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Initial takeaways from a case study of streamlined user-centered design

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Abstract:

User-centered design (UCD) has become almost the default way of designing map products that are easy to use and relevant to users. However, it is also recognized that the UCD process is more costly than a traditional process: attracting participants, processing large amounts of (often qualitative) data, organizing multiple iterative design cycles. How can we as cartographers center the user when designing but still manage our project timelines? Here we explore a streamlined, or "budget" UCD approach for the development of a thermal comfort-based navigation application and argue that short project timelines should not hinder the adoption of UCD in developing cartographic products.

The objective of the CoolStreets project was to develop an application providing users with real-time thermal comfort information as they commuted through the city of Munich. The application falls under the broader umbrella of health-based routing services which provide healthy route suggestions, particularly for pedestrians and cyclists with customizable route recommendations. We collaborated with ClimateFlux GmbH who developed a personalized AI-based API to quickly calculate the microclimate indicator of input points to evaluate the comfort levels along different routes and required a front-end application to demonstrate their API. Given a project timeline of one year and a team of two for both the design and development of the routing algorithm and the user interface of the application, we implemented a streamlined UCD process in the design of the user interface. Nevertheless, the adoption of the UCD process was instrumental in guiding the development of our application.

We iterated through three design cycles. In the first cycle, a competitive analysis was completed by researching applications which offered health-based routing. Instead of a systematic literature review, we compiled strengths and weaknesses of 28 different existing applications and projects. This familiarized the team with existing designs and uncovered potential design flaws and pitfalls in previous work. We then presented these strengths and weaknesses to the project partners and formalized technical requirements and intended functionalities of the application. This cycle concluded with a text-based description of the initial concept and a simple mockup to visualize the concept, which was presented to users in a questionnaire.

In the second cycle, user requirements were gathered and analyzed. This was done via a short (10-15 minute) questionnaire, which included a mix of closed and open-ended questions. The questionnaire focused on current mobility patterns relating to thermal comfort, users' current navigation tools and their use-contexts, preferences about personalization and the use of AI, and feedback and ideas about the initial concept. 66 local participants self-selected to participate and we found recruitment straightforward with flyers posted around the city. We do not report full results here, but most participants indicated the concept to be highly relevant and desired, however many were wary to provide information for a personalized route, especially to an application using AI. Based on these results, a conceptual sketch was drafted using the Five Design Sheet (FdS) method, where an initial idea is drafted on paper, followed by three diverse rough sketches. These ideas are presented in a workshop and results and ideas are summarized (Roberts et al., 2015). The results of this workshop indicated that a simple and very familiar design was preferred by the project partners and based on the user requirements analysis, would likely be better adopted by users. Next, a digital mockup (alpha release) was created using Figma. The mockup was static, but testers could walk through the flow of the app by touching "hotspots" on the interface, which would bring them to the next frame, thus simulating some interactivity.

In the third cycle, this alpha release was evaluated using an expert-based think aloud study, closely following Roth et al. (2015). Six cartographers and designers outside of the design team but within the department in various stages of their career (2 senior, 2 mid-level, 2 experienced master's students) were chosen. They were presented with the use-case derived from cycle two, and the alpha release of the application, then used the think aloud method while completing 16 benchmark tasks. During the study, we recorded a number of hinderances, usability issues, further ideas, and design flaws. Afterward, participants joined an open discussion about their overall thoughts and criticisms. Next, they answered questions related to the usability and utility of the application adapted from Roth et al. (2015), and completed

the AttrakDiff questionnaire to categorize the application's attractiveness (Hassenzahl et al., 2003). The AttrakDiff and usability and utility questionnaire indicated that a highly useable, useful and attractive application had been presented. The think aloud study and discussion, however, revealed 42 usability concerns which were ranked by severity. The input from this cycle resulted in 36 changes and 2 removals of features or interactions, while 4 were left unchanged due to technical considerations. The result was a beta prototype which was handed over to the project partners who plan to conduct in situ tests with the application.

We streamlined our study in a variety of ways. In the first cycle, we skipped a systematic literature review and compiled strengths and weaknesses of existing applications, which was straightforward while still providing an overall picture of the existing market. We found a text description paired with a simple mockup of the concept at the conclusion of the first cycle was enough to explain the application concept to users in the second cycle. The user requirements survey was one of the costliest steps of our process, but we found the answers to be highly valuable, particularly the open-ended questions. While these results took more effort to report and quantify (we used thematic content analysis), we found that we referred to them more when designing than the quantitative questions, which were more helpful in designing user profiles (for example, we noted marked enthusiasm for the app idea and demands for more personalized routing solutions that we would have otherwise missed with only close-ended questions). The FdS method was an effective collaborative method for taking the design from concept to sketch, and it was particularly helpful for discussing potentially conflicting design requirements from the project partners and users. Additionally pen and paper sketches are a quick way to get rough design ideas down without worrying about hammering out the details. In the third cycle, a static prototype with touchable "hotspots" was more than sufficient at this stage and only 6 of the 42 usability issues were related to the static nature of the alpha release. For evaluation at this stage, experts were recruited from our own department (outside of the project team). We found the benefit (in-person interviews, easy recruitment, thoughtful insights) to outweigh potential introduction of bias. The interviews could have been shortened by eliminating the AttrakDiff and usability/utility questionnaire, which were too broad to provide useful insight. These methods may be unsuitable for expert-based methods, or provide more insight when repeated later on in a project, and should be more carefully placed or eliminated if unneeded in shorter projects. The benchmark tasks paired with the think-aloud method proved to be excellent at uncovering usability and utility issues. Tasks need not be overly complicated at this stage, even simple tasks (e.g. *Is it sunny or shady at [location]?*), uncovered design flaws, though we recommend distributing them across some typology (see e.g. Roth 2012). Additionally, the think aloud method was critical here: often a task was completed correctly and quickly, but the verbal commentary from the experts indicated that there were stumbling blocks or sparked discussions. It is important to define a clear use case to present when using expert-based methods; we found that some reminders to approach the app from the point of view of previously outlined user profiles was necessary. In summary, a short project timeline or small team should not hinder the adoption of UCD. We were able to complete three short design cycles within one year, resulting in the handover of a beta release to our project partners for final in-situ tests.

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