

Enhancing Usability Engineering in Rural Areas Using Agile Methods

Rüdiger Heimgärtner¹, Alkesh Solanki², and Bernd Hollerit³

¹ Intercultural User Interface Consulting (IUIC), Germany

² Continental Engineering Services GmbH, Germany

³ University of Tokyo, Japan

ruediger.heimgaertner@iuic.de,

alkesh.solanki@conti-engineering.com,

hollerit@gmail.com

Abstract. Usability engineering is all about developing usable products and/or services for a certain user group in a specific context. In this paper, we present some ideas about how to enhance usability engineering in rural areas (i.e. for users in rural contexts) taking agile methods into account. First, rural areas, rural users and rural products are illustrated. We elucidate the cultural, technological and social differences and the specifics of rural areas. Then, we look at the most important steps according to the standard user-centered design process defined in ISO 9241-210 in order to identify possible challenges and implications for usability engineering in rural areas. Finally, we analyze how usability engineering profits by using agile methods in this context.

Keywords: Rural, Agile, HDI, Developing Countries, Newly Industrialized Countries, User-Centered Design, ISO 9241-210, Culture, HCI, Approach, Process, Structure, Intercultural, Intercultural User Interface Design, Standard, Usability Engineering, Intercultural Usability Engineering.

1 Rural Areas in the World

1.1 Developing and Newly Industrialized Countries

A developing country, also called a less-developed country (LDC),¹ is a nation with a lower living standard, underdeveloped industrial base, and a low Human Development Index (HDI) relative to other countries. The HDI is a composite statistic of life expectancy, education, and income indices used to rank countries into stages of human development. Figure 1 shows that India is a newly industrialized country with an HDI between industrialized and developing countries. The challenges of newly industrialized countries also affect developing countries because they lack even more than newly industrialized countries. Africa is the continent with the lowest average HDI even if almost all ranges of HDI are represented.

¹ Cf. URL=http://en.wikipedia.org/wiki/Developing_country_-_cite_note-1, last access 2014-02-24.

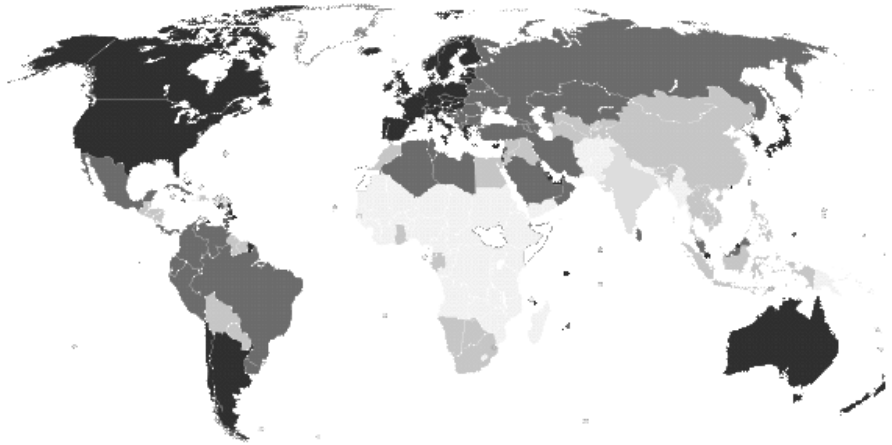


Fig. 1. 2013 UN Human Development Report Quartiles (cf. United Nations Human Development Index (HDI) rankings for 2012, URL=<https://data.undp.org/dataset/Table-1-Human-Development-Index-and-its-components/wxub-qc5k>, last access 2014-02-24). The lighter the areas in Figure 1, the lower the HDI ranking implying more and/or larger rural areas.

The economy of newly industrialized countries (NIC) has not yet reached developed country status but has, in a macroeconomic sense, outpaced their developing counterparts. Moreover, these nations are undergoing rapid economic growth (usually export-oriented). Ongoing industrialization is an important indicator of a NIC. NICs usually share some common features, including a switch from agricultural/rural to industrial economies, large national corporations operating on several continents, strong capital investment from foreign countries, political leadership in their area of influence as well as rapid growth of urban centers and population.

In this paper, the challenges for rural areas are exemplified by India because:

- India is the largest newly industrialized country of the world (1,237 billion inhabitants)²
- The per capita income of India is the lowest in the G8+5 countries.
- With the lowermost HDI of the G8+5 countries, India has the maximum potential for human resource development.
- According to a Goldman Sachs review of emerging economies, by 2050 the largest economies in the world will be as follows: China, USA, India, Brazil, and Mexico.³

² URL=https://www.google.de/search?q=einwohner+indien&oq=einwohner+indien&aqs=chrome..69i57j0l5.3003j0j4&sourceid=chrome&espv=210&es_sm=93&ie=UTF-8, last access 2014-02-26.

³ URL=<http://web.archive.org/web/20110810095039/http://www.chicagobooth.edu/alumni/clubs/pakistan/docs/next11dream-march%20%2707-goldmansachs.pdf>, last access 2014-02-26.

- In 2013, the Indian government invested 73175 INR in the development of rural areas regarding infrastructure, education and employment because 70% of India's population lives in rural areas.⁴
- A good portion of related work for HCI design in rural areas was researched in Namibia (cf. [1]), whose HDI is slightly higher than that of India.

1.2 Characterization of the Rural Areas in India

Electricity is available mostly everywhere in India. Rural areas are also mostly remote regions which suffer bad accessibility and are not very well connected to other economic centers. Mobile communication is available all over the country. In addition to the mainstream media, the rural development ministry of Indian government is investing in every new and emerging electronic media (radio, television, internet, social media and electronic library). Official websites are available in English and Hindi. E-government is available in all rural areas of India. This results in less corruption, more transparency and a revolution in mobile communication which ensures that people are accessible everywhere, since almost everybody in rural areas has a mobile phone with internet access. From the 1,237 billion inhabitants in total in India, there are:

- 904.56 million telephone subscribers (wireless and landline),
- 29.08 million land lines,
- 875.48 million cell phones.⁵

Amenities in the Following Areas Are Provided through Projects

- Water,
- Electricity,
- Construction and village maintenance,
- Village linked tourism,
- Streets,
- Integrated Rural Hub,
- Drainage,
- Rural Market,
- Solid Waste Management,
- Agri - Common Services Centre,
- Skill development,
- Warehousing,
- Development of economic activities,
- Any other rural-economy based project,
- Village street lighting,
- Telecommunications

⁴ URL=http://www.rural.nic.in/sites/downloads/annual-report/MoRDEnglish_AR2012_13.pdf, last access 2014-02-26.

⁵ URL=http://en.wikipedia.org/wiki/Telecommunications_statistics_in_India_-_cite_note-trai_subnumbers-6, last access 2014-02-24.

Rural Products. E-governance products, public information booths (internet activated), rural libraries might all have internet connections, providing m-commerce, e-commerce, m-banking, e-banking, communication (apps, chat, messages), information (news, databases), social media (facebook, google+) (cf. [2]) and mobile phones (cf. [1]). In addition, there is a tool for bridging the digital divide in rural India (cf. [3] and [4]).

User Groups. Rural users must work to live. Therefore, they do not have time to speak with the designer or test the product. In addition, they are often illiterate or not well educated, do not have good knowledge of English and speak only Hindi or a local language and therefore, they are not able to express their expectations and needs clearly. Rural users are not tech savvy and do not have formal computer education.

1.3 Challenges in Rural Areas in India

Accessibility to the user is not easy (great distances, no direct connectivity to rural areas, knowledge of local languages or translator necessary). HCI designers must have enhanced capabilities and skills such as being more flexible, pragmatic and empathic in order to understand the expectations and the needs of rural users. In addition, there are many other general challenges in designing HCI for rural areas (cf. [5], [6], [7], [8], [9], [10], [11], [3], [12], [13], [14], [15]) and in "designing in the wild" (cf. [16], [17], [18], [19]). In addition, in rural areas, bridging digital diversity is a fundamental political concern of "repairing worlds" (cf. [20]).

1.4 Approaches and Methods to Tackle the Challenges for HCI Design in Rural Areas

Several techniques must be applied such as "designing in the wild" (i.e. "in situ design", cf. [19]) or reframing HCI thinking by taking indigenous perspectives into account (cf. [21]). Motivated by the identified challenges for HCI design in rural areas, a growing number of researchers focus on adapting or discovering new approaches and methods with which to tackle the problems of using participatory design (cf. [22]) at genius loci (cf. [5]). Furthermore, several testing methods have been adapted to "oral" rural users (cf. [23]) such as digital story telling (cf. [24]), using oral repositories (cf. [25]) or 3D visualizations of indigenous knowledge (cf. [26]). Before we add the concept of agile methods to this solution portfolio, we analyze the implications of the challenges in rural areas to usability engineering.

2 Usability Engineering Challenges in Rural Areas

Let us now analyze the standard HCI development process in ISO 9241-210 (cf. [27]) concerning its use in rural contexts. Figure 2 shows an overview of the user-centered HCI design process. The process consists of various steps which will be analyzed concerning their use in HCI design for our purpose (cf. also [28]). First, we examine

the weaknesses in every process step, then we define and recommend implementing agile methods to improve the HCI design process for its application in rural areas. In addition, ISO 9241-210 refers also to the seven dialog principles defined in ISO 9241-110, which should be applied in human computer interaction design. They should be analyzed with regard to their applicability as general dialog principles in rural contexts. However, that is beyond the focus of this paper.

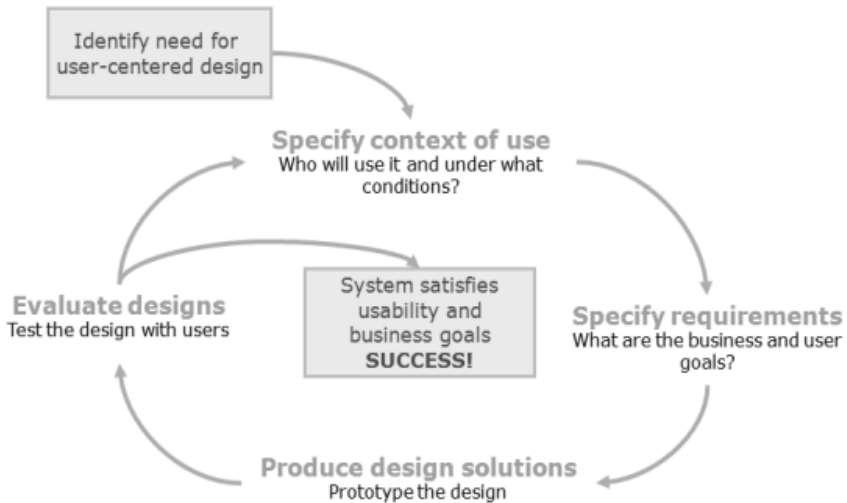


Fig. 2. User-Centered Design Process following ISO 9241-210

2.1 Understanding the Context of Use and Specifying User Requirements

We propose user-centered design for rural areas in particular, as the potential clients might not be familiar with computer software. In order to increase the willingness to adapt to new technologies, the design has to meet high usability standards. Furthermore, "watching what the users do rather than listening to what the users say" becomes even more applicable in the case of rural users because what they say is not exactly what they want or they must have. Here agile methods can be very supportive (cf. section 3 about leveraging agile methods). In this context, also secondary users (for example, local volunteers) can be contacted to obtain a better understanding and access to the primary user and his context of use and his user needs in order to determine the user requirements.

2.2 Producing Design Solutions and Evaluation

Evaluation and re-evaluation of the design has to be performed after every iteration until the users are satisfied with their user experience. New users testing a re-design might encounter problems that have not been discovered during earlier tests and we

must address them. Hence, in the rural context we must use unconventional methods such as disseminating messages through folk and traditional art forms, direct contact programs like rallies, door to door campaigns, village level meetings, film shows and videos⁶ to achieve a greater involvement of users during the design the product and also enabling the users to give meaningful feedback during the formative and summative evaluation of the prototypes and the final product. Hence, in rural contexts, it is even more efficient to apply agile principles (cf. section 3, (i) and (ii)): For instance, seeing the low-fidelity prototype as a living specification and preferring communication in place of comprehensive documentation. In addition, outdoor outreach mode is a most impressive medium of communication to transport the proper messages to the rural public.

3 Leveraging Agile Methods to Optimize the Usability Engineering Process for Rural Areas

Let us now direct our analysis to how usability engineering profits from using agile methods in the rural context and how the mentioned challenges in section 2 can be met and resolved using agile methods. Thereby the following principles and implications of the agile manifesto are addressed and applied:⁷

1. Individuals and interactions over processes and tools,
2. Working products (user interfaces) over comprehensive documentation,
3. Customer collaboration over contract negotiation,
4. Responding to change over following a plan.

The agile manifesto even supports "designing in the wild" / "in situ design" because the designer is locally on the spot living with the users. In such a rural context the agile manifesto can be lived literally: live requirements development, in situ design thinking, continuous integration and "just in time" deliveries. Also the evaluation feedback loop is fully integrated in the live process.

In fact, in situ design even pushes the agility of the whole process to a level higher than the one defined by the current agile process. Therefore, agile principles are necessary in usability engineering in rural areas because they support the principles of usability engineering and the necessary flexibility to in-situ design in rural areas covering the following aspects with ease:

- many deliveries/releases,
- live user feedback,
- collection, description and comprehension of user needs in short iterative cycles,
- permanent clarification of conflicting user needs and specification of user requirements,
- continuous integration, testing and evaluation.

⁶ Cf. URL=http://www.rural.nic.in/sites/downloads/annual-report/MoRDEnglish_AR2012_13.pdf, last access 2014-02-26.

⁷ Cf. URL=<http://agilemanifesto.org/>, last access 2014-02-24.

4 Conclusion

This agile HCI design process for rural areas represents a new approach by combining the best practices of the current HCI design process defined in ISO 9241-210 with the elements of the paradigms of "designing in the wild" and agility. Living this process, the UI designers will better understand the user needs in rural areas and accommodate the frequent changes for design. In addition, the approach reduces the development time dramatically by continuous live feedback loops.

References

1. Bidwell, N., Winschiers-Theophilus, H., Koch Kapuire, G., Rehm, M.: Pushing Personhood into Place: Situating Media in the Transfer of Rural Knowledge in Africa. *Journal of Human-Computer Studies* 69(10), S 618–S 631 (2011b); Special Issue on Locative Media
2. Bidwell, N.J., et al.: Please call ME. NU 4EVER: Callback & Social Media Sharing in Rural Africa. In: *Proceedings of The 10th International Workshop on Internalisation of Products and Systems*, Kuching, Malaysia (2011)
3. Das, R.K., Patra, M.R., Mahapatra, S.C.: e-grama: a tool for bridging the digital divide in rural India. In: *Proceedings of the 2nd International Conference on Theory and Practice of Electronic Governance*, pp. 361–366. ACM, Cairo (2008)
4. Design, I.B.: Low cost self-diagnosis tool for rural India, <http://indian-bydesign.wordpress.com/2010/05/06/product-feature-low-cost-self-diagnosis-tool-for-rural-india/> (May 6, 2010)
5. Bidwell, N.J., Browning, D.: Pursuing genius loci: interaction design and natural places. *Personal Ubiquitous Comput.* 14(1), 15–30 (2010)
6. Marshini, C., Tucker, W., Blake, E.: Developing locally Relevant Software Application for Rural Areas: South African Example, *Proceedings. In: SAICSIT* (2004)
7. Maunder, A., Marsden, G., Tucker, W.: Evaluating the relevance of the 'Real Access' criteria as a framework for rural HCI research. In: *Proceedings of CHI-SA, 2006*, pp. 57–79 (2006)
8. Sandhu, J.S., Altankhuyag, P., Amarsaikhan, D.: Serial hanging out: rapid ethnographic needs assessment in rural settings. In: Jacko, J.A. (ed.) *Human-Computer Interaction, HCII 2007, Part I. LNCS*, vol. 4550, pp. 614–623. Springer, Heidelberg (2007)
9. Zhao, J.: ICT4D: Internet adoption and usage among rural users in China. *Knowledge, Technology & Policy* 21(1), 9–18 (2008)
10. Walker, K., et al.: A resource kit for participatory socio-technical design in rural kenya. In: *CHI 2008 Extended Abstracts on Human Factors in Computing Systems*, pp. 2709–2714. ACM, Florence (2008)
11. Abdelnour-Nocera, J., Dunckley, L.: Sociotechnical research and knowledge communication in community-centred systems design: a technological frames perspective. *International Journal of Web Based Communities* 4(4), 476–490 (2008)
12. Sukumaran, A., et al.: Intermediated technology interaction in rural contexts. In: *CHI 2009 Extended Abstracts on Human Factors in Computing Systems*, pp. 3817–3822. ACM, Boston (2009)
13. Bidwell, N.J., et al.: Designing with mobile digital storytelling in rural Africa. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 1593–1602. ACM, Atlanta (2010)

14. Oreglia, E., Liu, Y., Zhao, W.: Designing for emerging rural users: experiences from China. In: CHI 2011 Proceedings of the 2011 Annual Conference on Human Factors in Computing Systems. ACM (2011)
15. Liu, J., et al.: How socio-economic structure influences rural users' acceptance of mobile entertainment. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 2203–2212. ACM, Atlanta (2010)
16. Button, G.: Cognition in the Wild, Edwin Hutchins. *Comput. Supported Coop. Work* 6(4), 391–395 (1997)
17. Dourish, P., et al.: Security in the wild: user strategies for managing security as an everyday, practical problem. *Personal and Ubiquitous Computing* 8(6), 391–401 (2004)
18. Marshall, P., et al.: Rethinking 'Multi-user': An in-the-wild study of how groups approach a walk-up-and-use tabletop interface. In: Conf. Hum. Fact. Comput. Syst. Proc. Conference on Human Factors in Computing Systems - Proceedings, pp. 3033–3042 (2011)
19. Rogers, Y.: Interaction design gone wild: striving for wild theory. *Interactions* 18(4), 58–62 (2011)
20. Jackson, S.J., Pompe, A., Krieshok, G.: Repair worlds: maintenance, repair, and ICT for development in rural Namibia. In: Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work, pp. 107–116. ACM, Seattle (2012)
21. Abdelnour-Nocera, J., et al.: Re-framing HCI through Local and Indigenous Perspectives. In: Campos, P., Graham, N., Jorge, J., Nunes, N., Palanque, P., Winckler, M. (eds.) INTERACT 2011, Part IV. LNCS, vol. 6949, pp. 738–739. Springer, Heidelberg (2011)
22. Winschiers-Theophilus, H., et al.: Being participated: a community approach. In: Proceedings of the 11th Biennial Participatory Design Conference, pp. 1–10. ACM, Sydney (2010)
23. Gorman, T., et al.: Adapting usability testing for oral, rural users. In: CHI 2011 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 1437–1440. ACM, Vancouver (2011)
24. Reitmaier, T., Bidwell, N.J., Marsden, G.: Situating digital storytelling within African communities. *International Journal of Human-Computer Studies* 69(10), 658–668 (2011)
25. Reitmaier, T., et al.: Communicating in designing an oral repository for rural African villages (2012)
26. Jensen, K.L., et al.: Putting it in perspective: designing a 3D visualization to contextualize indigenous knowledge in rural Namibia. In: Proceedings of the Designing Interactive Systems Conference, pp. 196–199. ACM, Newcastle Upon Tyne (2012)
27. DIN, DIN EN ISO 9241-210 Ergonomische Anforderungen der Mensch-System-Interaktion Teil 210: Prozess zur Gestaltung gebrauchstauglicher Systeme. BeuthVerlag, Berlin (2010)
28. Schoper, Y., Heimgärtner, R.: Lessons from Intercultural Project Management for the Intercultural HCI Design Process. In: Marcus, A. (ed.) DUXU/HCI 2013, Part II. LNCS, vol. 8013, pp. 95–104. Springer, Heidelberg (2013)