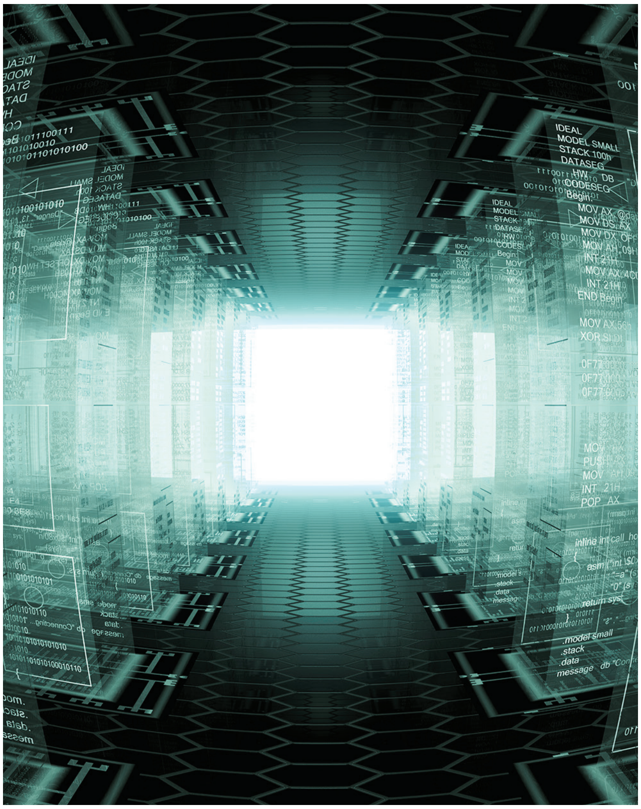

Human-Centered Design in Industry: Lessons from the Trenches

Carmelo Ardito, Paolo Buono, Danilo Caivano, Maria Francesca Costabile, and Rosa Lanzilotti, *University of Bari Aldo Moro*

Yvonne Dittrich, *IT University of Copenhagen*

Integration of human-centered design in a company's software development practice requires a thorough analysis of its current practices by both researchers and practitioners.

The complexity of today's interactive software systems makes their development challenging for both industry and research communities. There's considerable debate among designers on how to create systems that provide a more valuable user experience (UX). Another point of contention is how to share successful development experiences and transform them into or integrate them with ready-to-use software engineering practices.

The concept of usability emerged with the advent of interactive applications in the 1980s and has continued to evolve with technology. Today, human–computer interaction (HCI) researchers focus on designing for UX, which requires understanding user requirements from both pragmatic (system functionalities and interaction) and hedonic (aesthetics, emotions, and social involvement) points of view.[1] Usability is an important aspect of UX, but the success of products like the iPod and iPhone shows that consumers often value appearance as much as functionality. Human-centered design (HCD)[2] attempts to integrate these goals using an iterative process in which designers create and evaluate increasingly complex prototypes, possibly involving end users.

However, there's a gap between what academia proposes and what industry actually applies. Although several companies—especially those developing software products—have usability or UX departments, "the integration of usability engineering methods into software development life cycles is seldom realized in industrial settings."[3] The literature is full of articles arguing that this situation must change and suggesting new methodologies and techniques to optimize the impact of usability and UX on software products, but this isn't enough.

In past work with software companies, traditional methods such as online questionnaires, interviews, and focus groups were instrumental to understanding a company's work practices and overcoming some obstacles to HCD adoption. However, in many cases these methods failed to

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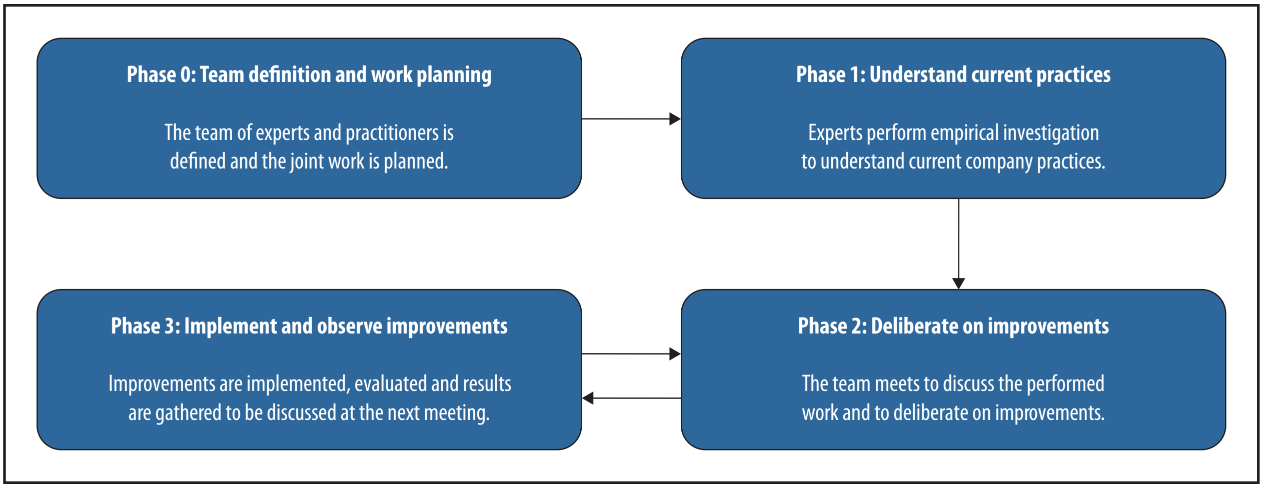
Phase 0: Team definition and work planning
The team of experts and practitioners is defined and the joint work is planned.
Phase 1: Understand current practices
Experts perform empirical investigation to understand current company practices.
Phase 2: Deliberate on improvements
The team meets to discuss the performed work and to deliberate on improvements.
Phase 3: Implement and observe improvements
Improvements are implemented, evaluated and results are gathered to be discussed at the next meeting.

Figure 1. Four-phase action-research schema inspired by cooperative method development.

persuade practitioners and managers to incorporate UX activities into their software development life cycle. We realized that actual integration of HCD requires a thorough analysis of a company's current software development practices together with the practitioners, working with them from inside the company. Through this cooperation, HCD methods can be adapted to the organization's particular resources and circumstances.

ACTION RESEARCH–BASED STUDY

Action research[4] is a social science methodology designed to help communities and organizations improve the way they address issues and solve problems and at the same time develop scientific knowledge about the problem and its solution. Researchers and practitioners work together as a team to assess current practices, propose a new course of action, implement changes, and evaluate the results. This collaboration results in a better understanding of the factors impacting the existing situation and the most suitable remedies.

Figure 1 outlines an action-research process called *cooperative method development* (CMD)[5] that we used to study the development practices of two business units of a medium-to-large-size software company in southern Italy. Each unit can be considered as a separate smaller company since it has its own managers, project leaders, designers, and developers. CMD consists of three main repeatable phases: understand current practices (phase 1), deliberate on improvements (phase 2), and implement and observe improvements (phase 3). We extended CMD with a phase 0, in which a team was established including four senior and two junior HCI researchers along with company practitioners.

It was agreed that each of the two junior researchers would work in a business unit for 60 working days (12 weeks). During phase 1, the two junior researchers investigated current company practices to identify their strengths and weaknesses. Phase 2 consisted of biweekly meetings, during which each junior researcher reported the empirical results and team members discussed the performed work and approved possible improvements. During phase 3, each junior researcher implemented the agreed-upon changes in the company software practices, performed evaluations, and collected the results for analysis at the next meeting.

STUDY RESULTS

The study highlighted numerous problems with the company's software development practices, particularly with respect to user involvement. Most practitioners were reluctant to let end users participate in design activities for several reasons—for example, they asserted that users are unable to clearly express their needs and are uncomfortable during tests, making it difficult for them to perform even simple tasks. The HCI researchers spent considerable time at the team meetings championing the benefits of including users in requirements specification.

The research team's work also demonstrated the importance of developing prototypes, starting with paper ones, and evaluating them with stakeholders including end users. The two junior HCI researchers applied a cost-effective approach that included heuristic evaluation and thinking-aloud tests on prototypes of increasing complexity, obtaining excellent results. They showed that, when resources are limited, even so-called "quick and dirty" methods capable of being implemented rapidly and inexpensively can be valuable.[6] For example, one researcher who was developing a tourist application asked a few company staff members to participate in the tests by executing typical tasks they would perform when visiting a town. The other researcher, who was helping to create a nautical app, enlisted two of his professional sailing friends in the tests. Informal discussions with users can also yield quick feedback and determine whether prototypes meet users' needs and expectations.

Ultimately, these action-research activities convinced the company of the advantages of usability engineering. The HCI researchers proposed various ways to improve software development practices, highlighting their pros and cons so that practitioners could choose the most appropriate techniques depending on the circumstances and available resources.

The study generated a promising follow-up. The practitioners clearly appreciated the work performed and hired two of our former students who had recently graduated in computer science and collaborated on some HCD projects. One of these two people served as a usability expert and continued the work of one of the study's two junior researchers. He was asked to assess the usability of the company's software modules, which were based on the previously created and evaluated prototypes. The practitioners were pleased to learn that the modules had very few problems, which were easily fixed, and asked him to apply the same HCD approach to other modules. The other new employee was tasked with porting some apps that provided citizen services from Android to iOS. He was first asked to evaluate the usability of the Android apps, which were developed according to the company's traditional approach. After analyzing the new employee's report, the company decided to design a completely new version of the app for iOS using the HCD approach, which proved to be much more effective.

It's researchers' responsibility to define appropriate usability and UX metrics as well as development practices that can support companies' adoption of HCD.

OTHER INSIGHTS

We clearly used a bottom-up approach in our study, working with company developers and project leaders to demonstrate the benefits of HCD. In most companies, however, real change can only occur with buy-in from top managers. These individuals tend to be older and less aware of or receptive to new methodological and technological innovations, and usually demand quantitative and qualitative evidence of the effectiveness of novel techniques before approving them. Integrating a top-down approach—that is, experience reports and evidence from empirical studies—would help convince upper management of HCD techniques' effectiveness.

In our study, as well as in several interviews and informal discussions with other companies,[7] it emerged that, as time and other resources are limited, companies focus only on the requirements formally established for a particular project during the product development process. Generally, such requirements don't include usability and UX.

This is especially true in the case of a request for proposal (RFP) or call for tender (CFT) issued by a government agency. Companies typically strive to satisfy only those requirements specified in an RFP or CFT. In Italy, for example, RFPs have required compliance with various criteria and methods to verify accessibility since 2004. Thus, to improve the current situation, public organizations should be encouraged to explicitly indicate usability and UX requirements in RFPs. However, due to the lack of objectively verifiable usability and UX requirements, this isn't easy to do.

It's researchers' responsibility to define appropriate usability and UX metrics as well as development practices that can support companies' adoption of HCD. We're currently discussing these issues with a working group of researchers and practitioners set up by the Italian Ministry of Public Administration that is analyzing the usability of websites and other public administration systems. We're also involving a government office in the region where our university is located that has published several RFPs about computer systems in recent years.

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Carmelo Ardito *is an assistant professor in the Interaction, Visualization, Usability & UX (IVU) Lab, Department of Computer Science, University of Bari Aldo Moro, Italy. Contact him at carmelo.ardito@uniba.it.*

Paolo Buono *is an assistant professor in the IVU Lab, Department of Computer Science, University of Bari Aldo Moro. He is also CEO of LARE (www.laresrl.com), a spin-off company of the University of Bari Aldo Moro. Contact him at paolo.buono@uniba.it.*

Danilo Caivano *is an assistant professor in the Software Engineering Research Lab (SerLab), Department of Computer Science, University of Bari Aldo Moro. He is also executive officer of SER&Practices (www.serandp.com), a spin-off company of the University of Bari Aldo Moro. Contact him at danilo.caivano@uniba.it.*

Maria Francesca Costabile *is a professor in the IVU Lab, Department of Computer Science, University of Bari Aldo Moro. Contact her at maria.costabile@uniba.it.*

Rosa Lanzilotti *is an assistant professor in the IVU Lab, Department of Computer Science, University of Bari Aldo Moro. Contact her at rosa.lanzilotti@uniba.it.*

Yvonne Dittrich *is an associate professor in the Software and Systems Section at IT University of Copenhagen, Denmark. Contact her at ydi@itu.dk.*

Editor: Mike Hinchey, Lero—the Irish Software Engineering Research Centre; mike.hinchey@lero.ie

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