USING PERSONAS IN THE CAPSTONE DESIGN COURSE

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Abstract

In their study of design methodology, students learn that quality function deployment begins with identifying customer needs and requirements. However, when tackling their capstone design project, unless the customer requirements have been spelled out in detail by a client, the students find that they do not have the resources necessary to do the kind market research really needed to get useful customer input. Typically the students either conduct interviews with people they can easily reach – family, friends, and classmates – or they attempt to survey locally or on special interest websites. As one might expect, the results of these searches are not very useful. Little new or unexpected information is uncovered and the results are pretty much what the students would have surmised without ever getting this information. In an attempt to improve the process of gathering customer input we have introduced the students to the concept of personas and required each design team to spend some time developing a half-dozen personas representing the breadth and depth of their target market. Although in actual practice personas are composites of real customers identified after extensive market research, and here they are products of the students' imaginations, we expect these personas to become their real customers who will "tell" the design team what their needs and requirements are for the product being developed. They should also be able to go back to these "real" customers when additional information is needed or when they need to test a concept. An anecdotal comparison of the quality of customer needs and requirements gained from the use of personas and the previous method of gathering customer input is investigated to determine if the introduction of personas has improved the quality of customer input in our capstone design course.

1. Introduction

The capstone design experience in the Electrical and Mechanical Engineering programs at The University of Texas at Tyler is a two course sequence, Senior Design I and II, taught jointly by faculty in the two programs. The first course is a one credit hour course (one three-hour design studio per week) in which design teams take a project from product description through concept development, and into the early stages of system design. The course culminates in a Primary Design Document which describes in detail the steps taken in arriving at the final design concept and architecture. The second semester course is a three credit hour course (three, three-hour design studios per semester) in which the team completes their design, produces a prototype to validate the design, and submits a Final Design Report. This sequence is preceded by a three credit hour course in design methodology taken in the junior year.

To qualify as capstone design experiences, projects must have a number of characteristics, including that they involve the design of innovative, commercially viable products. Having learned user-centric methods of product design in their earlier design methodology course, the students are quickly faced with the problem of identifying customer needs as they set out to develop target specifications for their product. Unless the customer requirements have been spelled out in detail by a client, the students find that they do not have the resources necessary to do the kind market research really needed to get useful customer input. Typically the students either conduct interviews with people they can easily reach – family, friends, and classmates – or they attempt to survey locally or on special interest websites. As one might expect, the results of these searches are not very useful. Little new or unexpected information is uncovered and the results are pretty much what the students would have come up with without ever collecting this information.

As Dave Olson [1] remarked in his book, *Exploiting Chaos: Cashing in on the Realities of Software Development*, speaking about software developers but he could as well have been talking about any product developers:

> "Every software developer builds products for someone. The label for this 'someone' is the customer surrogate who lives in the developer's head. This customer surrogate whispers requirements more compelling than any found in requirements documents. This customer surrogate colors every development decision made."

> "But what does this customer look like? In the absence of any other influence, the customer surrogate looks just like the developer. You've probably heard statements like, 'Our customers won't want to do that: I never do.' "

To reduce the tendency to listen to the "whispers" coming from within the student's heads and in an attempt to improve the process of gathering more useful customer input, the Senior Design students this year were introduced to the concept of personas. Each design team was required to develop personas representing the breadth and depth of their target market. Although in actual practice personas are composites of customers constructed from extensive market research data, here they were products of the students' imagined representatives of the target market. These personas were to become their real customers who would "tell" the design team what their needs and requirements were for the product being developed. The team should be able to go back to these "real" customers when additional information is needed or when they need to test a concept.

2. Personas

2.1 What is a Persona?
Pruitt credits Alan Cooper [3] with popularizing the use of personas for user centered design in Cooper's book, *The Inmates Are Running the Asylum* [2]. Although only a single chapter in the book was devoted to a discussion of personas, they quickly gained popularity in the software industry. Cooper described personas as,

> "Not real people, but they represent them throughout the design process. They are hypothetical archetypes of actual users. Although they are imaginary, they are defined with significant rigor and precision."

Others expanded the definition and applied the concept to product development in areas outside the software arena.

Pruitt describes a persona as a "detailed description of an imaginary person constructed out of well-understood, highly specialized data about real people." The importance of the persona is that these "clearly defined, memorable representations of users remain conspicuous in the minds of those who design and build products." Personas provide a usable alternative to the nebulous "user." They create a concrete, focused, and stable definition of the intended audience [2]. Calde *et al* added that personas "represent distinct groupings of behaviors, goals, and motivations observed and identified during the research phase." [4]

In practice, the creation of personas is preceded by the collection and analysis of as much quantitative and qualitative information about users as possible, with the highest priority market segments getting the highest priority [5]. Personas, then, humanize this vast and disparate data by capitalizing on one's ability to remember details about individual people [2].

2.2 How is a persona constructed?
Calibria suggests writing the personas by adding details around the behavioural traits, selecting details from the market research, such as working environment, frustrations, relationships with others, skill level, and some demographics, and giving each persona a name and a photo. Additional tips include keeping the persona to one page, adding personal details without going overboard, and including goals [6].

Godwin describes personas as one or two page descriptions that include behavior patterns, goals, skills, attitudes, and environment with a few fictional details to bring the persona to life. She stresses that each persona should have three or four important goals that help focus the design. Some may be life goals, but only if they provide insight into the design. Others may be experience goals that describe how the persona wants to feel when using the design: confident, having fun, or even not feeling stupid. Most important, however, would be end goals focusing on what the persona would get out of using a well-designed product. These could involve the end results from using the product or the work product from it, or it could even involve indirect benefits such as increased efficiency or lower costs [7].

The New Product Design and Business Development program at the University of Minnesota uses the following format for developing a persona [8]:

Name the person. Choose a realistic name, but not the name of any of your interviewees.

Demographics. List key information in a compact table. Age, occupation, location, income, education, marital status, hobbies, and anything else relevant to the product. You should list things like marital status and hobbies even if they appear on the surface not to be relevant. For example, a doctor with a hobby of playing video games may be more amenable to a PDA front end on a high tech medical devices.

Introduce the person. Summarize the person's job, activity, hobby. Write in third person as if the person were responding to the question, "What do you do?"

Describe the person's roles and tasks. One paragraph about what the person does (job, hobby or activity) that may relate to the product and the tasks that make up the activity. This paragraph sets the context for the product.

List the person's goals. A list and description of two or three goals related to the user and the task. What is this person trying to accomplish? What would they like to do better?

Photo. A stock photo, either headshot or full length. Age and gender match. Expression should match the person you are describing. Can be in context, but should show the face. Never use the photo of anyone you know or interviewed.

Quote. Include a characteristic quote that summarizes what the person does, what they need or how they feel about their job, hobby, kids (whatever is relevant). The quote should not be made up, but rather derived from quotes heard during the customer interviews.

The description is limited to one page, using an easy to read layout that follows good graphic design principles.

2.3 How effective are personas in product design?

Long [9] conducted a study at the National College of Art and Design (NCAD) in Dublin, Ireland, to assess and measure the effectiveness of using personas as a design tool giving designers any advantage in designing more effective and user-centered solutions. A group of third year Industrial Design students at NCAD were assigned a five-week design project. The group was divided into three groups. Two of the groups were given a persona that matched the target-user demographic outlined in the project brief.   The third group received only the design brief. The persona provided personal information about the fictitious character, her likes and dislikes, her home environment, and her attitude toward new technology. It described how she currently used the product. Her personal goals and those of the client were included. These goals were contained in the project brief provided to all three groups. The persona given to one of the groups included a photographic image and a text-based task scenario while the other had only an illustrated image with the persona and a storyboard task scenario.

In the end each project was evaluated using Nielsen's usability heuristics. The teams that used the persona scored higher than the control group without the persona (10.33 and 5.67 to 2.67 for the control.) Long concluded that the groups receiving the persona had a greater understanding of the user needs and designed solutions around the user-critical tasks to a greater degree than the control group. The gap between the control group and the persona groups was significantly larger at the research and concept stages, but the gap had narrowed by the end of the project. The two design teams having received the persona had a clear perception of who they were designing for and what the users' goals were. While in the end the control group also identified and addressed many of the design problems, it took them longer to reach this stage.

3. Methodology

In their Senior Design I course, students are presented a list of design topics to bid on for their senior design project. They return bids on three topics, in ranked order, which include their resumes, their interests in the particular design topics, and any special skills they possess that might apply. After the bids are received and reviewed by the instructors, design teams composed of three or more students are assembled for the projects receiving the most bids and staffed wherever possible by students who had the design topic as their first or second choice.

The topics are presented as requests for proposals (RFP's) describing in general what is desired, who the potential customers are, and what the deliverables are to be. The team that wins the bid for a particular topic then fleshes out what the product description will be in its response to the RFP. One of the first steps the team must take is to learn more about the market for the product. Except for projects sponsored by external clients where the client provides the customer needs, the design teams must identify what the customer needs are for the target market(s) identified for the product they are to develop.

This year, early in the first course but before any design had been attempted, several hours of class time were devoted to describing what personas are, explaining how they are used in the design world, and providing several references with persona examples and templates for constructing them. Each design team then developed a half-dozen personas representing the breadth and depth of their target market.

The teams then used their personas to develop the target specifications for their design. They were expected to continue to use their personas as they developed their final design specifications and later as questions arose where additional customer input might be needed.

This study presents an anecdotal comparison of the quality of customer needs and requirements gained from the use of personas and the previous method of gathering customer input to determine if the introduction of personas has improved the quality of customer input in the capstone design course.

4. Measuring the Success

4.1 Personas
The personas the teams developed were of varied format and quality. This was the students' first experience in developing personas. They had never before used personas to develop customer needs. The following are excerpts from personas submitted by several teams.

Example 1 (Project: Design of a novel propulsion system for a trolling boat)
> *Kevin is a 34 year old professional bass angler that travels all over the United States fishing bass tournaments year round for seven years now. In the last five years he has earned $600,000 from winnings and sponsors. He lives in Orlando, Florida with his wife and kid. When Kevin is not fishing, he loves spending time with his family and occasionally playing a round of golf.*

Kevin gets a new bass boat every two years from his sponsoring company Nitro along with other fishing equipment from Bass Pro Shops. These sponsors use Kevin to advertise their products by winning bass tournaments and staying in the spotlight. Kevin knows that if he fails to do well in these tournaments that these sponsors may cease to do so and that he will not provide for his family. Because of this, Kevin is always asking for the best equipment to help him catch more and bigger bass.

Kevin's goals are to win the Bass Master Classic tournament to prove his skills to others and to bring in more cash flow to provide for his family. Kevin also wants to be able to spend time with his family and understands that to be able to do this he must win more money with fewer tournaments so he can be home more.

Example 2 (Project: Design an automated trap shooting system)

__Name:__ Marge Belvadere

__Demographics:__ Marge is a 31 year old British married woman who works as a secretary for a local insurance company. Marge and her husband are middle class citizens that have just invested in a ranch due to her husband's avid hunting and clay pigeon shooting. Marge has picked up on both of her husband's hobbies and would love to learn more and advance in her skills of shooting. Her husband is teaching her daily about clay pigeon and hunting.

__Introduction:__ My name is Marge Belvadere I am a British citizen and I have been employed at my job at the insurance company for 10 years. I believe that spending time with my family is the most important thing in the world. I have always looked for something that my husband and I could share as a hobby and both enjoy. During the first 13 years of mine and my husband's marriage, he would go hunting only in certain seasons. When it wasn't hunting season, to keep his shooting accurate, he would shoot clay pigeons , and he fell in love with the sport. I eventually joined him on one of his trips to shoot clay pigeons, and I enjoyed watching and always wanted to learn. Finally, I told my husband that I would love to learn how to shoot as accurately as him, and this was also a way for us to get closer. I first started with target shooting and progressed into shooting clay pigeons, but I noticed that something was missing. I finally figured out that I would love to be more challenged.

__Roles and Tasks:__ My role as a mother and wife is to find more interesting and fun events that I can share with my family. To make memories that they will never forget even when I am not around anymore; Also memories that they can pass down to my grandchildren, to continue the family tradition.

__Goals:__ To be as good as or even better than my husband at clay pigeon shooting. To teach my children and grandchildren a new sport and hobby that we can all share. Also, to spend time with my family before I no longer have time.

Example 3 (Project: Design a realistic ground ball hitting machine for infield practice)

Greg is 36 years old and is a Nuclear Medicine Technician at Pacific Medical Imaging, Inc. in Los Angeles, California. Greg has been with Pacific Medical Imaging for 8 years. His job requirements consist of administering radiopharmaceuticals to patients and then monitoring the characteristics of the tissues and organs in which the drugs effect, as well as dealing with x-rays. Greg spends his spare time working with his two sons, Chad 13

years old and William 9 years old, in which they go hiking, play catch, or relax at home by watching movies. When Greg isn't working or spending time with his two sons, he enjoys working out, and continuously being athletic by going to the gym.

Greg and his wife are very active with both of their boys playing baseball. Chad plays second base for the Los Angeles Big Chiefs. Greg highly supports Chad in playing baseball, as Chad possesses natural talent and ability for the sport, and is striving to further his baseball career. By supporting Chad, Greg has a batting cage, with a pitching machine to allow Chad to practice daily to polish his hitting skills. Greg feels that there still needs to be a better way to allow his son Chad to work on his infield ball practice. By having a consistent, repetitive, realistic infield practice machine, Greg believes that this would be the perfect tool to sharpen his sons' skills and put him a step above everybody else.

All three of the examples painted imaginative pictures that humanized the intended user and brought them to life. The personas' life goals were expressed, but they all lacked those three or four important end goals that Godwin [7] says are required to focus the design. The next two examples did a better job providing design focusing goals.

Example 4 (Project: Design an auto-tuning Yagi antenna system)
> ***Name:*** *Barney Fife (Law Enforcement)*
> ***Introduction:*** *Barney has been a police officer for 10 years. He married his high school sweetheart and has 2 kids. He enjoys watching NASCAR races when he is off duty.*
> ***Roles and Tasks:*** *Barney uses radios to communicate with the dispatchers, without radios he would be cutoff and unable to do his job. There is an HF radio at the station that is used as a backup communications system. He wants to be able to use all the equipment without having to try and remember what the communications system coordinator said 8 months ago in the emergency communications course he had to attend.*
> ***Goals:*** *To easily maintain an open line of communication. To be able to use the backup radio system without pulling out the rest of his hair.*

Design focusing goals were expressed explicitly in the Roles and Tasks section and in the Goals section in this example.

Example 5 (Project: Design a means of removing zebra mussels and debris from pump station intakes)
> *Mr. Richard Ellis has worked in the Martin Creek power plant for 15 years, working his way up from maintenance to supervisor of operations. Mr. Ellis is married and has two kids, living in a 3 bedroom 2 bathroom house on two acres in the county. Mr. Ellis grew up in the area and visited the state park neighboring the power plant. His application for employment was accepted and his career began training for his job at Martin Creek power plant. Richard has not worked with technology as much as he would like but is competent in the use of the internet and basic programs such as basic word processing and computer games. Richard has a brand new blackberry and uses it for many things such as, multitasking, internet and contact and often times it the only technology that he uses.*

Since starting his job at the power plant Richard has always worked long hours in order to get ahead and be successful in his workplace. The average workweek that Richard first experienced was around 60 hours per week. The amount Richard has been working has decreased a little bit to around 45-50 hours per week but there are still the occasions that he must work 60 hour weeks to get caught up. The added responsibilities of becoming a supervisor have increased Richards pay and helped lower the amount of hours that he needs to complete his job. The increased responsibility also increased the amount of things that Richard must do during his time at work. Some of his duties include overseeing operations of the maintenance and labor management. Mr. Ellis Drives a fuel-efficient Toyota Camry and on nice days rides his motorcycle to work. Richard's job at the power plant is a good steady job that does not seem to have a very high dependence on the economic conditions. His position seems stable because everyone needs electricity and there will always be a need for workers to operate the machinery that produces electricity.

The main goals of the plant are to produce energy as clean and efficiently as possible, to reduce the environmental impact that the plant has on the surrounding environment, and to continue to supply enough power to meet the growing demands. In the area serviced by the Martin Creek power plant there are millions of homes and businesses that are relying on the service of the power plant. The plant uses water from Martin Lake, to produce energy, which the plant is located on. One of the key maintenance issues that Mr. Ellis has encountered in his position is the cleaning of the water intake pipe. Mr. Ellis says that the screen on the intake gets clogged constantly and must be routinely cleaned to keep enough water flowing to operate the plant. Mr. Ellis said that In his 15 years at the power plant he has been witness to the intake being so clogged up that the plant was forced to shut down temporarily. The task of cleaning the pipe is not a simple one. It takes a lot of manpower and time to clean the mollusks, lake weeds, and debris from the screen. The job is also a particularly dangerous job, says Richard, to clean the grate the employees must hang by safety lines and lean out over the spillway with manual hand rakes to clean it. There have been two incidents where employees have been injured cleaning the screen. Overall though Mr. Ellis enjoys his position at the power plant and looks forward to many more years at the plant working to help get electricity to the surrounding people.

The persona of Example 5, although long and rambling, contained several implicit design-related goals. In the first paragraph the persona was described as just beginning to use the newer technologies. This raised the question as to whether he would welcome a high tech design solution. In the third paragraph the persona revealed that the current methods are labor intensive and that he had witnessed some of the dangers they present. All of these observations could be reworded as design-oriented goals.

4.2 Target Specifications
The target specifications developed for design projects having personas like those in Examples 1, 2, and 3, if based at all on the personas, would have had to have come entirely from suppositions about what the lifestyles of the personas predicted the user needed in the design. These personas contained demographics, behavioral traits, relationships, and life goals but no goals focused on

what the persona wanted from the product or how it wanted to interact with it. While in most cases the target specifications the teams developed were well written and useful in the design process, they were in fact developed just as they would have been in previous years – they were almost entirely whatever the design team thought they or any user would want in such a product.

By contrast the target specifications for the design projects for which Examples 4 and 5 were typical could be traced back to many of the design-based goals found in the personas, although sometimes these goals were expressed only implicitly. In their final report on the design process through the system-level design, these design teams were able to cross-reference most of the target specifications with goals derived from the personas.

5. Conclusions

The anecdotal evidence of this study suggests that well-written personas, in particular those that contain design-focusing goals as described by Godwin [7] can provide a solid basis for user-centered target specifications.

Are these better than those the design team, acting as surrogate users, can come up with? Pruitt believes that personas provide a stable, concrete, focused definition of the intended user [2]. Past experience has shown that without the clear images and understanding of who the users are that personas can provide, "what the user wants" becomes a moving target resulting in significant creep away from the original design specifications. In the end, the final design solution tends to evolve into being more what the design team thinks it should be. This can be risky in the marketplace – the final design solution may have distanced itself from its customers.

This experiment with using personas in the capstone design course as a replacement for real market data will be continued in the future but the students will have to receive more training in creating useful personas for it to be a success. This initial study has shown how important it is to emphasize that while life goals for the personas tell us something about the persona, it is the end goals, the design focusing goals, that must be included to provide real guidance in establishing user needs and target specifications.

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