Beginning Design without a User
Application of Scenario-Based Design

Dominic LaCava & Helena M. Mentis

Lockheed Martin Maritime Systems & Sensors
199 Borton Landing Rd. Moorestown, NJ 08057
{*dominic.lacava, helena.m.mentis*}@lmco.com

Abstract

The user-centered design (UCD) process, much like any process, has to be adaptable to unknown situations and unconventional requirements. The following is a case study which exemplifies how the Human-Computer Interfaces group at Lockheed Martin pursued new endeavors in homeland security despite having no identifiable user by setting aside its UCD process and instead employing scenario-based design (SBD).

1 Introduction

A multitude of issues can arise when designing a user interface that requires a modification of one's user-centered design (UCD) process. It is important for students to learn that designers must be flexible when applying UCD methods to user interface design. The following paper describes the use of scenario-based design to overcome the unique design difficulty of designing new systems for a new domain with no identifiable users.

2 Problem Identified

When the U.S. Department of Homeland Security (DHS) was organized in 2002, existing defense and emergency agencies were saddled with homeland security (HLS) responsibilities and agendas in addition to their existing duties. Many agencies throughout the country were already stretching their monetary and personnel resources before this point. These new responsibilities were especially troublesome in high target cities and ports. For instance, Coast Guard (CG) entities around major East Coast cities went from more than 90% search and rescue missions to over 50% port security (Loy, 2002). This was almost impossible to do reliably with their current resources and technology. In addition, new emphases on information sharing and incident coordination demanded new communication structures to be implemented, which increased labor costs to implement the structures. The resulting strain on agencies such as the Coast Guard, Department of Transportation, and first responders (e.g. police, firefighters) required the development of new methods for monitoring and emergency response.

The need for these new methods was evident despite the absence of any official call for proposals from individual states or the DHS. Lockheed Martin business development (BD) personnel realized that this need matched our own expertise in systems integration, maritime domain knowledge, and command and control proficiency. BD approached the Command and Control (C2) Group to leverage its expertise to develop viable homeland security systems. With this directive, a team of engineers developed specifications for a HLS command and control system. Thus through an internal research and development (IR&D) effort Lockheed Martin began its foray into designing HLS systems with the intention of preparing for future customers' needs.

This task turned out to be more difficult than expected for the Human-Computer Interfaces team which was given the HLS design project. We entered the project in typical fashion, confident to follow our UCD process. Our UCD process for developing user interfaces adheres to the notion that "the essential principles of user-centered design are to make user issues central in the design process" (Preece, Roger, Sharp, Benyon, Holland & Carey, 1998, p.372). We do this by involving the users as early on in the process as possible. Thus within a structured UCD approach, designers must have a good conceptual understanding of the user requests, which includes understanding the users, the systems they use, the work they perform with the systems, and the environment in which they work.

We typically follow a five phase system development process that encompasses requirements gathering, design, prototyping, testing and implementation. Developers follow these five phases in a waterfall fashion, but with the Reprocess has a clear beginning with the requirements gathering phase and a clear ending with the implementation phase. In this process, requirements gathering is important because it drives the design and steers the usability testing.

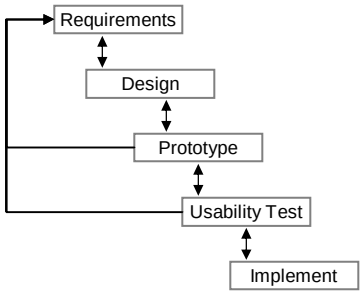

Figure 1 Iterative Waterfall Model (Preece, et al, p. 356)

However, in developing a solution for HLS, we could not follow this exact process. The following are five obstacles which blocked our efforts in following our process in a usual manner.

1. *We had no users.* Talking to or observing users to garner their tasks and work environment was next to impossible since there were no existing systems or identifiable future users. For instance, we could assume that the police department would be using the system, but who that specific user would be, what he/she would be doing, or where he/she would be working were undecided variables.
2. *We had no customer.* The consequences of not having a user would not have been so grave if we would have had some input from a customer. But, since this was internal research and development, we had no customer that was available to divulge operational information or dedicate time to our effort.
3. *We had limited understanding of the real problems to be solved.* Since homeland security was a new domain, we could make educated guesses as to what security problems existed but had very little evidence or support in knowing how agencies would respond to various HLS situations.
4. *DHS provided little guidance.* At the inception of the DHS, officials focused on organizational issues and did not provide many requirements for actually carrying out security tasks. In addition, involved agencies (i.e. Coast Guard, Department of Transportation, police, etc.) had only a nebulous idea of what needed to be done in order to execute orders and assignments coming from higher ranking agencies.
5. *We had to satisfy all potential user groups.* We did not want to limit ourselves by focusing only on one entity. Thus, systems that we devised had to be general enough to appeal to a wide array of potential customers from which we would be soliciting work.

3 Scenario Based Design

Realizing that our UCD process was not entirely suited to our situation, we decided to follow a modified procedure for gathering user requirements. We chose to begin our requirements gathering phase with devising scenarios as described by (Rosson & Carroll, 2002). The scenario-based development framework (SBD) was described as an alternative to the typical UCD waterfall model. A scenario was defined as "a story about people and their activities" (Rosson & Carroll, 2002, p.16). Scenarios embody elements such as an explicit setting and one or more actors who have specific goals in using the system. Most importantly they have a plot with a sequence of actions and reactions.

Another key aspect of SBD is to build a prototype as a trial version that will later be discarded. Designers that use SBD "view prototyping as a requirements analysis method" and thus use it earlier in the process to elicit feedback (Rosson & Carroll, 2002, p. 24). This was especially useful to us as you will see later in the paper.

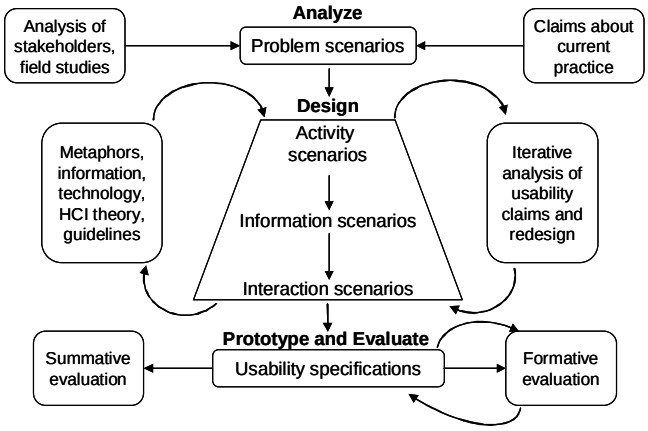

Figure 2 Scenario-Based Development Framework (Rosson & Carroll, 2002, p. 25)

As we moved forward with this process, we were forced to make assumptions and proceed in devising our own viable initial set of requirements until we could attain more information from a customer or user. We realized that homeland security would entail the collaboration of several agencies to provide surveillance and intelligence on a grand level. Recognizing the difficulty for several law enforcement agencies to share information in order to respond to emergencies and threats, we aimed to leverage our expertise in system integration, maritime domain awareness, and command and control systems to design a collaborative information-sharing system for maritime entities. Thus, we based our first set of requirements on literature, research, and current events as well as our own knowledge from our history of work with maritime security forces.

3.1 Player Requirements

The first step when creating the scenarios was to identify the players who would be responsible for homeland security. We structured the scenarios so that information from high-level intelligence sources would have to be shared with and disseminated to first responders and that information from the first responders would have to flow back up to higher level authorities.

Leveraging our maritime expertise, we designated the Coast Guard the main agency for gathering and disseminating information in our maritime homeland security schema. The Coast Guard has access to classified information and has the ability to sanitize data and pass it along to other lower-level/unclassified agencies. It also has the ability to guard, communicate, and defend through its fleet of surface and air vessels in the ocean as well as in local water ways and harbors. A second tier of the Coast Guard would be the Captain of the Port. Major harbors throughout the nation have a Captain of the Port who monitors and controls traffic in the harbor.

First responders were the other players in the scenarios of the system. We realized that a coordinating agency would be necessary to organize first responders in an area. This agency, which we identified as the Office of Emergency Management (OEM), would also be the entity that communicates with the Coast Guard in receiving and passing on information.

3.2 Collaboration Requirement

Drawing on our command and control expertise with maritime security forces, we were able to conceptualize the communication, coordination, and display of information for HLS. We conceptualized three-tiers of surveillance. The Coast Guard was positioned in the two higher tiers. The classified information would be accommodated by Coast Guard central command, likely acquired through other national intelligence agencies and possibly through sea and air assets near and far off the coasts. This high-level information would then be sanitized and passed on to the second tier Coast Guard entity, the Captain of the Port. The Captain is also beneficial in coordinating efforts with local authorities in guarding against threats. The OEM is the third tier of surveillance and response, which would coordinate the efforts of the first responders, mostly through sanitized information and direction from the Captain of

the Port. The OEM officials would also deliver information to the Captain who will pass it onto intelligence agencies. This command and control structure facilitates a collaborative environment of information flowing back and forth among all agencies.

3.3 Design Requirements

We were especially cognizant of the actual display of information to all agencies in order to present particular information to each player in each role. The intention was to ensure that all players have the same information, with sanitized information displayed where necessary. The focus of information display was to allow operators to quickly gain and maintain situational awareness so as to be aware of threats and to respond to them quickly. True situational awareness (SA) requires three components: perception, comprehension and projection. SA requires the perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and projection of their status in the near future (Endsley, 1995). Graphically representing information facilitated the timeliness of establishing and maintaining situational awareness. It also gave operators a context for understanding the information. The information representation and layout was consistent for all agencies so that they could share the same information and collaborate in providing security. From these requirements, we created a detailed scenario that addressed our proposed requirements and demonstrated capabilities for information sharing.

4 Prototyping the Scenario

After we developed our first set of user requirements and supporting scenarios we built an initial prototype to display the scenarios we envisioned. We used a rapid prototyping tool, Altia, to mock up our initial designs. We focused our designs on functionality that would be plausible for the scenarios we had devised. The most beneficial part of prototyping scenarios as opposed to a full functionality prototype is that only a subset of functionality has to be prototyped. Thus, this is a more cost effective and faster way to garner feedback from prospective customers and users. By prototyping the scenarios, we were able to conceptualize our ideas for information-sharing among several law enforcement agencies and had a vehicle to present our ideas to an audience involved in HLS.

We were fortunate to have the Business Development (BD) personnel use the prototyped scenarios as a conduit for discussion in order to stimulate customer interest in our HLS vision. This arrangement helped both parties. BD needed to foster customers' interest in what we were developing as well as have them believe we understood the problem and had solutions that would work. We used these demonstrations as "talk pieces" so we could get feedback from potential customers as to the validity of our scenarios, the scope of our understanding of the problem, and their opinion of our proposed solutions.

This began the iterative storyboard cycle. The BD demos turned into weekly occurrences that brought in people from various agencies with more requirements, issues to be solved, and suggestions for solutions. We constantly reconceptualized, updated, and refined the storyboards. After three months of refinement, we developed a sophisticated set of scenarios that encompassed many layers of HLS maritime communication for a multitude of possible HLS threats. In addition we collected a large set of requirements to continue our interface development without ever having a user or customer. Thus the use of scenario prototypes was a vital method for gathering user requirements.

5 Acquiring a User

In Fall 2003, we gained the attention of the Marine Safety Office (MSO) Group in Philadelphia, Pennsylvania. Showing the Coast Guard our prototyped scenarios gained their trust in that we understood the problems they faced, had a viable solution, and could implement it. They agreed to support us in developing a system for their monitoring of the waterways along the Delaware River in addition to integrating communication and standard operating procedures. This opportunity provided us with an actual user group on which to focus. In collaboration with the MSO, we began to design and build the first element in the system we had been envisioning.

Finally having a specific user group, we started the design process again following our waterfall UCD process with requirements gathering and task analysis. However, once we started to develop wire frame designs we discovered that we were not starting anew. We had a vision for what the larger system was to become and thus we found

ourselves able to design the current smaller system to be flexible enough to grow and be integrated into the final, full-functionality system in the future.

Prototyping our scenario was not without negative effects. We did find that we got easily mired in our old designs and found it hard to break free to develop new designs. We solved this problem by narrowing our focus on individual operators in the MSO command center and thus were able to refocus our understanding of what the specific operator goals and tasks would be. In understanding these goals and tasks, we were able to redesign the interface with a fresh perspective and one that was more focused on what the user wanted and expected.

Another negative consequence we encountered was that the prototype we developed set for our Business Development office and customers an expectation for a system that was immediately deliverable, which, of course, was not possible. We had to convince them both that for the first iteration we were only building a specific set of functionality and that it would be a number of iterations until the full system would be realized. Through the iterative process, we would be able to refine the functionality based on the customer feedback. Thus, we would assure a product that would address the users' needs for accomplishing the goals.

6 Conclusion

We learned from this situation that we can not always employ our standard UCD methodology. Situations arise that preclude us from following our processes and thus we have to utilize alternative methods. HCI theorists and practitioners should understand that learning UCD fundamentals and realizing that they are adaptable can help interface designers make the best choices for their projects.

Using scenario-based design on our particular problem led to Lockheed Martin expanding into a new business area. Because of our demos, we gained a customer by convincing the Coast Guard that we understood the scope of their problem and had viable solutions in mind. The interactive scenarios we demonstrated for potential customers and officials allowed us to engage our customers, which helped encourage discussions. Without these we would have been very limited in our ability to gather sufficient requirements, if any at all.

We also gained a clear understanding of the larger problem that faced homeland security and thus were able to create systems for individual agencies with the potential to be developed into a larger communication and response network. Had we started with one customer and not had gone through the larger system scenario cycle, we might have limited ourselves to a smaller agency-specific system that could not expand into a useful national system.

We are not claiming that this is the best way to work through the problem we faced. This is a situation that exemplifies the flexibility needed in using UCD methodologies. In interface design, UCD processes are not always capable of being executed in the exact manner they prescribe. Interface designers must realize that you can not always get a textbook problem. One must stay adaptable; guided by the process but not bound by it.

7 Acknowledgements

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