of course, one needs to find the right tools to disseminate usability, given the environment and situation.

We often need to spread the word and say what usability is, its importance, and how to apply it – and we might just start with the person sitting next to us and slowly move up in the "chain". In this process, we must be constructive and helpful. However, we should not only focus in stating the definitions; more importantly, we need to teach the skills that will enable them to improve their own work. Otherwise, UX practitioners will not be enough to tackle all needs – partners are needed. In addition to the organization or projects we belong to, practitioners must network with others across the entire corporation. We started by influencing those in our local site. We then approached other sites and countries working on the same projects. Afterwards, we partnered with other usability groups, from different business lines and business units, in a continuous effort to promote usability.

All work produced and achievements need to be shared. Information sessions, workshops, and so on, can be organized. The precondition is that sharing must be done with impact and results must be adapted to the target audience (e.g. when talking to software developers we can highlight the existing best practices in their design, while we show where they can continue to improve). People need to be convinced about what they can do immediately, otherwise they will never do it.

Practitioners' skills need to be recognized. This can be achieved by producing high-quality work, with impact and targeted to the audience, and by being part of the teams. Members should be individuals with different roles and backgrounds. The more diverse the team is, in terms of skills and positions they take within the company, the higher our chances of success. In our case, our team was mainly a functional and project team, while networking with other peers in the organization.

Overall, as practitioners, we need to demonstrate the benefits and how usability can result in better quality products, which take less time and effort to produce and maintain – even if compromises are needed. Only after tackling the main challenges, with continuous observation and adaption, can we begin to make a change.

### 4 Most useful tools

There are several tools and methodologies for applying usability. UX practitioners have to identity which tools are best suited and most effective, depending on their needs and work context. Here is a set of tools we found to be more effective, in the process of creating a wider acceptance and understanding of usability.

Heuristic evaluation is one of the most used usability inspection methods. Performed by a small set of evaluators, it consists in inspecting user interfaces (UIs) and judging their compliance with usability principles [7]. This is the tool our team uses the most, as it is easy, quick, and very effective. Initially, we produced detailed documents describing the problems, heuristics, severities and priorities, and proposed solutions. Nevertheless, we soon found out that these were not read by most and the textual descriptions easily lead to erroneous interpretations. Today, we use PowerPoint presentations with screenshots and call-outs, having short textual description on what are the issues and how they can be improved – where best practices are also highlighted. For more complex problems, we produce low-fidelity prototypes and underline the changes.

Prototypes are incomplete versions of our products or designs, which enable and promote discussion among the different stakeholders [7]. Considering the situation and the required detail, one can use different degrees of fidelity. Our choice usually depends on the available time, project relevancy, complexity, and target audience. For low levels of detail, we use paper prototyping or simple design tools (such as PowerPoint or Paint.Net). For high levels, we mainly use integrated development environments, such as NetBeans or Microsoft Visual Studio, which provide efficient tools to quickly produce working UIs.

User testing is a fundamental method of evaluation. One of the main pitfalls is the amount of time needed to prepare, evaluate, and analyze the results. In addition, for many practitioners from large corporations, end-users are not accessible. One way to address this limitation, while the organization does not fully support such initiatives, is to execute informal tests with random co-workers. Although these are not the end-users of our products, they still provide us with valuable insight to our designs, in addition to the expert evaluations. We reduce the usage of informal usability testing to the most complex design issues, where we usually produce high-fidelity prototypes that enable us to retrieve test data automatically. Undeniably, to produce high-quality, recognizable and consistent end-user applications, we need to produce organization-specific usability guidelines. These consider the corporate brand, look and feel, and specific product domains – e.g., network management – and, as a result, they should be included in different and interrelated documents. Regarding the target audience, although some feel that these guidelines are an added value to software developers and other roles within the organization [3], we have determined that most do not read or refer to them – in addition to the UX practitioners. Our recommendation is to invest in such guidelines, but keeping in mind that we are the main audience – as a continuous reference to enable us to create more consistent UIs. As a result, we can drop the detail or extensive descriptions on why these rules are so important.

Assuming there is no time for user research and there are no organization-specific usability guidelines, or the existing ones do not support us, we should always refer to platform conventions. Products are built for specific platforms, such as Microsoft, and users have clear expectations on how to interact with these systems.

From our experience, the best tool to communicate usability results is PowerPoint presentations. These must have exceptional quality, be targeted to the indended audience, reflect our inherent interest in promoting usability, and have impact. In all presentations we mostly use screenshots of our applications, of prototypes, or metaphors that support our message. Textual descriptions and bullets are kept to a minimum – usually we only have one or two slides with summary and proposed next steps. Keep in mind that "a picture is worth a thousand words".

Following Nike's strong market campaign, "Just do it!", this is the key "tool" for increasing usability awareness. Although some mention the need for management support [4, 12], it is not a pre-requisite. We need to accept that management changes are recurrent and keep in mind that the best way to get support is by showing relevant and high-quality work. As an infiltrated UX practitioner, we are asked to design and develop a new UI for our product. In the background, we do whatever it takes show others how to improve their work. In the beginning we do not need to inform our management of the required steps to create a world-class user experience, as they will likely not understand the reason for so many steps or so much time. Instead, we optimize our work and select the most quick and effective tools to achieve our goal. After sharing and presenting it, we will most-definitely gain their support.

### **5** Conclusions and future steps

In the past three years, our team has grown up to 20 team members – all part of the same functional team and organization. Coming from different educational and professional backgrounds, each contributed to the process of raising the awareness of usability in our enterprise. While some had strong background knowledge in usability engineering, others were trained on the job. Internally, the team was organized in four areas or centers-of-competence: UI development and engineering, software and UI testing, customer documentation, usability engineering and innovation. All worked for specific projects with typical and common software engineering roles.

We began implementing usability practices in our local organization (around 180 employees) and then approached co-workers from other countries. Soon after, we were providing consultancy to different business lines (more than 400 workers). In 2007, we were part of a business line with more than 800 employees. Today, in collaboration with strong and experienced associates from Germany and Finland, we disseminate usability best practices at a business unit level (currently reaching more than 4000 employees and more than 80 projects).

Since we first started, we have worked with more than 30 applications from different domains, both desktop and web oriented – reaching co-workers from United States of America, Portugal, Germany, Finland, Poland, China, among others. For the core projects in our business line, we have ensured a budget dedicated to usability practices, such as usability and heuristic evaluations, concept analysis and testing – performed by our own team members. In addition, we added usability related deliverables and quality criteria to the milestone list (e.g. UI testing and approval before each build is delivered to the integration or system test phases). Also, we have introduced templates and procedures, PowerPoint based, in order to simplify the creation of UIs specs for projects which still run in the traditional waterfall approach.

At this point, we lack empirical results to measure the effectiveness of our work. However, we have more than three years of experience in practicing and overcoming organizational barriers, at one of the largest telecommunications solutions provider. While we continue raising the awareness of usability, new challenges arise and new methods and tools will be needed in order to prevail. Until now, a bottom-up approach has been essential in our implementation. We accept that organizations and managements change, so we continuously observe and adapt. Depending on the situation, we select the most effective tools to get the work done – not waiting for management support as a pre-requisite for progress. In addition, team work is mandatory if we want to survive such a dynamically changing environment.

Currently, we are at stage 5 of corporate usability maturity [8]. At our business unit level there is currently an official usability group, responsible for related best practices across the corporation. Many of our team members are part of this group, together with partners from other countries. Additionally, the group is implementing more systematic usability processes for tracking the user experience quality, though there is still significant work ahead. This group is using additional approaches to overcome continuous challenges in raising usability awareness. Hopefully, we will share our findings back to the HCI community in a few years.

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# SMART User Experience Framework 1.0 Making information technology products & services better for users

#### Aparna Raman

### Abstract

The world is building smaller and visually better devices. However in the rush to do so, most people overlook user experience. Something that is marketed as user experience turns out to be a belligerent service. This affects the brand loyalty. The users of the information technology products and services fall for the splendor of the products and get into the vicious cycle of complex products, also paying a huge cost for it. But they do not have a choice. People have to go through tedious manuals to get used to the simplest of the functionality. The manufacturers and the service agents focus on making the products a shiny toy, forgetting the actual purpose of the product.

The thought of non-user friendly products will make the users frustrated. The users believe that product companies will make larger impacts on their lives, but their belief is shattered, when they find the basic functionality being tough for them. There still isn't a concrete methodology, which ensures that the product before being released to the users in the market will definitely make their lives simpler. This research basically aims on creating such a methodology will not only bring eureka in the technology world, but will also benefit the marketing world, as we will make brand loyal customers. The research aims the power of innovation, content information, input, insights and ideas to condense into a methodology, which will ensure that future world has high quality, visually fit and high standard user –friendly products and services.

SMART UX method is a cyclic method built on number of base SMART frameworks, the continuous iteration of which will impart best practices of making a highly usable product. The research methodology will include several case studies, archival research, interviews with stakeholders, and various forms of fieldwork. The methodology once developed will be experimentally applied on the development of several services and products, to help validate the approach and define the details. The framework 1.0 will be described in this paper.

### **Keywords**

Usability and Software, Enterprise Engineering

### **1** Introduction

The SMART user experience framework is a part of the "SMART User Experience Methodology". SMART methodology, is a methodology which is Simple & Scalable, Measurable, easily Adaptable, has high ROI and is Time saving. Therefore the term is coined as SMART. This methodology aims to gel with different software methodologies (for e.g. Waterfall Model, Agile Methodology, and Extreme Programming, Rational Unified Process etc). This paper deals with SMART framework 1.0 which is a preliminary scratch framework, based on which further development of a robust methodology will take place.

## 2 Current Literature

Usability Engineering is defined as "An approach to the development of software and systems which involves user participation from the outset and guarantees the efficacy of the product through the use of a usability specification and metrics" Faulkner (2000). Hakiel (1997) identifies two interdependent inhibitors that stand in the way of an integrated approach of usability and software engineering. "As long as product managers consider their product to be software, they will not appreciate the relevance of contributions from other, 'non-technical' disciplines". (Hakiel, 1997). Battle (2005) claims that usability integration is influenced by contextual issues such as the development lifecycle model, the organizational culture and the position of the User-Centered Design (UCD) -practitioner. The critical role that organizational aspects play in usability integration is reported by Seffah et al. (2005). Mayhew's (1999) Usability Engineering Lifecycle is a guide for incorporating usability engineering activities through development processes. More recent research on process integration is conducted by e.g. Göransson & al. (2003), Sousa & Furtado (2003), Granollers & al. (2002), Ferrè (2003) and Anderson & al.(2001). According to Ferrè (2003) and Anderson & al. (2001) integration of usability methods into existing software development processes requires an iterative development process. Schaffer (2004) proposes a method (The Schaffer Method) which approaches usability integration from evaluating and testing the existing applications. According to Aikio, Kari-Pekka. (2006), further research is required in usability engineering should focus on establishing a sound theoretical foundation on the topic of usability integration. It should produce practical and applicable results and recommendations for people who work in the fields of HCI, SE and ISR. There are few other literature evidences which have been used, which will further help brainstorming and come up with next stage of this framework (2.0).

This research paper will focus on the practical aspect and applicability aspect which has not been exploited to an extent.

### **3** Description

3.1 Why do we need this methodology

**User experience design** is a subset of the field of experience design which pertains to the creation of the architecture and interaction models which impact a user's perception of a device or system. The scope of the field is directed at affecting "all aspects of the user's interaction with the product: how it is perceived, learned, and used."- Donald Norman.

User Experience design once implemented delivers high returns .Some of the examples are:

- a) IBM spent millions in redesign : Within one week , use of help button reduced by 84% and sales increased by  $400\%^1$
- b) Sketchers moved its product selection close to home page which increased its sales more than 400%
- c) Dell applied usability principles to ecommerce website. Its sales increased to \$ 34 million per day in 6 months
- d) Digital Equipment Corporation used usability engineering techniques to identify and fix 20 different serious usability problems. Its revenue increased by 80%. Revenue increase exceeded projections by 66%.

There are some examples which reiterate the problems that crop up, when user experience is not used. User Experience is a concept that is extensible to the everyday things that we see, feel and do. We get into the trap of a bad design and then just probably get used to following that bad design. Some of the examples of bad design are:

**a**) **Trapped between doors:** The user does not know which direction to push and pull.



Source: Design of Everyday Things -Donald Norman

<sup>&</sup>lt;sup>1</sup> Cost-Justifying Usability by Randolph G. Bias and Deborah J. Mayhew

**b) Present signage example on the way to Delhi airport:** The image of the plane is confusing as its contradicting direction to the airport. One thinks, for a moment as to where one should go to head for Domestic Airport, Left or Right? Few days later this problem was resolved by a second signage board. But the first one still exists.



Figure 2 Source: www.usabilitymatters.org

This shows that not only in the information technology field, but our day to day lives are affected by numerous such examples.

Apart from day to day lives, we have few other examples to explain the problems in current scenario in India:

**IVR's.:** Interactive voice response, or **IVR**, is a technology that allows a computer to detect voice and keypad inputs. IVR technology is used extensively in telecommunications, but is also being introduced into automobile systems for hands free operation. IVR is often criticized as being unhelpful and difficult to use due to poor design and lack of appreciation of the caller's needs. Some callers object to providing voice response to an automated system and prefer speaking with a human respondent. A properly designed IVR application should provide the caller's needs promptly and with a minimum of complexity.

**SBI:** Secondly, we have the examples of the Indian banking site, like SBI (<u>www.sbi.co.in</u>), which is India's largest bank, where we need to search for using their online banking facility on the home page as they have such an incorrigible icon, which passes over the eye and we are still searching for the login option. For the correct login, we need to go to <u>www.onlinesbi.com</u>. Two sites for the same banking establishment,

isn't it confusing. Further there are lots of issues with the bank's site and it receives innumerous calls regarding it.

**I-phone:** With companies like Apple developing eye-gluing products like I-phone, one would expect the best of the world. But here comes a user experience criticism. "Participants uniformly found text entry SMS and e-mail to be difficult," User Centric's summary stated. "They were frustrated by the forced use the vertical keyboard and the lack of visibility for editing the middle of a word or sentence." The users were also annoyed to find that horizontal text entry was only available in the Safari browser. It is unimaginable isn't it? With such a good team of experienced user experience professional, should we expect such a review? This is because we still have the software engineering methodology different from the user experience team. There is no gelling factor. We do have some stakeholders in each of the process, but designing and implementing separates out in the actual process.

Hence, the most used sites/services or the products are the prey of bad user experience and hence show how they have lacked a methodology to come up to this level.

### 3.2 Background

Today we do not have a user experience product / service development methodology that can be followed as a base in the industry. Research done is still at preliminary stage. Every company or organization has its own user experience methodology which they claim to be an USP (unique selling proposition). There is this methodology craziness which goes around. Methodology craziness refers to the espousing of convenient beliefs, "truths" and proclamations about the right way or new way to do things. The methodology is typically proprietary or masked and is typically part of some form of a sales pitch- either for a report or a "customer experience management" solution. The "right or new way" implies that the approach is more refined, more advanced or a best practice. The problem with proprietary methodologies is that they are often inaccurate or distorted versions of the truth. The other obvious problem is that proprietary usability methodology, techniques, or research serves that company's interests, with a clear commercial bias.

User experience engineering has not been integrated well to the current existing software engineering methodology in the information technology sector. This methodology is another step towards making things simpler for the users.

### 3.3 Scope & Depth

The scope of this methodology is to create a unique and base setting **SMART** user experience methodology which imbibes its principles of being Simple & Scalable, Measurable, easily Adaptable, has high ROI (Return on Investment) and is time saving. The further explanation of the SMART principles is as follows:

#### a) Simple and Scalable

The methodology developed will be as simple as possible, so that the engineering teams get a feel of what they can achieve out of this methodology easily.

#### b) Measurable

The methodology will contain a clear set of metrics which will help us measure the desired result.

#### c) Adaptable

The methodology should be such that it gets easily mapped to a project or already existing method.

#### d) High Return on Investment:

This is one of the ways at looking at the value of user experience. The propositions are:

- i. High return on savings
- ii. Reduce development cost
- iii. Save redesign costs
- iv. Increase transaction/purchases
- v. Increase audience
- vi. Retain customers
- vii. Increase competitive edge
- viii. Increase efficiency
- ix. Increase user satisfaction
- x. Decrease support costs
- xi. Reduce training costs
- e) Time Saving

The reduce method should the development time as much as possible.

A fair degree of **misuse of user experience** seems to be emerging as the industry grows, and its main motive is sales and competitive differentiation. Some of the myths related to user experience are:

**Claim 1:** "Usability testing must be conducted in the user's natural setting".

Claim 2:"You need to test your website with hundreds of users".

Claim 3: "If it takes more than three clicks, forget it".

**Claim 4:** "Navigation is not important. Users don't care where they are in the website".

**Claim 5:** "Website usability can be measured by proprietary software, agents or algorithms".

These myths are misleading; therefore, it is very important to build a usable and a robust system. A system should not only be a technically appreciated product but a blend of a good user experience and high technology standards. There is a huge need to create such a scalable and time saving methodology which ensures that we are building the product not just for the client but for the customers as well. The companies which outsource as well as those who develop their own product have their own methods currently. This research aims to set a base standard in the industry.

Some of the examples of the companies selling methodology developed by their team are:

- Fredhopper
- Semantic Studios
- Usernomics
- Atrenet

And the list is endless, which shows that there is no standard methodology which needs to be in place for better product development. Following any process on its own and selling it by concluding it the best would not helpful in creating in really usable and appreciable product for the client. On one end, we get excellent results from user experience, but on the other end, the return on investment suffers if method is not properly applied. Let's look at following examples and statistics:

### **Examples:**

- "Savings from earlier vs. later changes: Changes cost less when made earlier in the development life cycle. Twenty changes in a project, at 32 hours per change and [a minimal] hourly rate of \$35, would cost \$22,400. Reducing this to 8 hours per change would reduce the cost to \$5,600. Savings = \$16,800." (*Human Factors International, 2001*)
- "A financial services company had to scrap an application it had developed, when, shortly before implementation, developers doing a User Acceptance test found a fatal flaw in their assumptions about how data would be entered. By this time, it was too late to change the underlying structure, and the application never implemented." (*Dray, 1995*)

### Statistics:

- When managers were polled regarding the reasons for the inaccurate cost estimates, the top four reasons were issues that could have been addressed by following best practices in usability engineering. These include frequent requests for changes by users, overlooked tasks, users' lack of understanding of their own requirements, and insufficient communication and understanding between users and analysts." (*Barker, 2000*)
- "A study of software engineering cost estimates showed that 63% of large software projects significantly overran their estimates (Nielsen, 1993). When asked to explain their inaccurate cost estimates, software managers cited 24 different reasons and, interestingly, the four reasons rated as having the highest responsibility were related to usability engineering. Proper usability engineering methodology will prevent most such problems and thus substantially reduce cost overruns in software projects." (*Nielsen, 1993*)

# 4 SMART Framework 1.0

The SMART framework 1.0 is the first step towards the building of the methodology. The development of SMART framework is based on the SMART principles and can be used for small scale services and products.

The SMART framework 1.0 basically consists of the following processes:

Stage 1: PARI stage: Plan, Analyze, Research & innovate stage

Stage 2: FAWP Stage: Feasibility, Architecture, Wire frame and Prototyping stage

Stage 3: IVSU Stage: Interaction, Validation, System Feedback and User Assistance stage

Stage 4: TUG Stage: Testing, Usability Testing and GUI standardization

Stage 5: PFL Stage: Pre launch, Feedback and Launch Stage



Figure 3 : SMART Framework 1.0

**Stage 1: PARI stage: Plan, Analyze, and Research & innovate stage:** This is the first stage, which is divided into five different phases as follows. This would **begin with the planning** for the user experience, conducting its cost benefit analysis. Other phases follow the planning phase.

#### Phase 1: Planning Phase

*a)* Cost Benefit analysis: The cost benefit analysis can be done in prior and the estimation of investment can be determined.

*b) Project plan:* The project plan needs to be developed with the timelines, schedules, budgets and the resources details

#### Phase 2: User Research Phase

a) *Understanding user*: This involves understanding what the user wants and how he wants it.

b) *Design discussion: agreements and disagreements-* The dos and don'ts of the designs are discussed at length.

#### Phase 3: User Centered Analysis

a) User profile, personas, and goals: User profile is a collection of personal data associated to a specific user. Personas are fictitious characters created to represent the different user types within a targeted demographic that might use a site or product. Personas are useful in considering the goals, desires, and limitations of the users in order to help to guide decisions about a product, such as features, interactions, and visual design.<sup>2</sup>

b) *Task Flows and flow charts*: Task flows are a tool to help us think through the design before a feature is actually developed. They allow us to interject the user into the flow of the application and determine if the conceptual model agrees with the user model.<sup>3</sup>

c) *Task analysis:* Task analysis is the analysis of how a task is accomplished, including a detailed description of both manual and mental activities, task and element durations, task frequency, task allocation, task complexity, environmental conditions, necessary clothing and equipment, and any other unique factors involved in or required for one or more people to perform a given task.<sup>4</sup>

d) *Data gathering:* The essential data *for* data gathering is done to study the requirements.

e) *Translation of user requirement into interface design:* After assembling a list of the functionality required of the system to accomplish the goals of the project and the potential needs of the users, the information architecture and interface design begins.

#### Phase 4: Market Research Phase

a) *Socio-cultural /anthropological analysis:* The detailed market study on the socio cultural factors will help enhance the requirement and hence the design.

b) *Branding/Graphic designing:* The branding of the product and service is decided.

Phase 5: Innovation Analysis

a) Listing innovative ideas is prepared

<sup>3</sup> http://www.pathf.com/blogs/2007/03/what\_are\_task\_f/

<sup>&</sup>lt;sup>2</sup> http://en.wikipedia.org/wiki/Persona\_(marketing)

<sup>&</sup>lt;sup>4</sup> http://en.wikipedia.org/wiki/Task\_analysis

#### b) Listing of customer pain point is done

c) Listing improvisation of HCI factor for the customer for that product/service is done

#### **Supporting Processes / Deliverables**

- Project Plan
- User Research Analysis Documents
- Persona/ Profile/ Task flows Document
- Requirement Document
- Market Research Report
- Innovation Idea list post cost benefit analysis

<u>Stage 2:</u> FAWP Stage: Feasibility, Architecture, Wire frame and **Prototyping stage:** This stage deals with the study of feasibility of both technical and non technical factors and further prototyping it. There are four phases in this stage

#### Phase 1: Feasibility Phase

a) List of technical issues is prepared b) Projection of problems and their solution are done

#### Phase 2: Architecture Phase

a) *Task structure:* The technical team is consulted for the task structure and other mentioned factors below and then consensus is derived of the same.

*b) Managing windows in case of thick clients and thin clients* The following design elements should be planned in the architecture phase:

c) Layout

d) Color

e) Presentation

f) Icons/ Metaphors

#### Phase 3: Wire frame Phase

*a) Paper prototyping:* "Paper prototyping is a variation of usability testing where representative users perform realistic tasks by interacting with a paper version of the interface that is manipulated by a person 'playing computer,' who doesn't explain how the interface is intended to work." – Paper Prototyping<sup>5</sup>

b) Creating wire frames: A wire frame is a basic visual guide used in interface design to suggest the structure of an interface and relationships between its pages<sup>6</sup>.

c) List potential issues

<sup>&</sup>lt;sup>5</sup> http://www.paperprototyping.com/what.html

<sup>&</sup>lt;sup>6</sup> http://en.wikipedia.org/wiki/Website\_wireframe

#### Phase 4: Prototype Phase

*a) Proof of concept:* This is done using suitable technology (For e.g. HTML pages for websites)

*b) Design Exploration:* The design is further discussed and improved *c) Technical Exploration:* The technical team is consulted to discuss the implementation of the user experience.

#### **Supporting Processes / Deliverables**

- Technical issue list
- Architecture Document
- Wire frame and potential issues
- Prototype

<u>Stage 3:</u> IVSU Stage: Interaction, Validation, System Feedback and User Assistance stage: This stage deals with the interaction check, validation of the prototype built and then further obtaining system feedback and user assistance to improve the prototype. There are three phases in this stage.

#### Phase 1: Interaction Phase

The following factors are decided to provide user interaction as per requirement:

*a) Visibility:* The system should always keep users informed about what is going on, through appropriate feedback within reasonable time <sup>7</sup>

b) Feedback: The user should get the expected feedback from the product/service

c) Affordances: The word "affordance" was originally invented by the perceptual psychologist J. J. Gibson (1977, 1979) to refer to the actionable properties between the world and an actor (a person or animal). For e.g.: Knobs are for turning is an affordance. According to Norman (1988) an affordance is the design aspect of an object which suggests how the object should be used; a visual clue to its function and use. Therefore affordances should be kept in mind, before moving forward with design.

*d) Mapping:* The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

<sup> $^{8}e$ </sup>) Constraints: The users should have the freedom. Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

*f) Habituation:* There should be consistency for the users to habituate. Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

<sup>&</sup>lt;sup>7</sup> http://www.useit.com/papers/heuristic/heuristic\_list.html

<sup>&</sup>lt;sup>8</sup> http://www.useit.com/papers/heuristic/heuristic\_list.html

#### g) Attending needs of disabled people

#### Phase 2: Validation Phase

*a)* Functionality validation: The user experience is checked for validation of the requirement.

b) Efficiency Evaluation: The efficiency of user interface is further explored

*c)* Task and deliverables validation: The deliverables are validated as per standards

### Phase 3: System feedback & User Assistance Phase

a) User Feedback Report

b) List of insights used as input

c) Feature Review

d) Bug Report Review

#### **Supporting Processes / Deliverables**

- Interaction Design Document
- Test Plan and Test Cases
- Feedback Report
- Bug Report

<u>Stage 4:</u> TUG Stage: Testing, Usability Testing and GUI standardization: This phase involves combining all components to get the whole picture of the product / service to be released. There are three phases in this stage.

### Phase 1: Testing Phase

*a) Functional Testing:* Testing with respect to mapping of requirement *b) Regression Testing:* Testing after changes are made

c) Integration Testing: Testing after components are integrated

d) Performance Testing: Testing of the working performance of product

#### Phase 2: Usability Testing Phase

a) Remote Testing/ Hallway Testing: Testing done with users in front of the experts or at remote location b) Feedback/suggestions

#### Phase 3: Standardization Phase

The standards document is developed with following process

a) Gather Data

b) Screen examples

- c) Brainstorming
- d) Write Standards
- e) Finalization

#### **Supporting Processes / Deliverables**

- Test Suite
- Traceability Matrix
- Test Script
- Usability Testing: This gives direct input on how real users use the system. It includes performance, accuracy, response and emotional response.
- Standard Document

<u>Stage 5:</u> PFL Stage: Pre launch, Feedback and Launch Stage: This phase deals with the pre-launch in which usability testing is done of the product/service and then the final launch and handover is done to the customers. There are three phases in this stage.

Phase 1: Prelaunch Phase

a) Resolution check

b) Browser & OS check

- c) Page load speed
- d) Hyperlink check
- e) Feedback incorporated

Phase 2: Feedback Phase

a) Important Feedback incorporated b) Record the feedback c) Retesting (Regression)

<u>Phase 3: Launch Phase</u> *a) Final Review and approval b) Launch* 

### **Supporting Processes / Deliverables**

Feedback Record

This methodology will provide **an assured release**, which would mean release to stakeholders is of high quality as well as gives an indication to all stakeholders (developers, customers) that the product brings with it an ease of use & hence improved life for users.

### 5 Conclusion

This is a preliminary framework, based on which small projects can start improving a service or product. But to make it scalable to larger extent and for it to be used with software methods, a further carved structure needs to be build. The SMART framework 2.0 will have the statistical implications of how much of each process should be carried for optimally achieving success and how it would differ from industry to industry. The integration of the software and the user experience methodology will also take place at the end of this research. These frameworks when combined will create a SMART methodology.

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# Sustained Service Provider–Customer Relationships in the Indian Context: Factors Influencing the Choice of Touch Points

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Abstract. The construct 'Touch Point', distinct from 'Channel' is proposed, and the outcome of an exploratory study which was aimed at understanding the preference of Touch Points used by Indian customers in various transactions undertaken in their relationship with Banks and Telecom Service Providers (TSP) is presented in this paper. The reasons for the choice were investigated, and it was found that Convenience, Security and Control were the dominant factors both for preferring as well as not preferring a Touch Point. Interestingly, convenience was far ahead compared to the other factors in influencing the choice. There were some surprises, such as very low preference towards Mobile phones and emails as Touch Points. It also appears that customers go through a deliberate process of selecting a Touch Point, rather than selecting one through habit.

**Keywords:** Channel, Touch point, Touch point Ecosystem, User Interaction, Service Relationships, Indian Customers.

### 1 Introduction

Indian customers are increasingly being serviced by firms with the help of a wide range of Touch Points. For instance firms now routinely use apart from the physical outlets, several other Touch Points such as portals, mobile messaging and emails. Some Touch points could be specific to the nature of their business.

Banks introduced ATMs somewhat late, but their acceptance is now widespread in India. Strengthening Internet infrastructure is enabling firms to service customers using Touch Points such as Portals and email. Even the Government owned organizations, like Indian Railways and the power utility services, which largely enjoy a monopoly and are perceived as slow adopters of technology have started using portals for improving the quality of service. The huge acceleration in telecommunications services subscriber base, particularly the expansion and penetration of mobile telephony is providing another set of Touch Points through which customers can carry out transactions. It has become imperative therefore to gather insights about which Touch Points customers choose to interact with the providers and decision criteria for choosing a Touch Point to carry out a specific kind of transaction. No significant research about this subject in the Indian context was found, and hence the need is acute.

### 2 Channel and 'Touch Point': Distinct Constructs

It was felt important to postulate the construct 'Touch Point' to carry out the investigation from the User Experience perspective. While there is abundant research around the concept of 'Channel', no scholarly studies of the construct 'Touch Point' were found. The term Touch Point (or touch point, or Touch-Point etc.) is used by some people and organizations, generally as a commonly understood phrase or defined in specific contexts (Lee, 2007; Brigman, n.d.). It might be noted that the references cited above are from web sites, blogs and trade publications. Rayport and Jaworski (2004) have used the term 'Service Interface' which comes close to the construct.

Probably, the perspectives of researchers in their studies about 'Channel' and channel choice did not demand introduction of the concept of Touch Point. There is however, a need to distinguish between Channel and Touch Point in order to adopt User Experience Design perspective. For instance, several studies that refer to Internet or 'Online Channel' do so with an implied sense 'Web sites or Portals accessed using a personal computer'. However, a portal could be accessed via a mobile device as well. Clearly, the experiential aspects of a Mobile portal are significantly different. It would be quite inappropriate to equate a Mobile portal and a traditional web portal. Another dimension is combination of the 'core' portal functionality with other modes of interaction. For example, a 'Portal' many a times incorporates online chat and the ability to send an email from within the portal itself. These facilities could be used in a single encounter, along with the core aspects of a web portal in a harmonious manner. For example, it was found that when online transactions fail customers chose to contact the provider via email (Holloway and Beatty 2003), probably using a link on the portal itself. However, researchers tend to club together portals and email as 'Online channels' or "Electronic Channels'. Several eCommerce portals extend the boundary of the service encounter, with confirmations of transactions sent as SMS text message. Evidently, it is necessary to recognize the different experiential characteristics such Touch Points have, and it would be inappropriate to club them together simply as 'online channels'. Similarly, studies pertaining to Self Service Technologies (SST) seem to be referring to Touch Points, rather than channels in an

implied sense (Meuter, Ostrom, Bitner, & Roundtree, 2003;Curran, Meuter, & Surprenant, 2003).

An examination of a popular physical banking 'Channel', an ATM, is informative. An 'ATM' in India is often a collection of Touch Points. The machine (ATM) is typically housed in an enclosure that resembles a small shop. Several Touch Points beyond the machine itself are generally available to augment and enhance the service experience. They include, a 'Drop box' in which cheques and common service requests could be deposited, a rack with a supply of forms and stationery, and posters advertising the offerings from the bank. Invariably, a security guard is present, who may on request help the customers in their transactions. The guard is another Touch Point, who provides a personal touch, albeit, not as a formal service offered by the bank! The security guard is likely be perceived by the customers as a 'bank representative'. In the Indian social context requesting help from strangers is an acceptable practice. As such, the importance of such 'informal' Touch Points in enhancing customer experience cannot be ignored. Clearly, a bank customer who visits an 'ATM' could end up interacting with any or several of the Touch Points that form the collection. It is easy to appreciate that an ATM fitted in a wall abutting a pedestrian thoroughfare as found in several countries and an 'ATM' in India have quite distinct experiential attributes. The User Experience of an 'ATM' in India can be designed effectively only if it is deconstructed as comprising interactions with several Touch Points.

There is a good case therefore from User Experience perspective to postulate 'channel' and 'Touch Point' as distinct, though connected constructs, which is the approach adopted in the present study.

The term 'Touch Point' has been defined for the purpose of this study as:

- a. An entity with which a User interacts to perform a transaction aimed at achieving a goal,
- b. OR an entity that plays a mediating role while a User performs a transaction aimed at achieving a goal
- c. The Provider has control on the presence and behavior of a Touch Point

### **3** Relevant studies

Channel' and 'Channel Choice' has been studied extensively in various fields such as Marketing, Financial Services, Banking and in the domain of Human Computer Interactions (HCI). Even though Channel and Touch Point are distinct concepts, the findings of such studies and those concerning aspects such as acceptance of channels, Self Service Technologies, and service experience do provide relevant insights.

It appears that the attitudes towards a specific channel influences global attitude towards other channels, including the self service channels, and that in turn is likely to influence selection of a particular Touch Point, such as ATM and Internet Banking (Curran, Meuter, & Surprenant, 2003). Key perceived benefits of Self Service Technology (SST) are convenience, availability 24 hours a day, ease of use and time saving. However, their continued use and customer advocacy is influenced by the relative comfort with the SSTs (Meuter, Ostrom, Bitner, & Roundtree, 2003). In
addition, enjoyment too seems to be playing a role in motivating customers to use SST (Bitner, Faranda, Hubbert, & Zeithaml, 1997). The choice of such channels seems also to be influenced by role clarity, extrinsic motivation, intrinsic motivation and Ability (Meuter, Bitner, Ostrom, & Brown, 2005). Dabholkar (1996), while investigating Service Quality perceptions of Technology based channels concluded that speed of use, reliability, ease of use, enjoyment and sense of control influence the choice of channel used. All these findings are relevant from Touch Point perspective as well. In a recent study of customer views of traditional and self service modes (Cunningham, Young, & Gerlach, 2009), uncovered an additional factor in favor of self service: reduction in anxiety caused by judgmental service representatives. This finding is pertinent in the Indian context, in which fear of social discrimination can and does influence behaviours. Corroborative, indication of a preference to ATMs exhibited by the people from relatively lower socio-economic class in India has been observed (De Angelia, Athavankar, Joshi, Coventrya, & Johnson, 2004). A South African study also discovered that the semi-literate preferred an ATM to a bank branch (Thatcher, Shaik, & Zimmerman, 2005). It appears that human contact can be both a positive and negative factor influencing the selection of Touch Points.

A study about online banking carried out in Finland revealed Perceived Usefulness, Perceived Ease Of Use, Perceived Enjoyment, awareness of and information on online banking, security and privacy as the factors that have impact on the acceptance of online banking (Pikkarainen, Pikkarainen, Karjaluoto, & Pahnila, 2004). Some of the factors might be applicable to other Touch Points as well.

Patricio et. al.(2003) found in Portugal that major perceived advantages of ATMs was accessibility and speed of performance, while physical security concerns and technical failures coming up as disadvantages. Telephone Banking was perceived as offering convenience and accessibility, and an intermediate level of personal service. The human contact provided by the operator was seen by the customers as an advantage in itself. Branch Banking was perceived as lacking in convenience and accessibility, apart from being considered negatively because of the time loss. Internet Banking was considered as efficient, with higher accessibility, convenience, and time saving, but lacking on perceived security. Discomfort with the technology was one of the negative influences in selecting a channel. It is known form other studies that perceptions about technology are important in customer's choice of channels (Meuter, Ostrom, Bitner, & Roundtree, 2003). Rugimbana (1995) conducted a study in South Australia to assess the perceptual factors influencing use and non-use of ATMs. It is likely that ATM as a Touch Point had not matured sufficiently at the time the study was conducted, and perhaps, the situation could have been similar to that prevailing in India at present. Users perceived ATMs to be convenient, generally easy to use and more compatible with their lifestyles than non-users. These findings supported a profile of the ATM user as being an individual who is younger, better educated, involved in the product/service class. However, the results indicate that peoples' perceptions of ATMs are more powerful predictors of ATM usage than respondent demographic variables. This is consistent with conclusions drawn by Meuter et. al. (2003), who found that demographic variables do not consistently predict the use of Technology based channels.

Only a few studies carried out in India in connection with channel preferences were found. A longitudinal study by Srivatsa & Srinivasan (2007) in the state of

Karnataka, India, revealed that convenience, control and security play an important role in the selection of channels. 'Habit' too was an important factor. Ambivalence towards Internet banking was noted. However, Kamakodi & Khan (2008) found that the urban Indian customers were quite comfortable and willing to use e-banking channels, though security did feature as a concern. At the same time, there was preference for human contact as well. This appears paradoxical, but could be explained to mean that customers may apply different considerations while selecting a Touch Point for different kind of transactions. Though the authors had clubbed together ATM and Internet (presumably Bank portal) as electronic banking, the insights are nevertheless useful.

While financial institutions worldwide have been at the forefront in adopting technology to offer multiple Touch Points to their customers, adoption of ATMs, Internet banking and Telebanking is a relatively recent phenomenon in the Indian banking sector. Consequently, there seem to be a small body of studies focused on customer's preference and acceptance of these Touch Points. The study presented here is a relevant addition to this knowledge.

#### 4 Focus and Scope of the Study

The study focused on two service provider relationships: Banking and Telecom Service Provider (TSP). These are the most common sustained relationships, which involve a range of transactions carried out during the period of relationship. The aspects covered were: a) To identify the range of Touch Points used by customers, b) Understand their preferences and choices of Touch Points for various transactions, c) To obtain a preliminary understanding of the factors that influence their choice. A corollary objective was to identify whether there are any correlations among the nature of transactions, the Touch Points preferred and the factors that influence the preference.

Considering the diversity in India in terms of sub cultures, education levels as well as income levels, it was likely that the usage patterns, perceptions and rationale behind selection and adoption of a specific Touch Point might be different from those in other countries. However, previous research points to Convenience, Control, Ease of use, Security of transaction, Personal Touch, Privacy, Attitude towards bank staff and Habit as the most influential factors. All these have been investigated in this study. Cultural influences, demographic variables and affective aspects were kept out of scope of this study.

Being of exploratory nature, no hypotheses was formulated or tested in this study.

#### 5 Methodology

The study was carried out in two stages: personal Interviews and administration of a self-filled questionnaire. The objective of the interviews was to find the common transactions, interviewees' choices of Touch Points for various kinds of transactions, and the reasons thereof. The findings from this stage informed the development of the questionnaire. The Questionnaire was in Microsoft Excel<sup>®</sup> format, and was sent by email. The form provided drop down lists form which the respondents chose a single option. In order to reduce the chance of error, pop-up tips and clarifications were embedded. The questionnaire included seven most common transactions pertaining to each relationship (e.g. 'withdrawing cash' and 'opening a fixed deposit' in banking, and 'Pay bill' and 'change subscription plan' in TSP relationship). Against each, the respondents were asked to select from a list of Touch Point:, the most preferred and the least preferred. An option 'Other' was provided, and if selected, the respondents were asked to mention what the 'other' Touch Point was. The respondents were asked to fill the single most important consideration for preferring and not preferring a Touch Point for that particular transaction. The factors to be investigated (see above) were embedded as positively worded and negatively worded statements (e.g. 'I feel secure' and 'I do not feel secure').

The population of interest for this study was all adults who use multiple touch points to transact with their service providers (Bank and Telecom Service Provider). Snowball sampling technique was used, with the initial respondents (10 numbers) drawn through purposive sampling from the intended population. They were in turn requested to send the questionnaire to at least ten additional respondents of their choice, encouraging them to select those with varied profiles. No control was exercised on this part of sampling. Participants were assured confidentiality and were given an opportunity to decline to participate in the study.

The questionnaire (probably) reached around 110 respondents. 94 semi-anonymous responses were received (though their email id was seen, no additional details to establish the identity were available). The exercise resulted into a sample size of 87 (Male = 56, Female=31), after rejecting substantially unfilled questionnaires. The entire sample comprised of educated people and the respondents largely came from urban areas – metros and large cities. The respondents were mostly comfortable with technology.

The minimum education level was 15 years (Graduates, as it is called in India). The majority (60%) of the population came from the age group of 25 to 35, with another 20% coming from the age group of 35 to 45. Distribution was somewhat biased towards males.

A large proportion (83%) of the respondents had Internet connection at home.

#### 7 Result and Discussion

**Touch Points and the reasons for preferring or not preferring them**: Looking at all the transactions, for all providers that were studied, The top three reasons both for preferring and not preferring a Touch Point pertained to the same factors, found to be in the order – Convenience, Security and Control.

Table 1. Reason for preferring a touch point- global view					
Rank	Reason for Preference				
1	It is convenient	58%			
2	I feel secure	12%			
3	I feel in control	9%			
4	4 I want to deal with human beings				
5	It is easy to use	7%			
6	Some other reason	3%			
7	Because of experience with the staff	2%			
8	Just habit!	1%			
9	I value privacy	0%			

Table 2. Reason for not preferring a touch point- global view				
Rank	Reason why not Preferred			
1	It is inconvenient	37%		
2	I do not feel secure	20%		
3	I do not feel in control	14%		
4	10%			
5				
	7%			
6	It is not easy to use	5%		
7	I miss the human contact	4%		
8	I have concerns about privacy	4%		
9	My discomfort with the			
	technology	1%		

It is interesting to note that Convenience (58%) is far ahead of the next factor, Security (12%), in determining the preference. It can be inferred that the perception about security of Touch Points is fairly positive, and the customers may largely be taking it for granted. However, feeling of Security seems to be playing a significant role in not preferring a Touch Point. It may be noted that this was in response to the question that asked for the least preferred Touch Point. Therefore, one can conclude that if providers want to improve the perception of 'security', they need to identify those Touch Points that are currently lacking in conveying the sense of security. Technology comfort did not appear to play a role in determining the preference of a Touch Point. One possible reason is that the prevailing design of technology based Touch Points such as ATM and Portals do not demand significant aptitude towards technology. Need for human contact did not seem to play a significant role in preferring a Touch Point (ranked 4th reason, at 8%). This is contra-intuitive, considering the social and culture milieu in India. One may venture to conclude that the at least those belonging to urban, educated population which formed the sampling frame, are quite comfortable with Self Service Touch Points. Privacy seems to play an insignificant role as far as Touch Point preference is concerned (close to 0%), and as a negative influence as well (4%). Possible explanation might be rooted in the Indian culture, where privacy is not a primary consideration in social life. The finding is consistent with the study about use of ATMs in India (De Angelia, Athavankar, Joshi, Coventrya, & Johnson, 2004). Habit also does not play any role, and it appears that at least the educated, urban Indian is open to trying out and even preferring new Touch Points. Also, it seems likely that customers go through a deliberate process of decision making before choosing an appropriate Touch Point to carry out a specific transaction.

Table 3 : Reasons for preferring a Touch Point - Banking					
Rank	Reason for Preference	Total			
1	It is convenient	62%			
2	I feel secure	14%			
3	It is easy to use	8%			
4	4 I want to deal with human beings				
5	I feel in control	6%			
6	Some other reason	1%			
7	Because of experience with the staff	1%			
8	Just habit!	1%			
9	I value privacy	1%			
	100%				

Table 4 : Reasons for not preferring a Touch Point - Banking					
Rank	Reason why not Preferred	Total			
1	It is inconvenient	41%			
2	I do not feel secure	23%			
3	I do not feel in control	10%			
4	4 Some other reason				
5	It is not easy to use	5%			
6	I have concerns about privacy	5%			
7	Because of experience with the staff	4%			
8	I miss the human contact	2%			
9	9 My discomfort with the technology				
	Grand Total	100%			

Looking at banking, interestingly, Ease of Use comes at the third place in determining the preference for a Touch Point, while sense of control retains the third rank in influencing why people do not prefer a Touch Point. However, when it comes to Telecom, sense of security lost it importance. Instead, sense of control has been ranked as the second most important positive and negative influence. A possible explanation could be that most transactions in this relationship, barring payment of bills, are not financial in nature. It can be inferred that the nature of transaction plays a role in determining the importance of factors that are considered while choosing a Touch Point.

Preference of Touch points (Banking) for various transactions: ATMs were preferred the most because of convenience (86%) and next because they were easy to use (4%). For the most common transaction done at an ATM, namely Withdrawing cash, 81 of 87 respondents preferred an ATM for withdrawing cash, while only 5 preferring the bank branch counter. Interestingly, of these five four gave the reason as "I feel Secure".

When it comes to Depositing a Cheque, ATM is one of the least preferred Touch Point (only 6% preferring it), while a Drop Box at the ATM is one the most preferred one (30%). One reason could be some models of ATM do not have the facility to deposit cheques. Also, it is likely that people find the process of depositing a cheque in an ATM to be cumbersome, even though an ATM may provide a better sense of security. At the same time, a drop box collocated with an ATM, possibly conveys a sense of security. This is corroborated by the finding that a drop box located at other places is not preferred (4%). It is apparent that ATM plus a drop box that is co-located work best together to support the most common and frequent transactions, namely withdrawing cash (77% reported carrying this out few times every month) and depositing cheques ( 22% reported doing it at least once or twice in a couple of

months). This strengthens a view that it may be beneficial to address Touch Points as parts of an ecosystem.

A miniscule 3% of respondents reported preferring Mobile banking. The preference towards emails as a Touch Point was also negligible (2% of all instances). This is despite the fact that all the respondents had at least one email account. One would expect that at least for transactions such as finding information, getting queries resolved or complaining, email could be an important Touch Point. It is interesting that those for whom email was the least preferred option for these transactions; the main reason was 'not being in control' (36%).

Bank's Portal is one of the main preferred Touch Points, for convenience as the reason (82%). However, it is also not perceived as secure. Among those who did not prefer it, 41% stated perceived (lack of) security as the reason. This is corroborated by the fact that for opening a Fixed Deposit it is the least preferred Touch Point for security considerations. An indirect corroboration too comes from the data. For 47% of the respondents, it is the most preferred Touch Point for finding information, which can be considered as a low risk transaction. The observations are consistent with studies referred to earlier, such as that by Pikkarainen et. Al (2004)

Counter at a bank branch, the most traditional Touch Point, still turns out to be the preferred Touch Point for certain kind of transactions in spite of being perceived as highly inconvenient. For example, for opening a fixed deposit, it is preferred by 74% of the respondents and 43% respondents preferred it for depositing a cheque. They also preferred it to complain about something (46%) and for Query resolution (30%). It appears from the data that apart from the sense of security that this Touch Pointy conveys, it fulfills the perceived need to deal with human beings and gives the customers a sense of control. It is likely that the terms 'query' and 'Information' may have deeper meaningwhen it comes to dealings with a Bank. Perhaps there are underlying aspects such a complexity of the 'query', open ended resolution, need for privacy and so on. One can draw the inference that Bank Branch is still an important Touch Point, and arguably will remain so in the foreseeable future. It has to be given due importance in the design of Touch Point ecosystem.

Call center seems to be a preferred Touch Point where convenience matters to the respondents (68%).

**Preference of Touch points in Telecom Service Provider (TSP) relationship for various transactions**: The top two preferred Touch Points for all transactions taken together were the call center and counter of the provider's outlet, being preferred for 37% and 17% times respectively. The call center is perceived as the most convenient (43% of all transactions where convenience was the criteria), and the Portal comes the next (17%).

Call center was largely the most preferred Touch Point except for payment of bills. It appears that TSPs have developed this Touch Point well and the respondents found to be most effective. The next best option was the Provider's outlet (17%). The primary reasons were: Security (53%), feeling of control (27%) and need for human contact (26%)

Payment of bills stands out as something where convenience appeared to matter the most, with 65% mentioning that as the reason for preferring a Touch Point. Security is the next reason, though much lower, with 15% reporting that as the main consideration. Payment of bills also includes topping up for prepaid mobile phone

subscription, which is a near zero risk transaction and for which the franchisees might be the most convenient Touch Point.

Convenience was the most important reason for selecting a Touch Point in TSP relationship. Security turned out to be much lower in importance. It is apparent that the nature of transactions is playing a major role. Probably the only transaction involving money, done by almost all the participants is paying bills. For any transaction in TSP relationship the financial aspect, if it does exist, involves modest sums, and the risk perception is likely to be lower. Since TSP relationship transactions do not involve large sums, their relative frequency was used to determine their importance to the customers, as well as to check if any grouping is possible to gather additional insights.

Two tailed Pearson's correlation was performed to check if the grouping of transactions indeed has strong commonality of reasons for preferring and not preferring a Touch Point. It was found that there is a significant positive correlation R (87) = 0.366, p <0.01 between 'add new services' and 'obtaining another subscription', R(87)=.454, p<.01 between 'changing the subscription' and 'obtaining another subscription' and R(87)=0.366, p <0.01 between 'changing the subscription' and 'obtaining another subscription' and R(87)=0.366, p <0.01 between 'obtaining another subscription' and 'adding new services'.

The reasons for preferring and not preferring the Touch Points for the transactions getting a query answered and complaint resolution were analyzed, after excluding those, who have never done one of the transactions. We found the Pearson's correlations as R (74) = .506, p<.01 for preference and R (74) = .593, p<.01 for not preferring.

It seems the frequency of transaction may have an important role to play in the selection of Touch Points. There appeared to be a distinct preference towards human mediated Touch Points for the infrequent transactions. It is therefore intriguing that need to deal with human beings was not mentioned as the reason for preferring them, but convenience was the primary criteria here too. It is likely that the availability of and access to human mediated Touch Points is so good that the respondents took the 'human contact' for granted, and convenience was at the top of the mind.

#### 8 Conclusion

Convenience, need to feel secure and need of control on transaction are clearly the top criteria in banking relationships. However, it is interesting that, Habit does not seem to play an important role. This may be because of the education level of the respondents, but possibly with the proliferation of Touch Points, the Indian customers might also be now more open to embracing new ways to carry out transactions. Since Habit was not a significant consideration, it is likely that the decision to use a Touch Point could be a conscious process, in which the pros and cons of using a Touch points as well as the situational factors may play a role. Further investigation in this regard could provide useful insights.

It has been established clearly that for transactions that involve perceived risk, Bank branch counter is the preferred option. While preference for 'Personal' channels for such transactions has been noticed in some studies (Black, Lockett, Ennew, Winklhofer, & McKechnie, 2002), interestingly, the bank's representative did not turn out as a preferred Touch Point. Considering that such representatives offer high level of flexibility and convenience in servicing the customers, this finding should cause surprise. It appears that the 'Brick and Mortar' and 'Institutional' attributes are relevant. For reasons of cost and perhaps, efficiency Indian banks are promoting a range of self service Touch Points. While those might indeed be convenient, and in general perceived as adequately secure, all of them do not appear to be adequately addressing the customers' perceived the need of security. It has been indicated earlier that if providers want to improve the perception of 'security', they need to identify those Touch Points that are currently lacking in conveying the sense of security. It was found that the Drop Box at an ATM and that at the Branch are preferred Touch Points for depositing a cheque. However, drop boxes at other locations at not preferred. Even though the primary reason mentioned was convenience, it is possible that the customers implicitly perceived as secure the Touch Points that provided strong cues of being part of the Bank.

Most banks in India offer mobile banking facility and promote its usage. It would be worth investigating the apparent lack of diffusion of mobile banking in spite of the huge penetration of mobile phones. In fact, Mobile banking does not seem to be in the consideration set of the users. The data collected in this study is insufficient to draw any insights, and further study in the usage (or lack of it) of Mobile banking and the reasons is indicated.

Banks use emails extensively to engage with the customers, and their portals too mention an email ID to which one could write. Therefore, the apathy towards email as a Touch Point is worth studying further. One may conjecture that it has to do with the maturity and promptness with which the email communications from the customers are handled by the banks, as well as because of the nature of the Touch Point and its design. The banks and other service providers may benefit from a better understanding of the reasons.

In case of TSP transactions, there is a marked preference towards human mediated, physical Touch Points for transactions carried out infrequently, but on the grounds of being convenient! The inconsistency can surely be probed to gather potentially important insights. It is likely that for these transactions customers perceived need to deal with human beings and they have simply sought the most convenient amongst human mediated Touch Points – call center or physical outlets. It is seen that TSPs have a truly large number outlets and franchisees, so it may be correct to suppose that that visiting one is not inconvenient at all.

The apathy towards using Mobile (SMS, Mobile Banking) and email has been commented upon earlier. Due to their easy access and near universal adoption as predominant modes of communication, ideally these Touch Points can play a significant role in the Touch Point ecosystem. These Touch Points are already used widely in provider initiated communications or as means to effect closure of transactions. There can be a conjecture that in case of Mobiles, the form factor and in case of mail the open ended – free format nature of the communications might be causing the hindrance. Portal, one of the most important self service Touch Points, is not preferred for financial transactions, mainly for perceived security concerns. These concerns might perhaps be unfounded in view of the prevailing encryption and security technologies. Minimum levels of encryptions are now mandated by law as

well. It is likely that this is an awareness issue. Also, it could be a design challenge, namely, how to convey the sense of security to the customers so that they are encouraged to use the Portals more.

The statistical analysis indicates a potentially beneficial approach in designing Touch Points. Based on the statistical evidence it appears feasible to identify groups of transactions based on the concerns or considerations users may have. This was noticed both in Banking as well as TSP transactions. Obviously, every Touch point will not be able to support all transactions. However, it should be possible to design a combination of Touch Points operating as an ecosystem that addresses the concerns and considerations pertaining to the group of transactions. The design of individual Touch Points and the ecosystem can provide the necessary cues, operational features and user experience that convince a customer that the concerns are indeed being addressed. ATM plus Drop Box, in an ATM enclosure is a good example of a combination which addresses the consideration of convenience, security and ease of use that supports two most frequent transactions – withdrawing cash and depositing a cheque. This approach is particularly relevant for encouraging self service, and should be validated through further study.

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# Graphic interfaces for sales interaction : a case of a consumer choosing colour for a product

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Abstract This paper reports usability issues that arose during an attempt to conceptualize a series of screens for allowing a consumer to choose the colour of a bicycle on the screen before placing an order for it. A palate of square grids was suggested. This was modeled on commonly adopted color specifying software programs used by designers. A survey of respondents' reactions to this square grid GUI indicated that there are two extreme ends of a solution spectrum. On one end, if the choice of available colours is basic and few in hues, the interaction is quick and easy but the probability of the consumer being not fully satisfied at the end is observed. On the other end of the solution spectrum - if a complex colour grid is incorporated the consumer may get confused and feel challenged to exercise his / her colour choice. The answer probably lies in between the two ends of the solution spectrum. It is suggested to use Fuzzy logic based intelligent or smart GUIs that adopt to the individual user at every click and address effectively the 'affective' component of the needs of users making choices on a GUI.

#### **1** Introduction

Interacting through computer screens has become all pervasive. Web commerce affords making personalized choices while ordering products by a consumer. The 'one to one' GUI interaction at the sale point, be it online or in show rooms, converts a nameless 'consumer' into a live emotional interacting 'user'. What seems to be a case of simply choosing from a given set of alternatives is not as satisfactory as it is assumed especially when elements such as colour, are involved. Choosing colour is a very personal as well as a cultural issue involving emotions, feelings, tastes and fashion trends. All these involve 'affective' components both for the designer as well as for the user.

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Manufacturers of products are now offering self customizable products under the label of 'participatory design'. Design elements such as colour, graphics, texture etc are allowed to be decided by users themselves. Automobile companies are attempting to recreate the entire experience of driving the car as well as 'fell' the interior trims on virtually platforms before a consumer can make a final choice. How does one approach the GUI for such an interaction? What degree of freedom can be afforded to exercise the choice? Should the consumer be allowed to self operate the GUI. How many variations are too many or too less for a user to exercise their choices especially when there is an established relationship between the design element and users' emotions. While on the one hand the available colour range for a given product can be limited due to manufacturing and cost constraints the user's emotional needs are to be satisfied at the decision making stage. An element of fun and freedom of choice needs to be built in such point of sale GUI interaction.

In this paper usability and interactivity issues that arose during an attempt to conceptualize a series of screens for allowing a consumer to choose the colour of a bicycle being ordered by the consumer are reported. The task was to encourage a consumer to explore and determining the colour choice for a bicycle on the screen before placing the order for it. In an initial GUI concept a palate of square grids was incorporated based on what is commonly used in color specifying software programs frequently used by designers. A survey was conducted involving 17 respondents in order to find out the usability issues of the square grid type of colour palate.

#### 2. Colour as a design element in marketing of products

Colours are universal but their choices are not. Colours have different meanings in different cultures. For example yellow coloured flower means death in Mexico. In France yellow is profanity and in Iran it connotes hate! [1]. Any manufacture intending to cater to an universal market cannot standardize product features that involve affect and cultural background of its consumer. It is widely reported in Design literature that consumers perceive color and form through different emotional filters that have roots in cultures.

In a case of a bicycle manufacturer [2] in Iran there are 38 different models of bicycles on offer. They include mountain bikes, city bikes, racing bikes, folding bikes, ladies bikes, tandem bikes and tricycle carriers. Apart from Iran the company has offices and sales outlets in three different countries with differing cultural practices. This manufacturer has market sales data that indicates a wide difference between geographical regions as far as colour preferences are concerned. For instance consumers in northern part of Iran who live by the Caspian Sea and close to the forest prefer green, blue, red and yellow, but people from the south of Iran living by the side of mountains and deserts prefer colours like black and shades of grey. Consumer preferences, attitudes and beliefs can be used to predict their buying behavior. [3]. However tastes and fashion trends being adopted by consumers are rapidly changing due to media exposer [4]. Therefore available buying behavior data may or may not be valid at the point of purchase or decision making. Consumer choice is affected by communications, ambiance and imagery that is constantly being bombarded by

media. [5]. Hence a consumer, if allowed to exercise the choice of a colour for a product, may indicate a very personal choice which may or may not match with the one based on predictions which in-turn is based on collected behavioral and cultural marketing data. This also has an effect on the range of choices that a consumer may need, so as to make a satisfying decision about a colour. A consumer may also want comparative visual stimuli and imagery to make a decision especially in the case of colour.

#### 3. Evaluation of a GUI concept for choosing colour for the bicycle.

In order to understand various usability issues that may be involved in conceptualizing a useable, emotionally sensitive (to the consumer) interactive GUI screen – a flash based prototype was executed (Fig 1, Fig 2). This prototype was intended to be used for heuristic evaluation. (Please note the English terms shown in fig 1 & 2 are a direct- exact translation of the local Iranian language instructions as they appear on the site).

Fig 1. First prototype screen for choosing the cycle model.



Fig 2 Second prototype screen for choosing the colour.



#### **3.1 The evaluation procedure**

Seventeen (17) subjects were involved in evaluating and testing the prototype. The age ranged between 20 and 28 years. Seven of the seventeen subjects were females out of which one was married. The subjects were asked to first chose one of the four cycle models (on the computer screen) which they wanted to buy and then were asked to decide on the colour they wanted from the second screen that came up after they selected their cycle model.







Fig 3 Users being tested at the IITG Useability laboratory.

The number of trails each subject tried out before being satisfied with their colour choice was noted down. They were also asked to write down on paper their general comments as to how easy it was, confusions if any, if there were any operational aspect they did not like or did not understand; what other method would have been better. The results have been summarized in the table 1 bellow.

Number	Gender	Age	Field	Job	Originally From	iser's Ipinion
1	М	21	B.Des Design	Student	Indore, MP	The idea is good to chose or assemble a bicycle. You can sort out colors according to their feel like yellow for sporty. That would have helped. You can add graphics on bicycles apart from colors .I could not find my last selection
2	F	21	B.des Design	Student	Bhopal, MP	While choosing the colors, I may like to eliminate few colors that I don't like (for e.g. green or yellow) at the initial level itself.

Table 1. Results compiled

3	F	20	B.Des Design	Student	Rajasthan	You can categorize the colors according to different activities like sporty colors, activity colors, girlish
4	M	30	PhD CS	Research	Andhra Pradesh	Buffer to keep track of all the previous colors selected. Is required
5	М	28	PhD CS	Research	Tamil Nadu	Too many colors were confusing. May be you can let people choose the major 3 colors and then go for variations or shades of them.
6	F	25	M.Tec.CSE	Student	West Beng	Can't find the color I want.
7	М	24	B.Tech CSE	Software developer	Bangalore	Range of Choice of colors is good. The interface was usable. It helped me test all the colors with the bicycle look & feel. However I could not remember which one was more appealing in the process of trying outall
8	М	23	M.Tech CSE	Student	UP	I think it easy to choose colors. Because in case of bicycles colors like brown, white and some light colors are not good in my sense. I think all the work is good and model was also good.
9	F	32	M.Tech CSE	Teaching	Assam	There is no difficulty for color selection. All colors are of good choice and out of trial and error method any one can choose a suitable color of choice.
10	М	18	B.Tech CSE	Student	Chennai	There is no difficulty in navigating through the page, I would like to have the whole spectrum of colors made available to me so that I can chose the particular shade of color I am fond of
11	М	20	B.Tech Chemical Eng.	Student	New Delhi	There is no problem in selecting the color of the bicycle and also gives a vibrant choice of colors. The 4 cycle designs presented are quite good also.
12	F	20	B.Tech (CSE)	Student	Guwahati	The webpages are made in an interesting form. There is no problem in going through the pages. The color choice indicator is good too
13	F	26	P.hD Bio technology	Researcher	Kolkata	The page is made interestingly. It is easy to choose product from this page. The colors number may be decreased so that customer won't be puzzled for choosing colors.
14	F	23	-	Housewife	Assam	I am confused through out the selection procedure. May be I was not sure of what I like
15	М	22	B Des	Student	Guwahati	It will be great if from pure color, I can select a shade and then the color which I choose can show various shades of that particular colors.
16	M	21	M Des	Student	-	First I need to see color in different Setup such as sporty, rich look, simple only then I can be sure.

#### 3.2 Generating Useability Heuristics

The comments of the respondents in table 1 along with the number of clicks were further rated by the authors using useability factors such as (a) Learnability ; (b) Efficiency; (c) Memoriability ; (d) Intuitive interactivity ; (e) satisfaction.

Each respondent's expressed opinion was carefully examined for prevalence of each of the above factors and they were either included or excluded under each of the five factors as shown in table 2. For example for respondent number 5's opinion - "Too many colors were confusing...." It was inferred that there was no difficulty in learning the operations of the GUI as he could operate it intuitively and understood

what he was doing -therefore under learnability factor in table 2 a tick mark was put. The respondent was confused and did not find the GUI efficient to operate. Therefore a cross mark was put under efficiency in table 2.

Table 2. Evaluating Useability Factors

Number	User's Opinion	Number of trials before finalizing colour	Learnability	Efficiency	Memorability	Intutive Interactivity	Satisfaction
1	The idea is good to chose or assemble a bicycle. You can sort out colors according to their feel like yellow for sporty. That would have helped. You can add graphics on bicycles apart from colors .I could not find my last selection	7	$\checkmark$	X	X	V	V
2	While choosing the colors, I may like to eliminate few colors that I don't like (for e.g. green or yellow) at the initial level itself.	14	$\checkmark$	X	X	V	V
3	You can categorize the colors according to different activities like sporty colors, activity colors, girlish colors, old people colors.	10	V	X	X	V	V
4	Buffer to keep track of all the previous colors selected. Is required.	17		X	X		$\checkmark$
5	Too many colors were confusing. May be you can let people choose the major 3 colors and then go for variations or shades of them.	15	$\checkmark$	X	X	V	V
6	Can't find the color I want.	23	$\checkmark$	X	X		Χ
7	Range of Choice of colors is good. The interface was usable. It helped me test all the colors with the bicycle look & feel. However I could not remember which one was more appealing in the process of trying outall	22	$\checkmark$	V	X	V	V
8	I think it easy to choose colors. Because in case of bicycles colors like brown, white and some light colors are not good in my sense. I think all the work is good and model was also good.	8	V	V	V	V	V
9	There is no difficulty for color selection. All colors are of good choice and out of trial and error method any one can choose a suitable color of choice.	8	V	V	V	V	V
10	There is no difficulty in navigating through the page, I would like to have the whole spectrum of colors made available to me so that I can chose the particular shade of color I am fond of	8	$\checkmark$	V	V	V	V
11	There is no problem in selecting the color of the bicycle and also gives a vibrant choice of colors. The 4 cycle designs presented are quite good also.	8					
12	The web pages are made in an interesting form. There is no problem in going through the pages. The color choice indicator is good too	1	V	V	V	V	V
13	The page is made interestingly. It is easy to choose product	9		X	X		

	from this page. The colors number may be decreased so						
	that customer won't be puzzled for choosing colors.						
14	I am confused through out the selection procedure.	9	$\checkmark$	Χ	Χ		Х
	May be I was not sure of what I like						
15	It will be great if from pure color, I can select a shade and	10	$\checkmark$	Χ			
	then the color which I choose can show various shades of						
	that particular colors.						
16	First I need to see color in different Setup such as sporty	12	$\checkmark$	Χ	Χ		
	, rich look, simple only then I can be sure.						
	TOTAL		16	6	6	16	15
	Percentage		100	37.5	37.5	100	93.7

Fig 4. Graph of evaluated useability factors



#### **3.3 Observations**

The overall result of the heuristic evaluation is depicted in the graph in Figure 4. From the graph one can infer that the majority of users did not find it difficult to learn to operate the GUI. The GUI was highly inefficient as it contributed to confusion in 65 % of users as far as colour decision making was concerned.

The GUI was also overloading on the memory of the users as only 37.5 % were able to remember their previous selections. The GUI was clearly not aiding the respondents in retaining their previous selections/colour choices made.

The GUI was found easy to interact with intuitively. This is so due to the high familiarity of the respondents with computers. The same cannot be said of a consumer unfamiliar with computer screens. While the GUI was found as satisfactory by the respondents, it cannot be ascertained as to which particular set of feature in the GUI contributed to this. The satisfaction rating could also mean satisfaction at completing a task successfully rather than satisfaction of the processes it self. It need not necessarily reflect on the overall satisfaction. The number of subjects is too small to make a conclusive inference but is sufficient enough to indicate presence of major useability issues.

The following can be inferred from the heuristics analysis findings:

(a) Number of colours need to be restricted to avoid confusion or memory loading.

(b) Need for incorporating a ' bin' to pick up and store colours and eliminate the unwanted ones from the screen to avoid confusion so as to be able to narrow down the choice.

(c)Improve the context for choosing by incorporating visual ambiance that encourages trying out colours on the product without fear of having to loading memory for comparisons.

(d) Provide a culturally congruent platform that allows playful exploration in a qualitative way along with a quantitative catagorisation of colour.

#### 4. Use of Fuzzy logic for aiding colour selection.

Colour theory in literature indicates two main approaches to studying colour namely the physics based Newtononian approach and the traditional perception & feelings based Aristotelian approach. [6]. The Newtonian approach is more evident in the GUIs of software programs dealing with designing applications such a s photos, illustrations, 3D modeling etc. The colour wheel, the RGB palette, etc are examples of the colour element applications in such software packages. The mixing of colours is effected by moving sliders the result of which is seen in a new box or by making a choise from a geometrically arranged grid of colours.

The Aristotelian approach to GUI – involving art, feelings, emotions etc are rarely incorporated into GUIs.

From the user point of view who has limited understanding of graphic colour theories the Newtonian type of GUIs are operable in terms of 'cliks'. However seldom does a user think of colour in isolation of the Form on which it is applied. A consumer who is a user has no scope of associating emotions and feelings in the grid like Newtonian GUI interfaces for colour. Colours are seen not existing as different independent hues in isolation but as mixed integral manifestation of qualities of material objects and nature. Colours have association with moods and personalities. They also have physiological implications [6]. In the Aristotelian approach one can hope for 'application' of colour rather than 'clicking' of colour as in Newtonian GUIs. Dimensions of the colour element such as Hue, Tint, Chroma, tone and value are to be understood not only in terms of their underlying Newtonian physics but also in terms of moods, feelings, and psychological effect – all put together as 'affect'. Fine arts literature for instance disuses colours in terms of 'romanticism, impressionism, modernism' but GUIs affording interactions on the 'romantic' plane or the Autum, Summer, Rainy season context are not usually found in computer applications programs. It is precisely this Aristotelian approach that is likely to be more useful and useable for a common user who wants to emotionally decide on a colour preference as a consumer.

Fuzzy logic systems [7] afford an advantageous possibility to blend in both qualitative as well as quantitative aspects of colours given the computing environment. Much of this is already in use in computing environments but it happens behind the interactive screen. Choosing colour involves uncertainty, approximate reasoning and comparative decision making . Fuzzy logic provides a

remarkably simple way to draw definite conclusion from vague, ambiguous or imprecise information being input into a fuzzy system. Fuzzy logic resembles human decision making with its ability to work from approximate data and find precise solutions. Newtonian way of doing things match the Classical or Boolean logic which has two values or states often expressed as 'yes or no', 'true or false', 'on or off', '0 or 1'. which are easily ' clickable'. Yet in the real world situations are not black or white but involve shades of gray. These shades of grey can be described and interacted with, using Fuzzy logic. The concept of fuzzy logic controls is based on "chunking" human thinking in terms of feelings rather than precise mathematical computation. It is very appropriate for dealing with colour which is a physical quantifiable element as well as a qualitative feeling and emotion involving element. The challenge for Useability HCI designer dealing with the element colour is how to visualize a GUI that is a blend of Aristotelians as well as Newtonian approach.

#### 4.1 Proposals for new GUI

The Taxonomy of HCI interactions involve all the three domains namely Cognitive, Affective and Psychomotor domains. The Affective domain of a user's interaction involves receiving information (appreciation) Responding (interest) Valuing (formation of attitude) Orgainising (feelings, emotions of the self) and finally acting to satiate the cycle.

This means that the first GUI screen needs to provide a qualitative experience of evoking emotions. It is proposed to use nature landscape scenery as one of possible evokers. In addition a butterfly iconic panel is being proposed. These two qualitative interactions wherein the user needs to chose preferred scenes as well as the butterfly to start with. It is proposed to use Fuzzy logic to come up with customized colour palate in the second screen. It is proposed to have a backend fuzzy logic program that will be smart enough to show hues, related shades & tints surrounding the users colour preferences as captured by the first two screens. Wire frames of the proposed GUI are under development and are as shown bellow.



#### 5. Conclusions

On one end, if the choice of available colours is basic and few in hues, the interaction is quick and easy but the probability of the consumer being not fully satisfied at the end of the decision processes is observed. On the other end of the solution spectrum - if a complex colour grid is incorporated the consumer may get confused and feel challenged to exercise his / her colour choice. The answer probably lies in between the two ends of the solution spectrum. A fuzzy logic based qualitative cum quantitative GUI is proposed.

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### Culture-Cognition Connection and its Relevance for Designing Web-based Educational Products in Indian Context

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**Abstract.** As the educational paradigms in India shift from the traditional classroom framework towards the information and communication technology framework, success in school education will heavily depend on the quality of the web-based educational products and the cultural and social relevance of the e-learning objects and tools. Learnability and navigability of the instructional modules will have to be integrated with the mental models, learning styles, and emotional profile of children from diverse socio-cultural backgrounds. The paper is an attempt to study the current educational websites/portals in terms of their user interface and interaction style features, attributes and properties. Also an attempt has been made to know what kind of preferences, choices, plans and strategies school children possess and bring to the context of using/consulting educational web sites and portals and how cultural and contextual variables influence these mental abilities.

**Keywords:** eLearning, Instructional design, Socio-cultural environments, IT and education, Usability in Cultural Context, Interactive Environments, Computers and Indian Children, Website Usability.

#### 1 Introduction

Cultures put different kinds of premium on different sets of skills and knowledge forms to ensure that the society stays intellectually productive and creates adequate employment opportunities in the society. A proper investigation into the cultural characteristics in education in India should be done to guide the design of user interface for educational web sites/portals. The current study is an attempt in this direction. The study is an explorative kind and one of the key objectives has been to know how culture colors cognition particularly at school level and to look for justification for incorporating the culture-cognition association in the design of educational websites for Indian school children. As part of this research plan a preliminary level investigation has been done to know in current situation how and in what manner the educational web sites and portals are being used by upper primary (6<sup>th</sup> to 8<sup>th</sup> graders) school children in various urban areas in India. This investigation is

supposed to give an account of users overall experience while negotiating with interface and interaction styles and features of the existing educational websites/portals.

We are living in the times where the only constant is change. Change is ubiquitous and in current times it is felt more so in the education domain. Technological advances and their ever-increasing ubiquitous nature create the challenge of how users distributed across different contexts, realities and dynamic conditions of life will accept the change in all kinds of products and services available to them. It is interesting to know also what do people do to blend with this all pervasive change in product, process, and services. Information technology is fundamentally transforming the way people learn and teach. After numerous deliberations on its pros and cons amongst the policy-makers [23], educationists, and various other stakeholders and benefactors of the academic environment, technology has entered the once inpenetrable traditional Indian classrooms. The initial euphoria accompanying this process, however, is now giving way to an increasing level of concern, discontent and confusion over the dissemination of instructional material to the students for whom it was initially acquired. The progressive intentions behind such a step are marred by human or material constraints and restrictions, such as, lack of motivation to learn or intention to use technology for teaching by the instructors [1], lack of essential resources or infrastructure to support and maintain the technology, or lack of appropriate and cost-effective instructional material.

Under various government schemes, the computers are delivered to the schools, but either the power supply eludes the school premises [31, 32, 33], or the instructors show reluctance to adoption of new technology or change in their teaching style and habits [34, 35, 36]. At times the instructors too have mental blocks in acceptance of technology [1] as an aid to teaching; as they are way too accustomed to the rote convergent/traditional modes of training [2] and hence are not open to experimentation with the divergent or other alternative modes learning which may be more interesting and captivating for school children. Studies evaluating technology integration in various educational settings by researchers in other nations, [3, 4, 5, 6, 7, 8] also report inadequate integration of information technology within the educational scope, with obstacles somewhat similar to those faced by the educational environments of India.

As indicated by instructors from various government and private schools in Ahmedabad, Chandigarh, Bangalore, Durgapur, Kanpur, and Bhubaneswar, with whom the researcher/s talked to personally, some of the major issues involving the available instructional material are: (a) Most of the material made available to them is in English, making it difficult for those children who aren't quite adept with the language to understand the content. (b) The Americanized accent of the instructions or the voice-over further complicates the issues. (c) It is difficult to adapt the learning materials into the regular curriculum unless enough exposure is given to children for easier adaptation to technology, which becomes difficult given the material and financial constraints in budgeting for IT by various schools. (d) The instructional material lack relevance to the social life of the children, or lack instructions as to how to connect the specific learning module to the social or cultural environment of the child. Sometimes the activities or examples provided in the content lack even the Indian context. (e) Lack of consideration towards the slow, medium or fast learning styles of the students poses to be another major roadblock in assimilation of the learning material. It is of utmost importance to consider the mental models and socioeconomical conditions, besides the educational settings of the children who would be accessing the learning module, for the instructional material to achieve its desired objectives and to extract the best of a student's analytical, practical and creative abilities, thus making the learning activity more motivating, interesting and interactive.

It may be noted that most of the issues mentioned above concerned the rural, semiurban and government-run schools. As funds weren't too much of a problem with the private urban schools, and the instructors were more open to experimentation in their teaching styles [9, 10], usage of technological tools was seen more frequently in their curriculum and classroom settings. For the purpose of this paper, children studying in the privately run schools<sup>1</sup> [11, 29] in urban areas would be taken into consideration.

With the marriage between the educational goals and technological advancements, many subjects can be made more experiential to the young learners for them to understand the value and applications of the knowledge thus acquired. Various historical events, solutions to complex mathematical equations, experiments which aren't possible in a school-laboratory setting, but find a mention in the course books can be taught with the help of multimedia applications [12, 24]. Utilization of more number of sensory faculties through the constructivistic and interactive applications increases the mental processing exponentially, thus enhancing the assimilation of information and its effective conversion into knowledge. When learning solutions meet their objectives, they create thought-evoking experiences, which can deliver enormous efficacy to the learning environment. Learning through usage of technological aids (which integrate audio and visual effects) is seen as more interesting and motivating by the trainees as they feel less threatened by the machine [13]. Given the differential mental make-ups and learning styles, it is possible through the technological educational aids to alter the pace of teaching according to the requirement of the learner, and thus are able to capture and retain the trainee's attention. All this, however, does require the optimal intervention of the instructor for effectively relating the content to the syllabus being taught through the course books. Hence contrary to the belief of many, technological educational aids do not depose the physical presence of the instructor; rather both complement each other's role in the educational settings of the  $21^{\text{st}}$  century [14].

#### 2 Why Think Out-of-the-Box?

A common premise of discussion on designing a training system is that a specific answer, or a specific set of answers, exists for a given question. Such questions are characteristic of convergent thinking. This type of learning allows people to obtain high scores on the academically correct answers. However, beyond higher education, people need to be creative in order to survive and prosper in the ever-challenging professional world. There is an enormous need to harness our imaginations and

<sup>&</sup>lt;sup>1</sup> The private education market in India is estimated to be worth \$40 billion in 2008 and will increase to \$68 billion by 2012.

creativity to work with, adapt to and exploit the complexity and change that is all around us in whatever context we work. This activity allows our mind to expand and find many possible answers [21], unlike convergent thinking, which only allows what the assumed solutions ought to be. This cognitive activity of the brain is a characteristic of divergent thinking, where the questioner attempts to diverge from facts to the possibilities that can be created from them. It is similar to "out-of-thebox" thinking. Divergent Thinking can also be called Thinking from the right (side of the) brain.

Rote learning is the outcome of convergent thinking propagated by the traditional classroom teaching. But interactive classroom teaching facilitates development of convergent thinking as well as divergent thinking simultaneously by making students brainstorm for the possible answers to a question posed by the teacher (Divergent Thinking), and later analysing the possible answers to provide the academically "correct" answer to the question (Convergent Thinking). Here Convergent Thinking and Divergent Thinking go hand-in-hand in developing the brain to think smarter [22]. Training, hence, should aim at increase of knowledge and skills, stimulation of intellect, enrichment of memory, elevation of emotions and release of intuition.

Each training system is unique, with different missions, strategies, environments, technologies, and people it is aimed for; hence, "one size fits all" approach does not work. The objectives to be addressed by the training, the expected deliverables from the users of the system, and such relevant information and theories must be made known to the creative team and the producers of the training system. Theories provide the guidelines, principles, and predictions that allow instruction designers, visual designers, information architects, and academicians to maintain a balance between form and function [25], and to create the right recipe for a given learning environment.

#### **3** Making Learning Effective

According to Joe L. Whitley, US management consultant, "Trainees learn only 16 percent of what they read; 20 percent of what they see; 30 percent of what they are told; 50 percent of what they see and are told and 70 percent of what they see, are told and respond to; and 90 percent of what they do." [30] The 'doing' act makes the trainees explore various possibilities for the 'means' and the 'ends', thereby encouraging them to think creatively. This method is backed by the Indian ancient scriptures also. Three learning *pramanas* (*sources of knowledge*, Sanskrit) by the famous Hindu law-giver Manu, which can be correlated here are – *Sravana Pramana* (provides opportunities for the trainees for active listening), *Drishya Pramana* (learning here takes place through visual presentations – seeing leads not only to believing but also to learning), and *Anubhava Pramana* (emphasizes learning by doing and experiencing).

Interactivity of e-Learning system addresses the requirement of 'doing' act by the trainees, that is, it promotes active involvement and engagement of the learner. e-Learning can greatly increase students' retention and satisfaction, as it enables increased human support and communication between students and instructors

through text chat technology, electronic bulletin boards, synchronous content delivery and online tutors, thereby creating a memorable learning experience. Creating these sorts of learning experiences, which challenge the learners' instincts, require rigorous understanding of the learner, the unique learning styles, and the curriculum [26].

It is largely acknowledged that learning becomes more effective when people participate in activities that are useful in their real life and are culturally relevant to them. Learning at school requires students to pay attention, to observe, to memorize, to understand, to set goals and to assume responsibility for their own learning [28]. Experts opine that learning skills correlate to various stages of child development, linguistic skills, kinesthetic abilities and social skills [27]. As children interact with their environment, they learn problem solving skills, critical thinking skills, and language skills. Relating new information to prior knowledge is critical for learning, hence it is important to show the relationship between what the children would be learning about and what they already know from their past experiences. Children learn best in environments that are conducive and aligned to their cognitive and mental models, environments that are playful, experimental, allow for a great degree of exploration, and raise a child's curiosity, besides providing constant motivation in terms of some reward points or praise for the efforts of the child.

#### 4 Factors Influencing Adaptation to Technological Aids

Given the fast pace at which the course curriculum is covered by the teachers in the school, the children hardly have any time to digest and process the flood of information pouring down on them. This leads to increasing levels of confusion, with their older experiences and newer situations generally coming in conflict or at times becoming obsolete in the fast developing environment around them. Only if the training systems are designed to incorporate flexible learning and training styles, can they complement the classroom tutoring and achieve the intended educational goals. Undoubtedly technology is playing a very important role in hastening the supply of expert and age-appropriate information that can seamlessly be incorporated into the classroom or home learning environments of the students. By employing the audiovisual technological learning aids, the learners are afforded opportunities to use their multi-sensory approach [20]. Audio-visuals provide illustrations, sounds, music, etc, through which the complexity and intriguing variety of life are visually projected.

However, as most of the learning modules are taught from 'off-the-shelf' instructional packages, the children get only what is supplied to them, i.e., fixed images are projected on their minds under the presumptions that on an average, any child would understand the information being supplied to him. They don't take into account the individual personality factors like personal biases, prejudices, local cultural strengths and conditions of the child. The perceptions are developed due to one's exposure to environmental factors; individuals' own response to such factors, that is, interaction between one's own experience, observation and interaction with environmental factors, which are generally different for each individual. They become universal because some experiences and observations are common for most individuals. Since the perceptions of two individuals are generally never similar over an image, stimuli or issue, their understanding, analysis and application are profoundly influenced by the personal traits of the people involved.

## 5 Difference in Learnability and Navigability of the Instructional Modules

With the objective to understand the influence of perception based on observation and experience on the adaptability of children to varied instructional content, contextual enquiry method was used to solicit feedback of elementary-school children on the navigability and learnability of the instructional modules available on various educational websites, either designed especially for the Indian children or having a universal context. The study was conducted in four different places in the country i.e. Ahmedabad, Calcutta, Bangalore, and Chandigarh. During this research conducted on usability of educational websites for children in the age-group 8-12 year-olds (Tweens), from the preliminary findings it has been found that keeping the age group and medium of education constant, children responded differently to the educational content. Their comprehension of textual labels and visual symbols also differed. Their ease in navigability of the websites too differed even though they had past experience of at least one year (with minimum once a month) in accessing the Internet at home or school. This clause of one-year Internet experience was based on the research findings of Cox Communications, that by the time the children are 9 years old, 90% of tweens report having used the internet; most spend 1-2 hours online per day; their online "presence" (e.g. email, IM, etc.) doubles or even triples between ages 8-10 and 11-12; Girls and older children are significantly more active and social online than boys and younger children of this age group.

The perceptual acuity of the children in the age group of 8 to 12 year-olds reaches a level that children can understand the way two or more software tools can be used together to accomplish a task [15]. Their literalness and rule-driven nature allows them to learn arbitrary rules and behaviors, making them adaptable to different kinds of computer interfaces. Children do not simply take in what they observe as it is presented – they reconstruct it according to their mental models [16]. They begin to think in abstract terms, and become more focused on interactions with others [17]. The majority of children of this age group, some 88%, use the Internet to visit Web sites, followed by 72% who send and receive emails. To be online, they 32% forgo watching television and 23% give up reading magazines [18]. Web sites are accessed mostly for Games and Puzzles (32%), following by their utilization for doing Homework (27%) and conducting Research (26%) [19].

As feedback was taken from children living in different cities, the initial findings of this research suggest that children exposed to multiple socio-cultural environments have a relatively broader outlook and are easily able to recognize various cultural symbols and visuals and adapt with greater ease to such a content as compared to those with limited exposure to other cultures and traditions. Children, whose parents are in transferable jobs, tend to come face-to-face with a variety of social and cultural settings. As they come in contact with different languages, customs, traditions, festivals, and social environments, it is far easier for them to experience and identify some of the cultural and traditional customs and symbols of the states or countries they have stayed in. This widens their perceptions and leads to increase in their mental databank about various things and processes; they are better able to form opinions to related questions and situations, which in turn is a pre-requisite for divergent thinking.

Regarding children who have lived in the same socio-cultural environment throughout, it was found that their perceptions and knowledge are essentially based on the information supplied to them through books and encyclopedias, course curriculum based projects and activities, television programs, CDs/DVDs on culture and customs of India, or through experiences of their family and friends. First-hand experience of and exposure to the varied environments has more impact on the mind than the knowledge acquired from other means. This helps the children who have lived in the multi-socio-cultural environments to adapt and easily recognize the relevance of a culture-specific symbol used in the course curriculum or in the technological educational aids.

Children, whose parent(s) were in transferable job(s), mainly belonged to small nuclear families, with at the most one sibling, though in most of the surveyed cases, they were the only child of their parents. 80 percent of these children had a computer at home, to which they had free access and which they used for playing games in their leisure time, especially when they were alone at home. These children were more conversant with usage of technology as being alone with their PCs gave them more freedom to explore and experiment with various options of the games and software applications. This translated to better adaptability to learn the software applications being taught at school. They were more adept with the textual labels or visual symbols like home, back, etc and could understand what the arrows in the interface could imply. This, however, hasn't been derived whether these children are better in understanding the web interfaces of educational websites, than those children with limited access to interactive computer games or websites; these are just the preliminary findings. It just means that the speed with which these children navigate through the pages and the ease with which they make use of the mouse or the keys on the keyboard, is better than those who have limited access or who were less conversant with technology. This knowledge becomes indispensable to the pedagogical developers who must take into account the limitations faced by children who have limited access to technology and have had a limited exposure to varied socio-cultural environments. Learning solutions must incorporate enough depth of content and information, and styles of navigability of content which facilitate its learnability and helps to widen the horizons of these children also.

Amongst the children surveyed so far, the following key similarities have been noticed: Educational websites are mostly accessed for project work / homework; Children show more patience while browsing the gaming websites than the educational websites; They make use of Back button of browser for reaching home page and very rarely did any child know the usage of logo/branding for reaching the home page; They are quite appreciative of the pedagogical agents as they feel connected to them while browsing the content; They preferred search primarily through the textual links and secondary preference was given to search box; They weren't clear about what 'Contact Us' label can do and also, how to send the email if the default Outlook Express opens; Children with less frequent access to the Internet

could not easily make out between the advertisements and the website related images / content; Children were less explorative while accessing the educational websites as compared to the gaming websites.

#### 6 Culture, Education, Information Technology and Indian Context

Culture influences and affects various aspects of education. It is highly desirable that educational portal and web site designers should design the user interface of the web sites on the basis of known cultural dimensions relevant for educational practices and pursuits in the target culture. Cultures value different type talent, intelligence, capabilities, aptitudes, and different forms of knowledge at different times. Cultures put different kinds of premium on different sets of skills and knowledge forms to ensure that the society stays intellectually productive and creates adequate employment opportunities in the society. A proper investigation into the cultural characteristics in education in India should be done to guide the design of user interface for educational web sites/portals. The current study is an attempt in this direction.

Technological orientation in most of the Indian schools is not sufficient in current situation. Computer as a curricula level component is new in Indian school system though this issue is taking momentum in recent times. The motivation and involvement to consult web resources depends upon whether the student is doing a project individually or in groups. Peer group influences do exist for use of computer for doing class room projects and assignments. Students mostly consult educational resources from the web for additional information after they get a base level information from the teacher and prescribed book on the subject. Most of the cases the students are not very skilled in navigating strategically or locating looked for information effectively. This is due to lack of regularity and practice in consulting the educational web sites in day to day basis. Mostly teachers in the Indian schools are not power users of educational web sites. They do not give much importance to web educational resources as value addition to educational practices in the country. In modern schools which are mostly privately run and with advanced educational infrastructure it is observed that students use web resources more frequently for various purposes and this skill prompt them to look for readymade information on areas of their class room study topics and subjects.

Students who regularly use computers and web resources gain skill and efficiency gradually their web search behavior. They develop navigational strategies to navigate the website/blog/portal satisfactorily. Normally in Indian situation the question of using web and not using it and to what extent level/extent and to what regularity depends largely on the motivation and attitude of the student towards knowledge, education, pedagogical practices, achievement, computers, and educational technologies available in the society. Motivation and attitude towards computers and web for educational purposes are influence by various factors i.e. parents, teachers, school policies, peer groups and the social status and rank the student belongs to. Students high on achievement motivation show positive attitude and willingness to learn from technology based sources and adapt quickly to educational technologies. Many a time the students' learning style and the instructional design style of the web site differ and this mismatch does not encourage school students to use web

educational resources regularly. Most of the schools in India do not have broadband internet connection which is required as educational web sites/portals contain heavy graphics and image contents and internet speed is very much required in school environments as children are many in numbers in schools while computers and internet connections are few and children want faster results in their web browsing and searching activities.

Children bring different set of expectations, knowledge, skills, abilities, computer expertise, and internet awareness/literacy to the web site interface. What is important to know is how children make meaning or create sense in computer-mediated environments, while interacting with the text, images, audio-video and navigational elements of multimedia design and similar contents in the web site. The interface features, functions, interaction style, and the information architecture of the education web site should be developed on the children's cognitive profiles so that they get better user experience while using the sites. India has also rich story telling and visual narrative structures and traditions. Children play many kinds of games which are also part of Indian tradition and culture. Indian culture has also provided in a deeply embedded manner various forms of multimodality in communication and the communicative practice of children has unique cultural flavor. Indian children participate in a lot of game like activities and possess rich social and collaboration experience. They have unique tests and preferences for aesthetically pleasing things and objects. Children in India are exposed to rich array of visual symbols, signs, icons etc. which are part of the culture. All these facts about Indian culture provide a rich framework for interface and interaction designers of educational websites, tools and products. They can build the interaction design on the principles of cultural communicative framework and practices.

During the course of the current research it has been found that cultural background strongly shapes and influences children's choices and preferences regarding the graphical elements of websites i.e. page layout, format, color, navigational architecture, typography, information architecture etc. In case of educational portal/website user-centered design approach is missing completely in Indian context as children as the main users have not been considered or consulted adequately in terms of their needs, interests, knowledge, style, demographic and psychographic influences, computer and technological awareness and competency etc. Genuine participation of children in the design process of educational sites/portals should be practiced and encouraged in India.

#### 7 Conclusion

It may be concluded here that exposure to multiple socio-cultural environments can have a positive impact on the intellectual development of the child. Children who have stayed in a variety of environments tend to have a broader outlook and adaptability to various learning applications and content. They are better able to opinionate and suggest diverse solutions to a given problem based on their own experience, which is a pre-requisite for divergent thinking. These children are more conversant with usage of technology. They are more explorative and open to experimentation, which translates to their displaying better adaptability to e-Learning solutions and software applications being taught at school.

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