UTILIZING VIRTUAL SIMULATION TECHNOLOGY TO INCREASE IMPLEMENTATION OF SAFE AGING IN PLACE MODIFICATIONS

by

Denise Rae McAllister

A Dissertation

Submitted to the Faculty of Purdue University

In Partial Fulfillment of the Requirements for the degree of

Doctor of Philosophy

Department of Construction Management Technology

West Lafayette, Indiana

August 2019

THE PURDUE UNIVERSITY GRADUATE SCHOOL
STATEMENT OF COMMITTEE APPROVAL

Dr. Emad Elwakil, Chair

School of Construction Management Technology

Dr. Kareshmeh Afsari

School of Construction Management Technology

Dr. Brandon Pitts

School of Industrial Engineering

Dr. Bryan Hubbard

School of Construction Management Technology

Approved by:

Dr. Yi Jiang

Head of the Graduate Program

This work is dedicated to my father, Thomas J. McAllister. His passion for and devotion to education set me on the path I am now completing. His early message, "meaningful work is the key to happiness" set in me a resolve to always seek meaning in my work. During my 3rd year at Purdue, Dad came to visit me on campus. As we were walking to lunch at the John Purdue Room, past John Purdue's grave, Dad told me a story I had never heard. When I was a baby, and he in his early 20's, he hitchhiked to Purdue from Vincennes Indiana to inquire about the possibility of studying engineering. He realized during that visit he would not be able to pursue the goal of a Purdue engineering degree while providing for his young wife and growing family. He didn't seem the least bit disappointed, he was merely sharing a memory that came to him as we walked across Memorial Mall. Perhaps that is one of the many reasons he was beside himself with excitement as I approached my graduation. On July 11, 2019, my father was struck and killed while crossing the street during his early morning stroll. It is to my deepest regret that he was unable to see me walk across the stage, but, in his mind, he knew without a doubt that I was going to make it. The last voice mail he left for me, a few days before he died, reminded me that if I couldn't find a citation for something in my dissertation at this late date, it would be perfectly fine to just delete that information because I likely had way more than I needed.

I love you, Dad.

ACKNOWLEDGMENTS

I would like to express my deepest gratitude and sincere appreciation to my advisor Dr. Emad Elwakil, for his enthusiastic and firm guidance. I would also like to thank Dr. Kareshmeh Afsari, Dr. Brandon Pitts, and Dr. Bryan Hubbard for your continued wisdom and their unending willingness to share it with me. Thank you to Dr. Daphene Koch who worked with me on the preliminary phases before leaving Purdue. I would also like to acknowledge my Mater's Committee. Many thanks to Dr. Randy Rapp, Dr. H.J. Kwon and Dr. Mark Shaurette. You helped me set a firm foundation for this study. It has been an honor to work with all of you and learn from your invaluable experience.

Lastly, I could never have completed this pursuit without the support of my family, especially my five children, my parents and my siblings. They have certainly traveled this journey with me.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AI	Persons Interested in Aging in Place for Themselves
CP	Construction Professional
DP	Design Professional
FF	Friends and Family Members Interested in Aging in Place
HP	Health Care Professional
StatSig	Statistical Significance
WT	Walkthrough

ABSTRACT

Author: McAllister, Denise, R. PhD
Institution: Purdue University
Degree Received: August 2019
Title: Utilizing Architectural Visualization Technology to Enhance Confidence in Safe Aging in Place Modification
Committee Chair: Emad Elwakil

Dedicated industry professionals from design, construction, and health care are working to provide attractive, constructible, functional and safe home modifications for aging in place. The commitment is to keep senior members of local communities in the homes they love, rather than to segregate them into big box retirement communities. This study explores the confidence level of both individuals interested in aging place for themselves and their friends and family members in aging in place modifications. In additions to those interested in aging in place for themselves and their friends and family members, invested professionals from design, construction and health care are surveyed to measure their confidence in common modifications. A 3d walkthrough is tested to investigate if confidence levels increase with the use of a walkthrough to communicate recommended modifications.

Friends and family members of those intending to age in place were significantly more concerned about the safety of their aging person, than the aging person themselves. Those friends and family members were also more impacted by viewing the video walkthrough than any of the other groups.

CHAPTER 1. INTRODUCTION

This chapter describes the scope, significance, definitions, as well as assumptions, limitations and delimitations of this research study. The study ~~which~~ tested user confidence inspired by the utilization of a digital, 3D walkthrough of suburban, Midwestern ranch home featuring products and construction modifications intended to support safe aging in place.

1.1 Scope

This project proposes to use architectural visualization technology in the form of a digital walkthrough of a 1970's ranch home to test this design communication method. The walkthrough was creating using Building Information Modeling software exported into 3D rendering and animation software. The walkthrough communicates structural and non-structural modifications and products and amenities which support safe, attractive and comfortable aging in place. The walk-through focuses on egress to and a tour of the master bathroom. Study participants included older adults, their friends and family members, and involved designer, construction and health care professionals. Utilizing a digital walkthrough, a tour of potential home modifications derived from an American Association for Retired Persons (AARP) checklist and a checklist created by researcher H.J. Kwon and Judith Beamish (Kwon H. B., Boomers housing for later life: Comparison of multifamily housing communities and senior housing communities, 2010) (McAllister Wilder D. , Universal Design Project Check list, 2014) allows users to experience products and home modification strategies intended to support their needs to safely and comfortably age in place. The architectural visualization was created utilizing the same design process a construction or design professional would use. A project program, or overview, was written utilizing a persona representing an older adult who does not use a wheelchair but struggles with strength and mobility issues. Conceptual design drawings were made of a proposed floor plan. Those drawings were then reviewed with design and construction professionals. From the findings from those reviews, a 3D walkthrough was created and inserted into the survey. The survey with the imbedded walkthrough was pilot tested on thirty-eight individuals with several iterations occurring during the testing phase in response to their comments. The final iteration of the survey with the imbedded 3D walkthrough was created to test a snowball sample of the population regarding their confidence in the visualized products and modifications.

1.2 Significance

When considering the significance of the problem being investigated in this study, literature was reviewed regarding the size and anticipated growth of the aging population. Also reviewed was the anticipated impact on the housing stock in the United States as well as on the economy. The effect of existing housing types on the ability for a person to remain independent was explored. It was found a significant amount of research in this area is being done by those in

Figure 1.1 below graphically represents this information.

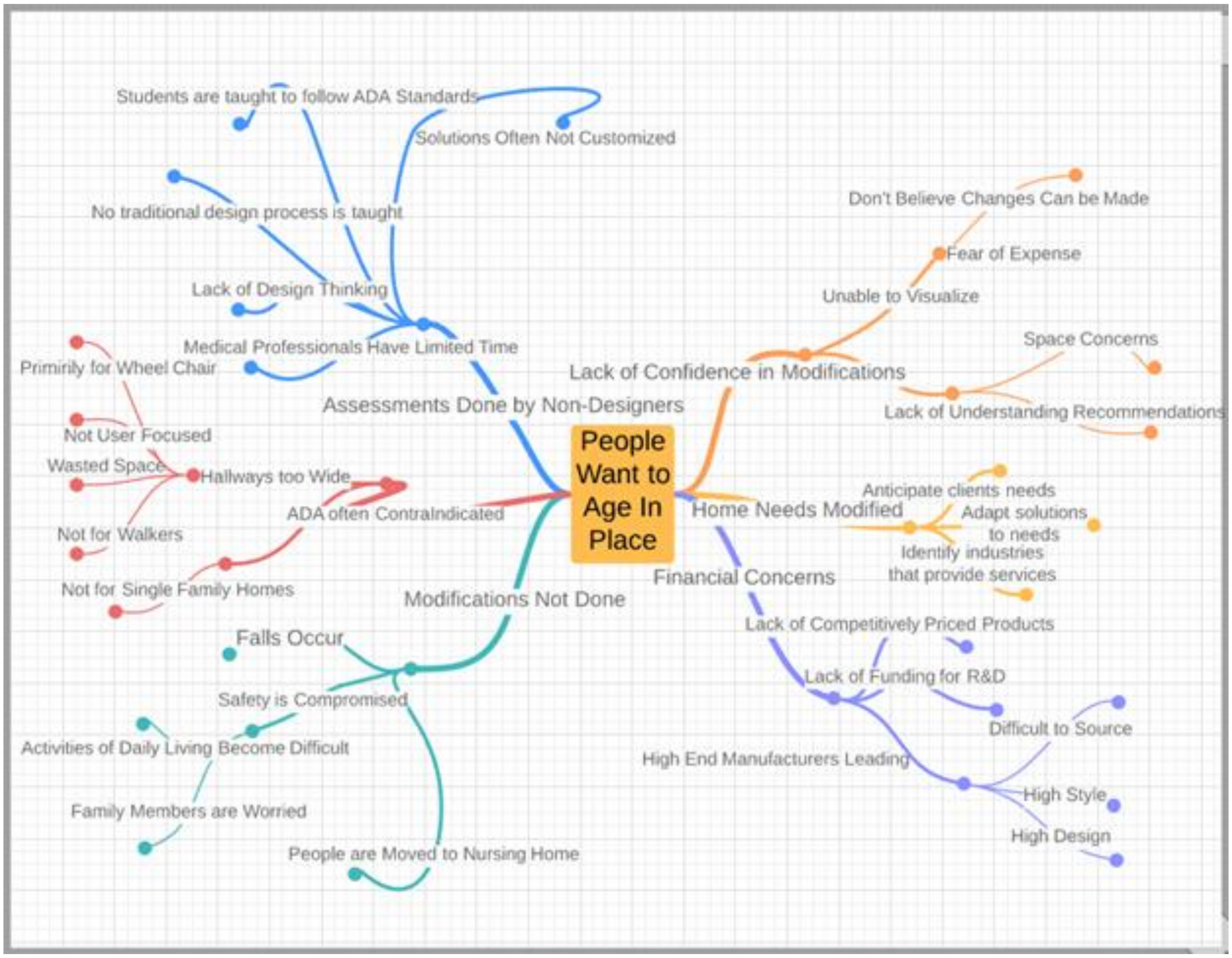


Figure 1.1 Significance of the Problem

The elderly population of the United States is large and growing rapidly and expected to have a significant impact on the nation's housing needs and on the nation's economy (Smith, 1987). Since disability rates increase with age, population aging will bring substantial increases in the number of persons with physical limitations and on the nation's economy (Blackburn, 2013). Inadequacies in home design cause disability in inhabitants by not allowing those with physical limitations to function safely (Sarah L Szanton, 2011). Most research is being done through a medical lens (Kwon H. A., 2015) which leaves those in the design industry underrepresented in the literature. Additionally, large sections of the population are not aware of many of the products and modifications available. Designers instinctively design for able-bodied users and are either unaware of the needs of users with different capabilities, or do not know how to accommodate their needs (Keates, 2006).

Research indicates environmental factors both in and outside of the home contribute barriers to successful aging in place (Aging in Place and Remodeling, 2017) (Mather, 2016) (McAllister-Wilder, 2017). The literature also points to the importance of home modifications in ensuring a safe, healthy home which contributes to the well-being of the aging individual. The aging population has concerns about remaining independent and safe in their homes, in part because there are very few examples of attractive solutions for making the adaptations they need. The nation's housing needs are expected to be impacted by the expanding elderly population in the United States (Aging Statistics, 2008) (McAllister Wilder D. , The effects of common diseases on mobility, 2011). Falls amongst the elderly in their homes are a leading cause of trauma which often lead to disability and subsequent admission to a nursing facility (Thorsten Nikolaus, 2003).

Respondents who had higher residential satisfaction with their housing unit were more likely to desire to age in place (Kwon H. A., 2015). Additionally, smart home technology can support safety for those aging in place (Kwon S. , 2016). Interactive architectural visualization allows the user to interact with the visualized environment (Heimgartner, 2017) which can assist study participants experience the scale of proposed home modifications in relationship to their own proxemic realities.

The purpose of this project was to test a 3D animated walkthrough of home modifications to determine if it can increase confidence in recommended modifications for persons interested in aging in place themselves as well as their friends and family members. Design, health care and construction professionals who design spaces which support the safety and comfort of persons aging in place would be able to use this tool, once available, to increase the acceptance and implementation of recommended modifications.

by assist design, health care, and construction professionals who design spaces which support the safety and comfort of persons aging in place. As a result of seeing the walkthrough,

Objectives were to study the confidence level of common home modifications by older adults and their friends and family members. Home modifications which are recommended to allow older adults to live independently, comfortably and safely in the home of their choice were shown in the walkthrough and questioned about in the survey. Confidence levels were tested both before and after viewing the 3D, animated, walkthrough. Modifications considered were an entrance ramp, wider doorways and hallways, handrails by stairs, grab bars in bath and toileting areas, a walk-in shower with a built-in seat and both a taller, comfort height toilet and a smart toilet. By considering their confidence in the studied modifications both before and after participants viewed the walkthrough, the researcher hoped to test the impact of a 3D, animated, walkthrough which could potentially be used by professionals making recommendations for home modifications for successfully aging in place.

Many people who would like to age in place are coerced to leave their homes when simple, cost effective modifications could be made to allow them to age in place safely (Thordardottir B. M., 2018) (Brandt, 2014). Because most research about aging in place is conducted through a medical rather than a design/construction lens, looking at the issue from an interior design, construction and architectural lens brings the design thinking process into the efforts to effectively design and communicate solutions for adapting an existing home for comfortably and safely aging in place.

According to Frieden (Frieden T. , 2013):

- One in four Americans aged 65+ falls each year.
- Every 11 seconds, an older adult is treated in the emergency room for a fall; every 19 minutes, some older adult dies from a fall.
- Falls are the leading cause of fatal injury and the most common cause of non-fatal trauma-related hospital admissions among older adults.
- Falls result in more than 2.8 million injuries treated in emergency departments annually, including over 800,000 hospitalizations and more than 27,000 deaths.
- In 2014, the total cost of fall injuries was $31 billion.
- The financial toll for older adult falls is expected to increase as the population ages and may reach $67.7 billion by 2020 (Frieden T. , 2013).

1.3 Definitions

Accessible design:

“To design accessible, or for universal access, requires the designers to design for the wants, needs and aspirations of a diverse range of users, many of whom will differ significantly from the designer’s experience.” (Keates, 2006, p. 269) (Lidwell, 2003)

BIM: (Building Information Modeling)

An intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to plan more efficiently, design, construct, and manage buildings and infrastructure (What is BIM, 2017).

Confidence:

The belief that one can rely on something. Confidence is measured by the trust, belief, or faith the respondent has on the attractiveness, constructability, functionality, and safety of recommended modifications for aging in place (Webster's Dictionary, 2018).

Home Modifications:

The conversion or adaptation of the residential environment to make performing tasks easier, reduce accidents, and support independent living (Home Mods, 2017).

Inclusive design:

To design inclusively, or for universal access, requires the designers to design for the wants, needs, and aspirations of a diverse range of users, many of whom will differ significantly from the designers' experiences" (Keates, 2006, p. 269). For this study, the term accessible design will be used because it is believed to be most widely understood in the residential design and construction industry.

Older Adult:

Generally defined according to a range of characteristics including chronological age, change in social role and changes in functional abilities. In high-resourced countries older age is generally defined in relation to retirement from paid employment and receipt of a pension, at 60 or 65 years (Definition of an older or elderly person, 2010).

Safety:

The condition of being protected from or unlikely to cause danger, risk, or injury (Slip, Trip and Fall Prevention, 2016).

Single Family Home:

> "The single-family statistics include fully detached, semi-detached (semi attached, side-by-side), row houses, and townhouses. In the case of attached units, each must be separated from the adjacent unit by a ground-to-roof wall to be classified as a single-family structure. Also, these units must not share heating/air-conditioning systems or utilities" (United States Census Bureau, 2016).

1.4 Research Questions and Hypothesis

RQ1: Does a digital walk-through increase the confidence level of professionals and end users in the potential of proposed home modifications intended to support safe, comfortable and attractive aging in place?

RQ2: What differences in confidence level exist between studied groups. Group one includes older adults and their family members. Group two includes professional designers, construction professionals and medical professionals

Hypothesis: The use of an architectural visualization tool created by combining building information modeling software with 3D rendering and animation software to create a digital, 3D walk-through can communicate recommended modifications which allow older adults to safely and comfortably remain independent in their homes thus influencing the confidence in those modifications.

1.5 The Gap

Despite evidence regarding the importance and effectiveness of home modifications for aging in place, people are reluctant to follow the recommendations made by health care, construction, hospital discharge and design professionals. Significantly, most of the home assessments and resulting recommendations are made by those in medical, geriatric and social science fields rather than design professionals such as interior designers and architects.

Non-design professionals are not as skilled at communicating design solutions to their clients. Many are certified to conduct home assessments to determine needed modifications; the methods used to communicate those recommendations often include low technology methods such as verbal descriptions. As shown in the findings of this dissertation, friends and family members of persons hoping to age in place have significant concerns and a measuredly greater lack of confidence in common modifications.

According to the U.S. Centers for Disease Control and Prevention: (Prevention, 2006)

- Falls are the leading cause of fatal injury and the most common cause of nonfatal trauma-related hospital admissions among older adults.
- Falls result in more than 2.8 million injuries treated in emergency departments annually, including over 800,000 hospitalizations and more than 27,000 deaths.
- In 2014, the total cost of fall injuries was $31 billion.
- The financial toll for older adult falls is expected to increase as the population ages and may reach $67.7 billion by 2020. (Frieden, 2013)
- Many people do not have confidence in safe home modifications to support aging in place

The American Association of Retired Persons (AARP) identified housing features that seniors find are especially important in the later years as they begin to experience reduced eyesight, poorer balance, and reduced flexibility. Those features include:

- Safety features such as non-slip floor surfaces
- Bathroom aides such as grab bars
- A personal alert system that allows people to call for help in emergencies
- Entrance without steps
- Wider doorways
- Lever door handles
- Higher electrical outlets
- Lower electrical switches

1.6 Limitations

The limitations of this research study include:

- Participants in the study may have already decided against remodeling an existing home in favor of a fresh start in a new home.
- Participants in the study may be from a higher socio-economic class and therefore may not have significant empathy for less privileged individuals.
- This study focused on perceptions made from viewing the provided digital walk through of selected modifications made to a midcentury ranch home.
- Participants feelings about styles and colors, beyond the modifications being studied, may bias them against the visualization.
- While comparisons are made between those interested in aging in place for themselves and those interested in a friend or family member, they are not matched sets.

1.7 Delimitations

The following delimitations were fundamental to this study

- This research is not expected to uncover all hidden biases of home modifications which are recommended to assist in aging in place.
- This study does not identify prejudices participants might have about the feasibility of remodeling their home or the home of their family members.
- Participants of the study had higher education levels than the general population.
- Participants may have chosen to participate in the study because they have previous experience with the topic or higher than average level of interest.

1.8 Summary

This chapter explores the challenge to communicate, through architectural visualization in the form of a digital walkthrough, products and home modifications which can increase the safety of an existing home for those desiring to age in place. It explains the scope of the study and the significance of the problem while exploring how the study might contribute to the residential design and construction industry. Lastly, a list of defined key terms is provided as well as related limitations and delimitations.

CHAPTER 2. REVIEW OF RELEVANT LITERATURE

2.1 Introduction

There is significant literature regarding various issues facing the growing population of older adults (Wilder, 2018). Weakening cognitive and physical health conflict with the ability to maintain independence. Architects, designers and real estate developers are building state of the art facilities to providing resort type accommodations for the elderly. Fine dining on site, light filled gyms designed for a plethora of exercise opportunities and opportunities to socialize with like-minded individuals are advertised. Unfortunately, such planned communities segregate the aging demographic from the rest of society and denies the communities in which they live, at least in part, the resources and experiences of older adults. This literature review looks at amenities conducive to safe aging in place and smart home technologies that provide support. Qualities of Continuing Care Retirement Communities (CCRC) are considered regarding a defined list of supportive characteristics and the impact of such strategies on neighboring cities and towns. Additionally, literature regarding the possibility of retrofitting existing homes and the features most essential to safe aging in place is reviewed. The role of architectural simulation utilizing building information modeling combined with gaming software is examined as a potentially effective method of presenting products and modifications which promote safety for those aging in place. Lastly, future directions are examined.

It is known that the population is aging and will need universally designed housing to enable their safety as physical effects of aging are experienced. It is also known that a significant percentage of the aging population is living in the Midwest (Wilder, 2018). A recent study conducted by the researcher determined that older adults and related stakeholders are willing to spend money on home modifications to support safety when aging in place. Certain home modifications are known to create a safer environment for aging while smart home technology is known to support independence of older adults in their homes. Lastly, rendering and animation software, used with 3D modeling software can be used to better communicate proposed home modifications.

2.2 Growing Needs

A large majority of people wish to stay in their homes and retain personal independence as they age. Not being able to do so causes concern (Kwon H. B., Boomers housing for later life: Comparison of multifamily housing communities and senior housing communities, 2010). Approximately 14.1 percent of the U.S. population, or 40 million Americans, were at least 65 years old in the year 2013. By 2040, there will be nearly twice as many and 28 million of them will be at least 80 years old, according to Census Bureau projections (quickfacts.census.gov, 2015). A small percentage of these aging Americans are residing in continuing care retirement communities. Many more have chosen to stay in their homes, often located in naturally occurring retirement communities where more than 50 percent of the homeowners are over the age of 65 (Memken, 2007) (Wilder, 2018).

A program known as CAPABLE (Community Aging in Place--Advancing Better Living for Elders) has been developed at the Johns Hopkins School of Nursing to empower low-income seniors to safely age in place (CAPABLE Community Aging in Place--Advancing Better Living for Elders, 2016) (Ruiz, 2017). CAPABLE addresses both environmental qualities of the home as well as the cost of needed modifications. The program forms teams of professionals which include a nurse, an occupational therapist, and a handyman. The team's objective is to address both the home environment while using the capabilities of the older adults themselves to improve their safety and independence.

2.3 User Perceptions

Community Aging in Place--Advancing Better Living for Elders

Table 2. 1 Symptoms and Design Solutions to Common Diseases

Disease	**Symptoms**	**Design Solutions**
Gait Disorders	Uneven Walk	Even floors, accessible grab bars
Parkinson's Disease	Instability, Fatigue	Grab bars, ambient lighting
Rheumatoid Arthritis	Strength Limits	Ease to grasp hardware
Osteoarthritis, Osteoporosis	Strength Limits	Accessible hardware, grab bars
Arthritis	Strength Limits, Mobility Issues	Ergonomically designed tools
COPD	Breathing Difficulty	Mobile trash containers, air quality control
Cardiac Disease	Systolic and Dialogic Failure	Supportive furniture, equipment
Polymyalgia	Limited Range of Motion	Easily reached, accessible furniture, fixtures, and equipment
Glaucoma	Reduced Vision	Tactile solutions, color choices, contrast control

2.3.1 Designing for Changes in Spatial Memory

Spatial memory, the ability to recall where objects are in relation to each other in space, (Hooyman; Kayak pg. 194) appears to decline with age. Studies have not definitively determined whether the problem is in encoding and processing the information or in retrieving the available information (McAllister Wilder D. , Designing for Changes in Spatial Memory, 2012).

There are many modifications of a home that can assist persons as they age when it comes to the supporting loss of spatial memory. According to Cynthia Leibrock, in her book "Design Details for Health", there are many things that can help a person orient themselves in their living space (Leibrock, 2011). One simple tactic is to include a bulletin board in a room where a lot of time is spent. That board can be used for seasonal displays or to post the day of the week and scheduled events. A calendar and clock are also important to assist in orientation. Because it is easy for the elderly to lose track of time, even to the point of not being sure if it is day or night, providing a space with a view of the outdoors is also essential to wellbeing.

In public spaces, disorientation can be caused by repetitive elements in the design. A long corridor with doors on both sides can be confusing for any user, but particularly so for a person with limited spatial memory. Lighting and ceiling effects can be used to break up the long spaces and minimize disorientation. Walking and visual distances can also be shortened by providing seating in niches every twenty feet. The seating serves a dual purpose, allowing those with physical limitations the opportunity to rest as well as the confidence to move about the facility as well as providing those with cognitive spatial memory issues to better orient themselves in the environment.

Orientation can also be improved or reduced by pattern (Leibrock, 2011, p. 86). It is always best to eliminate bold patterns, stripes, and undulating patterns. However, older people maybe feel more comfortable with subtle patterns from the era when they were in their prime. For the younger old, those aged 65 to 74 (The population 65 years and older: 2016, 2016) (Little, 2016), this is becoming more of the mid-century look, which can be described as modern or contemporary. The current use of very traditional design styles in housing for the elderly might need to move more toward the styles popular in the 50's and 60's. Many older adults are drawn to the clean lines and whimsical geometric patterns that are making a comeback, primarily because those are the styles that remind them of their young adult years.

Regarding cognitive skills of the elderly, lighting can also be used to improve those skills. Concentration difficulties can be made worse by use of fluorescent lighting, which, due to the increased concern for energy use, had become common, even in a residential setting. The new LED light fixtures are a much better choice as is access to nature and sunlight. Visually confusing environments further impair concentration. Such things as converging lines which might be caused by contrasting baseboards, wainscoting, valances, and handrails can cause physical distress, particularly for people who already are experiencing a loss of spatial memory. Using a monochromatic color scheme can help alleviate those issues, but the need to discern where changes occur in floor surfaces, where the handrails are when needing to reach out to avoid a fall, and needs of the elderly when navigating through a space must be balanced with those caused by cognitive changes as a person ages.

2.3.2 Designing for Changes in Cognition

A loss of intelligence as one ages is not as likely as once thought, particularly if one stays physically and intellectually active. Much work is being done to ensure that people can age gracefully in a home that they love and that sustains them both physically and emotionally.

Information regarding environmental issues which might affect the quality of life of those suffering from Alzheimer's disease informs those planning home modifications. "Simple changes, such as removing sources of glare and making lighting levels consistent throughout the house, can prevent confusion and 'sun downing,' a condition that affects some AD patients as natural light levels change and the become more fatigued later in the day" (Hooyman N. , 2010, p. 252).

Research being conducted at Southern Illinois University Carbondale by Professor Melinda LaGarce is looking for a connection between the angle of light entering a space and the incidence of sundown syndrome. Preliminary results suggest when the sun begins to fall the rays entering a space indicate the coming of evening. That, in turn, triggers a response in the Alzheimer's patient that it is time to move from daytime activities to evening activities. When a patient is unable to make that move, he or she becomes very agitated. It is believed that controlling the angle of light entering a space can eliminate or at least limit the severity of these reactions. As a result, the progression of the disease is believed to be slowed. Light can be controlled with the use of simple window coverings, or by positioning sleeping rooms in other than west facing elevations. When this is done, positive results are expected.

It is through studies like the one above that interior designers and architects can gain the information they need to positively affect the wellbeing of clients. Additional effects of the built environments include visual cues such as photographs placed outside bedrooms to assist patients in recognizing a space as his/her own. It has been found that patients in advanced stages of AD are more likely to recognize themselves in photographs than through a textual sign spelling out their name. Because of the risk of patients removing those photographs, such memory boxes are usually locked for security.

Additional information found in *Environmental Psychology for Design,* written by Dak Kopec, "Designers should provide visual cues, such as signs on doors and exits, to discourage wandering in locations where dementia sufferers live. Marking a residence with the occupant's personality has been shown to bolster self-esteem. Consider modifying dementia patients' environments so they can better adjust to their lives, as this behavioral approach is, essentially, the only 'treatment' that will benefit sufferers." Additionally, efforts to hide the exits from a space that a patient might not be safe using can effectively alleviate the agitation suffered when the patient is unable to escape from a space (Kopec, 2017).

Additional advice found in Kopec's book advises those charged with designing spaces for people suffering from Alzheimer's disease includes ensuring that patients don't encounter an abrupt visual change in the flooring surface along their path. For example, a dark rug or mat along the path can cause the patient to stop suddenly, thus increasing their risk of falling. Someone suffering from Alzheimer's disease may view this as a black hole and may instinctively hesitate of suddenly stop.

A particularly exciting development expected to help members of the aging population stay in their homes longer and enjoy a high quality of life regardless of changing cognitive functions is that of the smart home. According to an article written by Barbara Knecht, which appeared in Architectural Record in 2004 (Knecht, B., 2004), university researchers are experimenting with sensors, cameras and monitors installed in house labs to learn about physical and social behavior of the occupants. This information is being analyzed to help with preventative health care, to alert family members who might live far away to changes in living patterns, and even to remind the occupant to take medication of feed their pets and water their plants. Work at the Georgia Tech Aware Home, which is a conventional looking house began in May of 2000. Experiments are being conducted to help design technology which can support everyday activities as they relate to the cognitive changes that happen with aging. Memory aid technologies can help with loss of short-term memory, even allowing users to look back to see if they added sugar or salt to a dish they are preparing, where they left their keys, or if they took their medicine.

2.3.3 Designing for Older Adults with Vision Challenges

When designing for older adults with vision challenges the items below need to be kept in mind. Braille on all dials, knobs, etc. (example: washer, stove)

- No sharp edges
- Light sensors
- Audible temperature readers for thermostat, oven, and bill readers
- Audible food labeling
- Different wall and floor materials for each space
- Minimal obstacles in pathways
- Built in color identifiers
- No projections off walls
- Handrails used in difficult areas
- Audible clocks
- Audible walk signals
- Braille on signage at appropriate height
- Minimizing the load capacity for the space
- Depending on the level of blindness, using appropriate type of lighting if necessary
- Precautions near staircases
- Limited temporary items

(Null, Universal Design Principals and Models, 2014).

2.3.4 Designing for Issues Specific to Women and Aging in Place

Chapter fifteen of Social Gerontology: A Multidisciplinary Perspective paints a positive picture regarding progress made in research on aging, specifically regarding women. Looking at the studies, and the results of those studies, one is reminded of the role that women have played in society and how that role has dramatically changed during the past fifty years (Hooyman N. A., 2010). Additionally, according to an article that appeared in The Western Journal of Medicine in October of 1997, the prognosis for aging women is only going to get better.

While the life expectancy of women exceeds that of men by almost seven years, women spend twice as many years disabled prior to death. However, as women become more dominant in the workplace, and more likely to plan for their own retirement, they will be empowered regarding their own aging. Most, if not all the studies cited in Social Gerontology: A Multidisciplinary Perspective were done on women from the traditional generation. The traditional generation is defined as the generation of people born before 1945 in the United States (Traditionalist Generation: Definition and Characteristics, 2018) Those women were not raised to stand on their own, to have their own careers, or to collect their own wealth. In contrast, women born in the baby boomer generation were the first to become financially independent and to rely on their own resources as they age.

As those women can more adequately control the factors that contribute to their health and wellbeing, their situations are expected to dramatically improve. Women are now much more likely to take control of not only their finances but of their health as they approach retirement age, and even sooner. These women will be aware of their needs, both financially and physically, much more so than those of their mothers and grandmothers. As a result, future studies are expected to show dramatic differences in the prognosis of women as they age. The onset of chronic diseases that have been experienced by women of the traditional generation, those that have been primarily studied to date, will be delayed, or even alleviated due to the roles that women are now playing in our society and their active participation in planning for their financial and health related futures.

2.4 Residential Environmental Quality

According to Louie Delaware and Erik Listou, founders of the Living in Place Institute, less than four percent of current single-family homes have three of the most critical safety features which include zero-step entrances to the home, single floor living, wide hallways, and doors. Even more concerning, only 1 percent of homes has electrical controls reachable from wheelchair and lever style handles on faucets and doors (Delaware & Listou, 2017).

2.4.1 Universal Design

Dr. Roberta Null is known in interior design and architectural circles as the grandmother of incorporating universal design components into interior spaces. This researcher was blessed to be a student in a course offered by Purdue University in the Design Construction Integration program where she was generous enough to join the students via the internet, which made her, at 80 years of age, very nervous. During that lecture, she shared her passion for universal design and her intense desire to recruit all design professionals to live by the principles of universal design. Dr. Null received the 1986 ASID Environmental Design Award for designing of training kitchens at the San Diego Center for the Blind (Null, Universal Design Principals and Models, 2014). According to Dr. Null, the term universal design was originally coined by Robert Mace, an architect who was committed to eliminating the term special needs from those who are committed to gain or maintain personal, physical, independence. Dr. Null emphasizes in her book, “universal design principles are good for almost everyone, as they become incorporated into the everyday world, the similarities between people, as well as their needs for similar products and environments, will become more apparent” (Null, Universal Design Principals and Models, 2014, p. 12).

According to Roberta Null, (Null, Universal Design Principals and Models, 2014) the seven universal design principles are:

1. Equitable Use: Ensures that materials and furniture doesn't discriminate against anyone.
2. Flexibility Use: Ensures that the spaces you design are flexible and able to accommodate all users regardless of physical abilities
3. Simple and Intuitive Use: Ensures that things are kept simple and complicated solutions are avoided.
4. Perceptible Information: Encourages the use of pictures on signage and tactile surfaces to differentiate various areas and zones
5. Tolerance for Error: Ensures walkways are clear of tripping hazards. For example, a trashcan placed under the call buttons for an elevator, might endanger a person who is blind could easily bump into them and fall (plus it would make it harder for them to be able to find the buttons).
6. Low Physical Effort: Attempt to ensure that users are comfortable and are not straining while using the space. For example, you don't want to make counter tops in a restaurant kitchen too low, or the chefs will be bent over all night, which will cause back pain.
7. Size and Space for Approach and Use: Attempt to provide objects such as handrails of the proper diameter and the proper height

In her book, she provides the following universal design project checklist (Null, Universal Design Principals and Models, 2014):

<u>DOORS AND DOORWAYS</u>

- All doorways to be a minimum of 32" clear width.
- Clear and unobstructed floor space on the pull side of door to be the width of door +24".

- Enough clear space must exist at both the doorway and any hallways to permit a 90-degree turn.
- Doors to have lever handles.
- Require no more than 8.5 lbs. of force at exterior and 5 lbs. at interior doors to open and close.

WINDOWS

- Provide a clear floor space at each window
- Ensure that locks and operations are within reach of a seated person
- Provide for a parallel approach with a 4’-0” minimum width

FINISHES

- Hard surface flooring to be slip resistant
- Any thresholds to be no more than ¼”

KITCHEN

Space Planning:

- A minimum of 2’-6” x 4’-0” in front of each feature
- Knee space of at least 19” at each work center
- Any exposed plumbing traps or disposals must be insulated or concealed behind a panel
- Minimum of 5’ between facing cabinet fronts
- Adequate turn around space is available (5’ circle)

Countertops, Cabinets, and Storage:

- Heights between 30 – 34” for use by wheelchair bound
- Height of 36” for standing visitors who may be helping in the kitchen
- Full Extension drawers

- All drawers above counter height to have at least one low side
- Mobile carts can be used in areas where knee space is required
- Countertop storage units to be used to maximize the back part of counter tops

Range:

- Front mounted controls
- 32” to 34” height
- Minimum of 12” of heat resistant counter space is available on each side of the range
- Knee space is available on at least one side of the range

Clean up and food prep sinks:

- Install disposal under one bowl and fully enclose
- Provide knee space to access adjoining dishwasher
- Provide shallow sink bowls installed as close to the front of counter as possible

Refrigerator:

- Provide French door refrigerator with bottom freezer
- Provide ice and water in doors
- Provide a minimum of 2’-6” x 4’-0” floor space parallel to the refrigerator
- Locate away from any corners
- Allow counter space on each side

BATHROOM:

- Provide tub with transfer seat for soaking
- Provide 5’ x 5’ roll in shower
- Install grab bars throughout
- Allow minimum of 2’-6” x full width of tub floor clearance

- Provide lever shower control
- Include handheld shower head and hose on wall clip
- Provide separate two-way lever handle diverter valve in shower and tub areas
- Offset controls in tub toward the outside
- Use scald proof valves on all faucets
- Mount lavatory at 32”
- Adequate knee space to permit a close approach to lavatory
- Use lever faucet controls
- Toilet to be mounted 18” from side wall and 18” above the floor
- Toilet to have 4’-0” x 4’-8” to the side or front for access
- Use grab bars both vertically and horizontally to side and behind toilet mounted no more or no less than 1-1/2” from walls

BEDROOM:

- Maneuvering spaces to be at least 3’ wide
- Provide 5’ diameter turning space
- Transfer space of 3’ – 6” next to access side of bed to allow for unassisted lateral transfer
- Allow clear floor space of 2’-6” x 4’ – 0” for reaching windows
- Provide enough outlets near the bed at a reachable height and location
- Allow for emergency access out of sleeping area either through a window or door
- Closets to have a minimum of 60” clear door openings
- Mount adjustable lower shelving in closets at a minimum of 15” aff
- Mount adjustable higher shelving at 3’-0” to 4’-0” aff

- Provide low mirror over low dresser

Source: (Null, 2014)

2.4.2 Home Health Care and Aging in Place

Current health care plans, including Medicare, focus on acute care issues rather than long term health care. However, as we age, particularly the oldest old, there is an increasing need for assistance performing activities of daily living (ADL) such as bathing, cooking, and cleaning. When considering home modifications for aging in place, one must look to current and future actions on the part of the insurance industry (McAllister Wilder D. K., 2017) .

When considering the Affordable Care Act and ADL, as well as future directions which might become reality as the healthcare system changes, many are asking questions, but few answers are yet available.

An article in the Cape Gazette, written by their in-house staff notes (Impact of Delaware's new health insurance on seniors, 2015), “for many seniors, questions about the new federal healthcare law and its effect on senior healthcare remain unanswered at this time. Significant issues, including Delaware's new health insurance exchanges, hospital readmission policies, the Medicare doctor shortage, and concerns about being able to remain at home as they age are of great importance to seniors”. A symposium sponsored by the Sussex County Advisory Committee for the Aging & Adults with Physical Disabilities was held on October 9, 2013 to share information regarding the Affordable Care Act, aging at home versus a nursing facility, and how to live a more active, healthier lifestyle. The major issues regarding home-based care determined at the conference included:

- Attendant Services
- Home Delivered Meals

• Personal Care

• Home Modification

The report summarizing their findings is still pending, but the existence of the symposium points positively to changes in the services that will enable people to age in place.

Another positive initiative includes helping patients stay engaged in their own care through Electronic Health Record Keeping. The Affordable Care Act contains health care reform initiatives, including the requirement that doctors provide a way for their patients to receive follow up care, ask questions about their health and engage with the new on-line or other traditional communication tools. Five percent of the pay provided to them will be withheld unless they can prove a proportion of their patients are being engaged. According to Tim Smokoff, chief executive officer of Numera Inc., a Seattle company that specializes in patient engagement through telehealth and online social connections, “We at Numera, Inc. recommend that providers focus on aging in place - keeping older people in their own homes rather than in long-term care facilities, usually with the aid of monitoring technology - as well as management of chronic conditions and post-acute care. “They are going to get more than 5 percent if they invest in those areas," Smokoff says”.

2.5 Aging in Place in the United States

Where exactly in the United States are members of the 65 and older age group living? Typically, the states with the largest proportions of seniors were different from those with the largest actual numbers of elderly. Of all the states, Florida has the highest percentage of senior citizens while California has the largest actual number of elderly persons. When considering proportions, Florida is followed closely by Maine, West Virginia, Vermont, Pennsylvania, Montana, Delaware, Hawaii, Oregon, and Arizona (Burton, 2017). Pennsylvania, with 16 percent aged 65 years and above and Florida, where 19 percent of the total population are elderly were among the top ten in terms of both total numbers and relative percentages of elderly. This fact is attributed to a net positive entry of elderly greater than that seen among younger persons. Interestingly, the younger generation's migration patterns across the United States have been very different than those of the older population. While the southern states are often thought to be attracting people who are moving on to retirement, the Midwest and Northeast states have the highest percentages of elderly relative to their total populations. Indiana ranks 34th on the list with 14.27 percent of the population falling in the elderly category. However, #1, Florida has 19.06 percent and #10 Arizona has 15.90 percent, so there isn't a huge change until we get to Alaska, with 9.49 percent. In fact, the top ten varies from 19.06 percent to 15.90 percent, the second group, #'s 11 through 20 vary from 15.84 percent to 15.37 percent, the third group, to which Indiana belongs varies from 15.25 percent to 14.48 percent, the third group from 14.39 percent to 13.88 percent with the bottom group, minus the lowest of Texas (11.49 percent), Utah (10.02 percent) and Alaska (9.49 percent) varying between 13.78 percent and 12.37 percent. Clearly, every state in the union is experiencing a large and growing percent of their population in the over 65 age group. See figure 2.1 for a graphical description of these statistics.

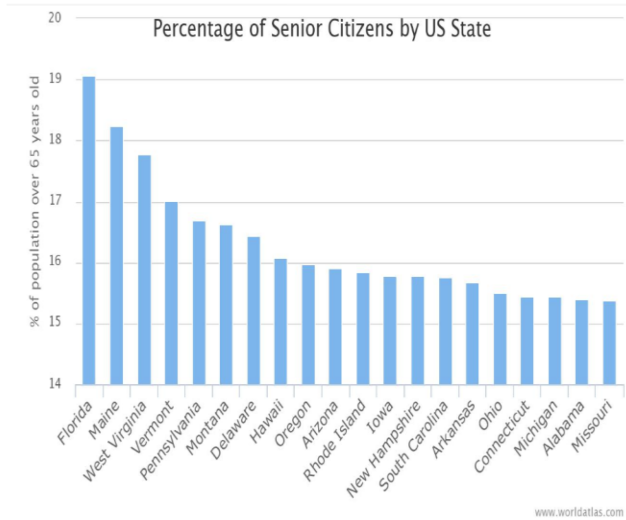
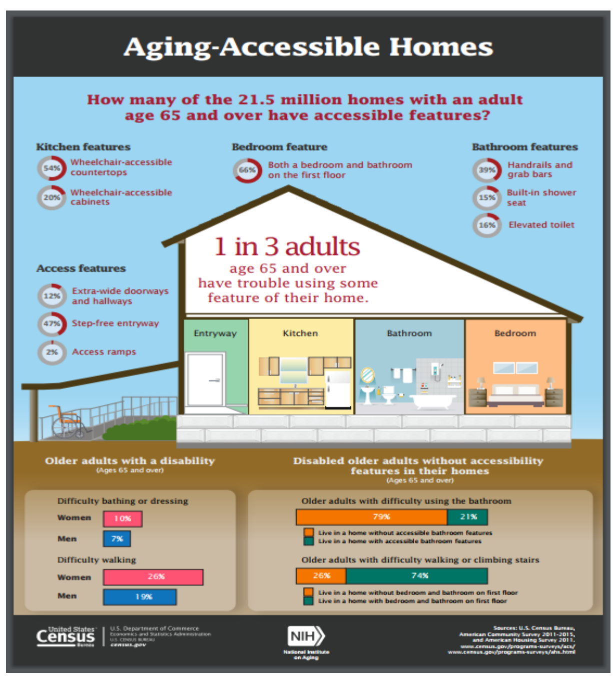


Figure 2.1 Percentage of Senior Citizens by US State



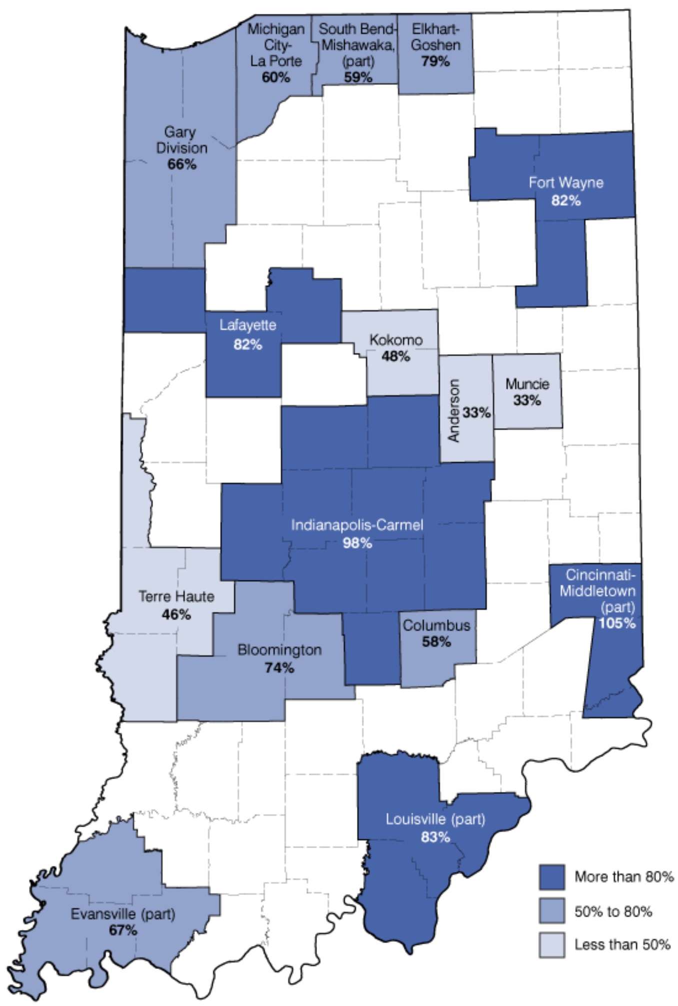
Source US Census Bureau

Figure 2.2 Aging Accessible Homes

2.6 Aging in Place in Indiana

According to inContext, a bi-monthly publication of the Indiana Business Research Center at IU's Kelly School of Business, adults age 65 and older made up 13 percent of Indiana's population as of Census 2010. This number is projected to grow to 20 percent by 2030 (Justis, 2012). Figure 2.3 shows the projected percent change in population age 65 and older between 2010 and 2030. Figure 2.2 demonstrates issues common to aging in place challenges.

Figure 1: Percent Change in Population Age 65 and Older, 2010 to 2030



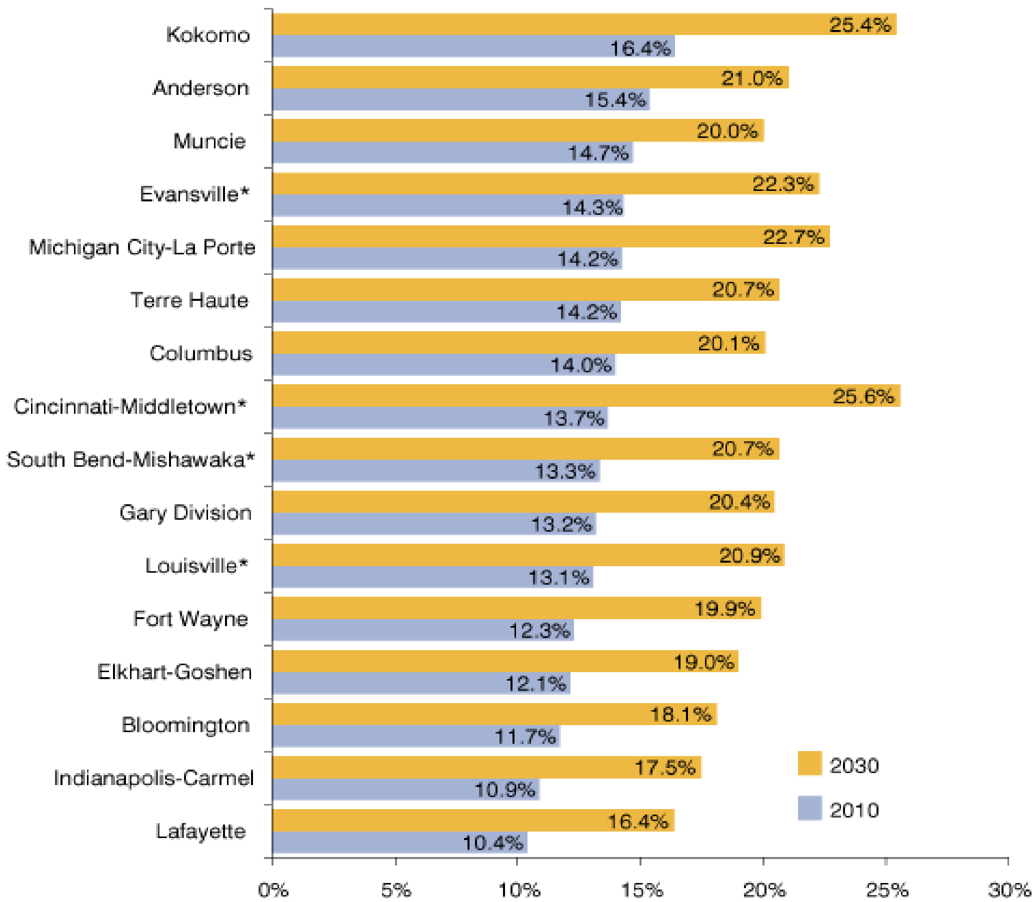
Note: The percent change for the non-metro portion of the state is 55 percent.
Source: Indiana Business Research Center

Figure 2.3 Percentage Change in Population Age 65 and Older, 2010 to 2030

The authors note that five of Indiana's metropolitan areas will see increases of more than 80 percent in the population group aged 65 and older in the next 20 years. This is shown in figure 2.3. Anticipating a relatively strong net immigration of older adults, the senior population in the Indiana portion of the Cincinnati-Middletown metropolitan will more than double. Two factors explain that rapid aging; first is the strong immigration of older adults, second is this region in unique in that it consists of three counties, Dearborn, Franklin, and Ohio, that are on the periphery of the neighboring metropolitan area and have relatively small populations. These counties lack the large urban core that will tend to keep many metropolitan areas young.

Of the sixteen areas, only four are expected to experience growth of less than 50 percent, with 32 percent anticipated for Anderson, 33 percent for Muncie, 46 percent for Terre Haute and 48 percent for Kokomo. Three of those are expected to experience declines in population and the fourth, Terre Haute has only a growth of only a few hundred residents. Figure 2.4 graphically demonstrates the anticipated change in the elder population in Indiana's cities and towns between 2010 and 2030.

Figure 2: Percent of Population Age 65 and Older, 2010 and 2030



*Indiana portion only

Note: The share for the non-metro portion of the state is expected to grow from 15 percent in 2010 to 23.3 percent by 2030.

Source: Indiana Business Research Center

Figure 2.4 Pergcent of Populations Age 65 and Older, 2010 and 2030

2.6.1 Aging in Place and Community Revitalization

Retirees can revitalize America's small towns (Hooyman, 2010) (McAllister Wilder, 2013). Planned housing communities are expected to play a part in that revitalization. Communities such as Seaside in Florida and 6 North Apartments in St. Louis Missouri are two examples of planned communities with different sustainable and historic preservation profiles.

Regarding Seaside, a press release from twenty years mentioned that it was geared toward a multi-generational population and that all the houses were required to have front porches so that neighbors could look out for each other. A recent post on their blog reiterates that feeling.

> "But it goes deeper. It is the vision of a small town, much like the countless ones dotting the pre-WWII landscape. Much like the old-world European villages, where a person could stroll anywhere she wanted to go for anything she needed. Where everything is within easy reach. Where walking is the most popular pastime. Where people linger longer in the market to chat. Or stop by front porches for afternoon visits.
>
> The architecture of Seaside is all these things. Every neighbor connected." (Bare Feet and Sandy Floors, 2011).

The 6 North apartments in St. Louis are an example of construction and development efforts directed toward revitalizing existing communities instead of building new. According to the program for the Universal Design Summit 5, which included a tour of this development, it potentially meets anticipated needs for supporting aging in place and revitalizing communities at the same time.

> "The 6 North Apartments are a model of Universal Design done well from adaptive re-use of urban land in the city. This is the first fully universally designed, mixed income, multi-family property in the U.S., developed and managed by McCormack Baron Salazar. From the street to the unit, and all that comes between, universal features are apparent in the 80 units in the heart of the Central West End of St. Louis. See streetscape, lobby, parking, community space, fitness center, live/work units-all seamlessly incorporating universal features!
>
> MBS now includes neighborhood schools, early childhood education, youth activities, resident job training and self-sufficiency, economic development, access to quality health services, and environmental stewardship and energy efficiency as core activities in comprehensive neighborhood revitalization (6 North Apartments, 2013)."

When envisioning the ideal scenario for aging in place, such a development provides inspiration. It is essential that all the neighborhoods in all the towns which will be providing housing for all generations meet these standards which provide a multi-generational community the opportunity to enjoy the opportunity to interact with each other.

2.6.2 Lessons Learned from Continuing Care Retirement Communities

Living in a CCRC may benefit some older persons (McAllister-Wilder, 2017). Better self-rated health with similar rates of utilizing home-based services and hospitalization have been noted by both those residing in the age integrated communities or naturally occurring retirement communities while reporting more chronic medical conditions at the 2-year follow-up (Gaines, 2011).

Continuing care retirement communities feature several amenities which support independent living. A recent study looked at the role of several design characteristics of a residential retirement community in fostering place attachment and social support, respectively, among a group of elderly residents recently relocated to the community. Three physical variables were considered; proximity to the main activity center, individuals whose residences are situated to enhance the possibility of unplanned social encounters, and residents whose homes are near an enclosed outdoor gardening space. All those studied reported greater place attachments to their community with results varying based on the three physical variables (Sugihara, 2000) (McAllister-Wilder, 2017).

To explore the relationship between measures of physical performance, physical activity, and self-reported physical activity, data was collected from participants living in a CCRC as part of a larger study which explored physical activity, physical abilities, and psychosocial factors in older adults. No relationship was found between tests of physical performance, physical activity, and PASE (The Physical Activity Scale for the Elderly) scores. One explanation might be that people living in CCRC's do not engage in behaviors that contribute to total PASE score in the same proportion as do other independently living adults. Specifically, light housework, heavy housework, outdoor gardening, home repair and lawn and yard care contributed 60% to the total PASE score. This information could be used to justify funding for NORC environments, to duplicate the amenities which contribute to better health and well-being while supporting independent aging adults in the healthy aspects of staying in their own homes (Zalewski, 2009) (McAllister-Wilder, 2017).

New technology regarding Geographical Information Systems (GIS), sustainable cities, residential building stock, and energy conservation in cities was studied as part of a recent project. The goal was to develop a valid integrated assessment tool which would be applicable for the urban built environment, particularly about residential buildings and their energy performance. A thorough analysis of available statistical data followed by a survey and literature search was conducted. Aging in Place and Multi-Generational Housing

The growth of the multigenerational family has grown by 60 percent since 1990 (Hooyman N. A., 2010). A multigenerational family is "broadly defined by interactional and emotional quality, not necessarily by members living together, by birth of marriage." (Hooyman N. , 2010, p. 245). Due to the social as well as economic and physical needs of the older members of our society, there are many reasons to draw our focus towards housing that accommodates a variety of age groups. As demonstrated in the below list, there are seven primary design trends supporting multigenerational households (Aging in Place and Remodeling, 2017).

- First-floor master suites and dual masters
- Lower level living areas
- Living space above the garage or in an extra garage bay

- Separate entrances
- Second kitchens
- Private spaces for each generation
- Rental apartments within single-family homes

Interestingly, the notion of multigenerational housing is a historic concept that is making a comeback. According to the Pew Research Center, in 1900, about 57 percent of people aged 65 and older lived in households with other members of their extended families. A multi-generational household is defined to include at least two adult generations. A record 49 million people (one out of six) currently live in such households. In 2009, about 6.6 million American households had at least three generations of family members, which indicate an increase of 30 percent since 2000. Even more significant, when multi-generational is more narrowly defined to include at least two adult generations, a record 49 million people (one out of six) live in such households (McAllister-Wilder, 2017).

One must wonder why we have seen such a significant increase in multigenerational housing (Bady, 2011). One obvious reason it the recession. Young adults are moving back home with their parents, either because they have lost their job or the job, they have doesn't pay enough to cover the cost of rent. Longer life spans as well as expanded home-healthcare options enable baby boomers to move ailing relatives into their homes instead of placing them in nursing homes. A recent wave of immigration of Asians and Hispanics is also fueling the formation of multi-generational households.

What aspects of a home's design contribute to the quality of life of those living in this home? One factor of home design which contributes to quality of life of those living in multigenerational housing is the presence of individual kitchens for each family. When Lita

Dirks, whose Greenwood Village, Colorado based firm merchandised the model home at Brightwell Crossing, was developing his multi-generational prototypes, he felt it was important to introduce some sort of kitchen area to each space, even if it was just a small kitchenette.

Adding a second kitchen could raise the price of the home by $10,000 to $15,000, but that type of space is an incredible opportunity for a multi-generational household.

Beyond the second kitchen, there are many more components that the designer of a multiple generation household needs to consider. They include private entrances as well as internal access to various parts of the shared home as well as individual storage and outdoor retreat areas specific to each family.

2.7 Aging in Place and Home Modifications

According to a survey conducted by NAHB Remodelers, the remodeling arm of the National Association of Home Builders (NAHB), the past five years have seen increases in homeowner awareness of aging in place remodeling projects as well as the number of remodelers engaging in those projects (Aging in Place and Remodeling, 2017). Released on May 1, 2017 as a kick off to National Home Remodeling Month, the survey of remodelers revealed that simple and affordable modifications are increasing in popularity In summary, a multigenerational home provides a place where grandma, her baby boomer daughter, and her X generation daughter who finds herself divorced with a Y generation child can live in comfort and collaboration.

It was learned though the survey that 80 percent of remodeling companies are doing aging-in-place projects. The five aging-in-place remodeling projects showing the greatest increase since a previous survey conducted in 2013 showed the following increases.

- Added or improved lighting (increase of 12 percent)
- Installation of curb less shower (increase of 9 percent)

- Installation of grab bars (increase of 7 percent)
- Installation of non-slip flooring (increase of 7 percent)
- Widening of doorways (increase of 5 percent)

More complex projects saw a slight decrease in popularity, adding an entry-level bedroom dropped one point to 33 percent and installing ramps or lowering thresholds decreased two points to 49 percent.

2.7.1 State of Current Housing Stock

In a report released by the Joint Center for Housing Studies at Harvard University, presented research analyzes remodeling activity by older homeowners (Will, 2015). Because such features are critical to supporting older adults need for safety, the research takes into consideration the current and projected demand for and supply of homes with accessibility features. The ultimate attempt of the conducted research was to publicize what the implications of an aging society for home modification providers in the construction industry and the anticipated demand for home accessibility retrofits currently and soon.

2.7.2 Spending on Home Improvements by Older Adults

Section II of the above referenced Harvard study examines the spending habits for older adults on home modifications and predicts how and why this spending has recently changed. Section III looks at attitudinal survey data from the Demand Institute on Aging in Place and Home Accessibility Modifications. The Demand Institute is a non-profit think tank which focuses on how consumer demand is evolving around the world (Aging in Place and Home Accessibility, 2015). The group reports that although many older owners report they want to age in place, few are focused specifically on the accessibility aspects required. Section IV of the paper analyses the current demand for and supply of homes with accessibility features. It also describes the current need for homes with accessible feature across social, economic, and locational characteristics of the population with disabilities or impairments. Also, in the study is a discussion of the typical costs of home accessibility modifications. Lastly, Section V of the paper projects future demand and supply gap of homes with accessible features in consideration of the expected growth of the older population expected in coming decades. These projections suggest the need for significant investment in home modifications to narrow the gap between supply and demand (Will, 2015). See Figure 2.5 for a list by percentage.

Figure 2.5 Types of Projects for Accessibility & Safety

2.7 Aging in Place and Home Modifications

According to a survey conducted by NAHB Remodelers, the remodeling arm of the National Association of Home Builders (NAHB), the past five years have seen increases in homeowner awareness of aging in place remodeling projects as well as the number of remodelers engaging in those projects (Aging in Place and Remodeling, 2017). Released on May 1, 2017 as a kick off to National Home Remodeling Month, the survey of remodelers revealed that simple and affordable modifications are increasing in popularity In summary, a multigenerational home provides a place where grandma, her baby boomer daughter, and her X generation daughter who finds herself divorced with a Y generation child can live in comfort and collaboration.

According to the survey, 80 percent of remodeling companies are doing aging-in-place projects. The five aging-in-place remodeling projects showing the greatest increase since a previous survey conducted in 2013 showed the following increases.

- Added or improved lighting (increase of 12 percent)
- Installation of curb less shower (increase of 9 percent)
- Installation of grab bars (increase of 7 percent)
- Installation of non-slip flooring (increase of 7 percent)
- Widening of doorways (increase of 5 percent)

More complex projects saw a slight decrease in popularity, adding an entry-level bedroom dropped one point to 33 percent and installing ramps or lowering thresholds decreased two points to 49 percent.

2.7.1 State of Current Housing Stock

In a report released by the Joint Center for Housing Studies at Harvard University, presented research analyzes remodeling activity by older homeowners (Will, 2015). Because such features are critical to supporting older adults need for safety, the research takes into consideration the current and projected demand for and supply of homes with accessibility features. The ultimate attempt of the conducted research was to publicize what the implications of an aging society for home modification providers in the construction industry and the anticipated demand for home accessibility retrofits currently and soon.

2.7.2 Research Efforts Regarding Aging in Place

The issue of aging in place is not being studied extensively through construction, interior design and architectural lenses; rather primarily though medical, geriatric and social science lenses. Additionally, there is a deficiency in the codes and guidelines being used to formulate recommendations for aging in place. Starting with the American's with Disability Act, they are typically written for wheelchair users rather than for those dealing with the issues typical of an older adult aging independently.

As mentioned, challenges and opportunities of aging in place are being studied by researchers in several disciplines but not construction, interior design and architecture (Tofle, 2015). While design and construction professionals are studying aging and the built environment, most of the efforts are focused on public and multi-family housing rather than single family residences. Well represented are researchers from social gerontology (Chappel, 2004), nursing (Marquardt, 2011) geriatric medicine (Weakley, 2017), psychology (Fausset, 2011), sociology (Cumming, 1999) occupational therapy (Barras, 2005), rehabilitation science (Tanner, 2008), health science (Thordardottir B. M., 2018)**.** computer science and informatics (Hamm J. M., 2017), economics (Johnson, 2018), injury research and prevention (Scott, 2007), and urban planning (Day, 2000).

Beyond the plethora of fields represented in the research, an equally complex mix is represented in the assessments which identify issues and the guidelines used to make home modification recommendations. After a need is identified, recommendations are based on a variety of guidelines, check lists, and codes and standards which may or may not accurately support the older adults' specific needs. Additionally, many professionals are becoming certified to act as specialists in aging in place home modifications. As is the case with researchers, construction and interior design are underrepresented. While the technical information gained through available training programs is important, critical design thinking skills cannot be taught to non-design professionals in a short-term certification course.

A leading certification program has been developed by the National Association of Home Builders (NAHB) (Talley, 2005) (Clark, 2017). Persons preparing to become certified aging in place specialists (CAPS) by NAHB are introduced to four standards which outline guidelines for environments for those with various disabilities (Builders, 2009). Students are informed that “Many regulations exist for commercial and public properties regarding accessibility, but private dwellings are almost completely unregulated. However, within the commercial regulations are important guiding principles for the safety and welfare of occupants of private dwellings too” (Builders, 2009, pp. 3 - 4) . The guidelines introduced in the CAPS training course are as follows

ANSI (American National Standards Institute) is an organization dedicated to “enhance both the global competitiveness of U.S. business and the U.S. quality of life by promoting and facilitating voluntary consensus standards and conformity assessment systems and safeguarding their integrity” as retrieved from their website. (About Us, 2018)

ADAAG (The Americans with Disabilities Act Accessibility Guidelines) is an index of guidelines as found in the Americans with Disability Act (Guidelines, 2018)

UFAS (Uniform Federal Accessibility Standards) is a document outlining design and construction for ready access to handicapped persons.

FHAG (Fair Housing Accessibility Guidelines) outlines requirements for multi-family housing insuring handicap accessibility in federal housing units.

In addition to these codes and standards, prospective CAPS individuals are also encouraged to be familiar with their individual state and local residential building code. For instance, Indiana has adapted the 2018 International Residential Building Code for single and two-family homes.

In addition to those introduced in NAHB’s certification course, one can find other organizations mentioned in the literature, with standards and guidelines of their own. These include The National Institute of Health, the National Safety Council (Clark, 2017), The USDA

Section 504 (Johnson, 2018), The County of Brevard Florida Codes and Standards Assessments (Board, 2018) and many others. A leading, peer reviewed academic journal widely publishing research about aging and the built environment is the Journal of Housing for the Elderly. In the most read article to appear to date, authors discuss the impact of modifications recommended in response to accessible standards. (Tanner, 2008). The authors review several issues affecting the impact of the use of modifications to the bathroom or main entrance of a home. An example was given of a project which followed The Australian Standards for Access and Mobility. The authors noted the resulting modifications did not meet the needs of the users in the study because "the standards are designed for persons in wheelchairs and none of the participants used wheelchairs, this created problems such as a clothes line installed at a height dangerous for a standing person (Tanner, 2008, pp. 205-206).

Assessment protocol varies as much as the researchers studying aging in place. Leading the effort to conduct home assessments and make recommendations for home modifications are occupational therapists. These assessment tools all include an assessment of the physical features of the home and the physical limitations of the older adult. While they provide valuable information the construction specialist must then rely on building codes and standards to guide the indicated modifications.

The primary assessment tool used by occupational therapists for those aging with dementia and living at home is the Home Environmental Assessment Protocol (HEAP), developed by social gerontologists Laura N. Gitlin and Mary Corcoran. A newly designed assessment tool is currently being tested. The Home Safety Self-Assessment Tool (HSSAT) was developed by occupational therapists to alleviate the costly home visits by OT's and fill the gap that exists with aging individuals who are not being seen by an occupational therapist to support aging in place. Other tools include those developed by NSCF (National Survey of Child and Families), and ACS (American Community Survey Office).

Often, homeowners reject implementing recommended modifications. Even when modifications are implemented, less than 50% of those modifications are still being utilized 12 months after the original assessment and implementation (Atwal, 2014) (Hamm J. M., 2017). A review of 14 studies concluded that pre-discharge home assessment visits reduce the risk of falls and readmission to the hospital (Lockwood, 2017). However, the authors question if the current system is the best method, in part because patients tend to fear not performing adequately and not being allowed to go home (Lockwood, 2017) (Hamm J. M., 2017) (Atwal, 2014) so may not be totally honest about their needs.

In contrast, the information gathering process used in interior design, known as programming, puts the user's needs in the forefront, rather than user's abilities to perform as is done in the assessment model used by occupational therapists (Atwal, 2014). Insurance companies have been applying pressure to limit the number of home visits conducted by occupational therapists, due to the amount of time involved as well as the cost (Lockwood, 2017). This change could open opportunities for architects, interior designers and construction specialists trained to provide advice for aging in place to conduct those assessments. A study conducted by computer science researchers from Brunel University in St. Johns, London proposed training occupational therapists to use a virtual reality interior design application to better improve the collaboration between OT's and their patients (Atwal, 2014). The process of properly solving a design problem goes far beyond simply utilizing a design program; few occupational therapists are trained in the design thinking skills required to fully evaluate user needs and a given environment to adequately propose an appropriate solution. Similarly, a three-dimensional measurement aid prototype which would allow a patient to work with their therapist to accurately take measurements to better mitigate fall risk, is being developed and tested (Hamm J. M., 2017). A lack of user input into the process is known to result in less adherence to the recommendations (Thordardottir B. F., 2018) (Atwal, 2014). Design professionals are also knowledgeable of universal design features which prepare them to anticipate and design for future situations, something which is not always done when the home assessment process is conducted by health care practitioners (Thordardottir B. M., 2018).

A design and presentation tool utilizing Building Information Modeling and architectural visualization can offer universal design solutions and when presented to the end user, inspire confidence in the proposed home modifications. An interior designer, with experience in residential design, universal design, accessibility, and aging in place is ideally suited to develop such a tool.

2.7.3 Spending on Home Improvements by Older Adults

Section II of the above referenced Harvard study examines the spending habits for older adults on home modifications and predicts how and why this spending has recently changed. Section III looks at attitudinal survey data from the Demand Institute on Aging in Place and Home Accessibility Modifications. The Demand Institute is a non-profit think tank which focuses on how consumer demand is evolving around the world (Aging in Place and Home Accessibility, 2015). The group reports that although many older owners report they want to age in place, few are focused specifically on the accessibility aspects required. Section IV of the paper analyses the current demand for and supply of homes with accessibility features. It also describes the current need for homes with accessible feature across social, economic, and locational characteristics of the population with disabilities or impairments. Also, in the study is a discussion of the typical costs of home accessibility modifications. Lastly, Section V of the paper projects future demand and supply gap of homes with accessible features in consideration of the expected growth of the older population expected in coming decades. These projections suggest the need for significant investment in home modifications to narrow the gap between supply and demand (Will, 2015). Figure 2.6 demonstrates the types of projects being done for accessibility and safety by the National Association of Home Builders.

Figure 2.6 Types of Projects for Accessibility & Safety

2.7.4 Funding Sources for Aging in Place Home Modifications

The Department of Health and Human Services supplies funds for health service to states while the Department of Housing and Urban Development supplies funds for housing services to localities. Additionally, beyond federal funding sources and regulations, local governments have the responsibility for and authority over planning and community development efforts (Ball, 2017).

Geographical Systems Technology (GIS), provides the opportunity to map where seniors live and the types of homes they inhabit. Emory University’s Office of Community Partnerships and the Community Housing Resource center collaborated to create a collection of maps which demonstrate how local community leaders can use GIS to facilitate the collaborations necessary for successful local aging in place strategies.

Purdue University has an active GIS group. Purdue Libraries, in collaboration with members of the GIS community at Purdue provided an international forum for users of geographic information systems (GIS) technology to demonstrate real-world applications currently being used at Purdue. Faculty members Fabian Winkler and Shannon McMullen from the Patti and Rusty Rueff School of Visual and Performing Arts demonstrated work they are doing with augmented reality. Much like the work being done in the Envision Center, they are using open source software including Unity and Vuforia. There were no demonstrations at the 2017 event focused on identifying the location and housing environment of Indiana's aging population. Capturing that information, as was done in the following maps created at Emory University could inform researchers regarding the needs of Indiana's communities and citizens regarding aging in place.

Figure 2.8 graphically shows the locations of Naturally Occurring Retirement Communities in Atlanta, while Figure 2.9 shows where health and housing providers are located. A gap in services near those aging in place is evident. Figure 2.9 identifies the location of high-risk seniors. These GIS maps demonstrate opportunity for a closer look in communities around the United States utilizing GIS.

Identifying Naturally Occurring Retirement Communities

This map of the 10 county region including the City of Atlanta, maps the density of seniors. Those census block groups in which 25 percent of the population is over the age of 65, are marked in red. These communities meet the definition of Naturally Occurring Retirement Communities (NORCs) – communities that were not designed as retirement or senior-specific communities, but are populated by a significant number of seniors because residents have aged in place. These communities should be considered for targeted comprehensive service delivery.

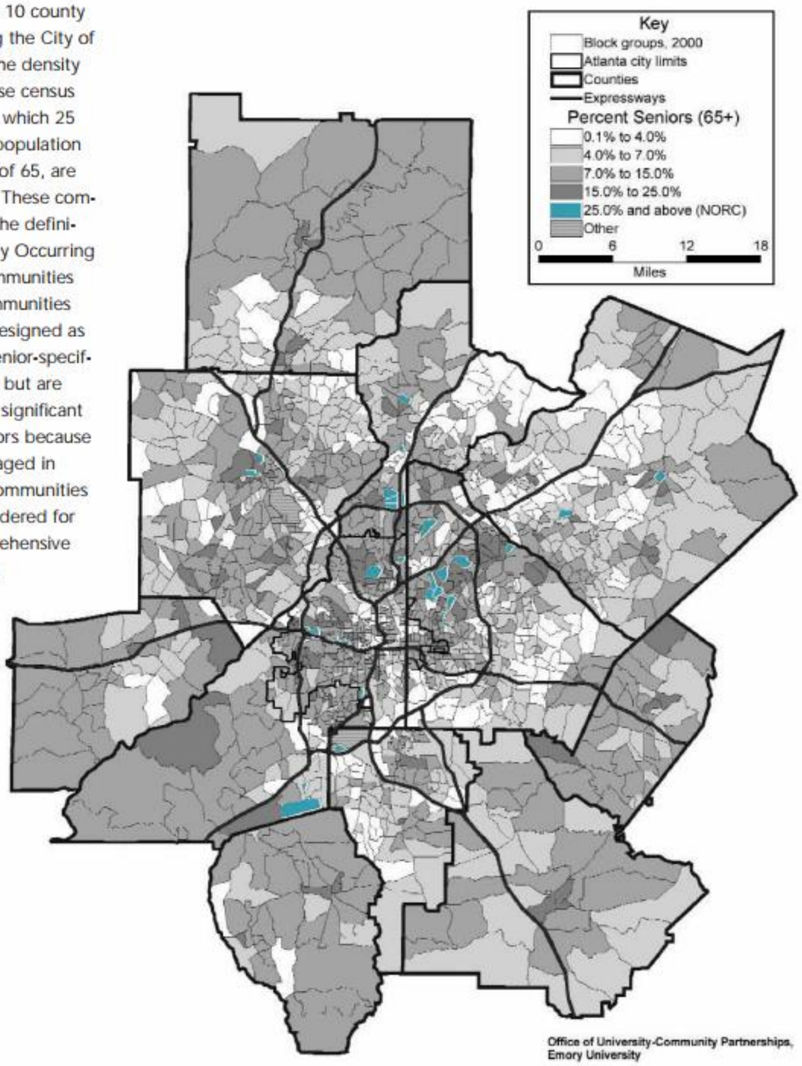


Figure 2.7 Identifying Naturally Occurring Retirement Communities

Locating Health and Housing Providers

The location of service providers and major senior living facilities are mapped throughout the ten county region. Living facilities include nursing homes, continuing care retirement communities, assisted living facilities and HUD 202 buildings. Service facilities include senior centers and health clinics. Services which operate out of one location but serve a larger geographic area are indicated as outpost facilities. These include home health services, meals on wheels programs and personal care assistance.

By mapping the location of these services, communities can identify possible overlaps and potential partnerships to provide more comprehensive local services.

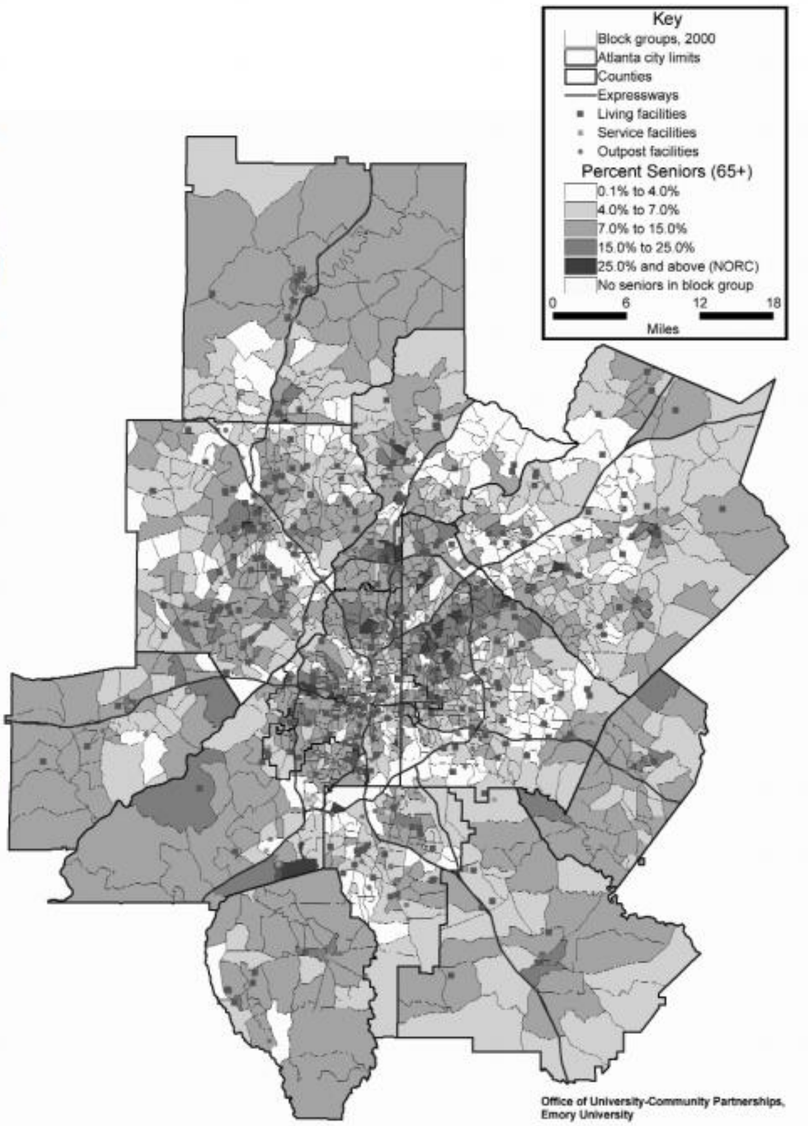


Figure 2.8 Locating Health and Housing Providers

Identifying High Risk Seniors

This map of the 10 county region identifies those census block groups with a high percentage of seniors above the age of 75 living alone. These seniors have been identified as high risk and in need of comprehensive health and housing to maintain their independence.

Knowing the location of these communities can be very important to a community's planning efforts. By targeting Aging in Place strategies in these areas, communities may be more likely to achieve the cost savings of prevention programs.

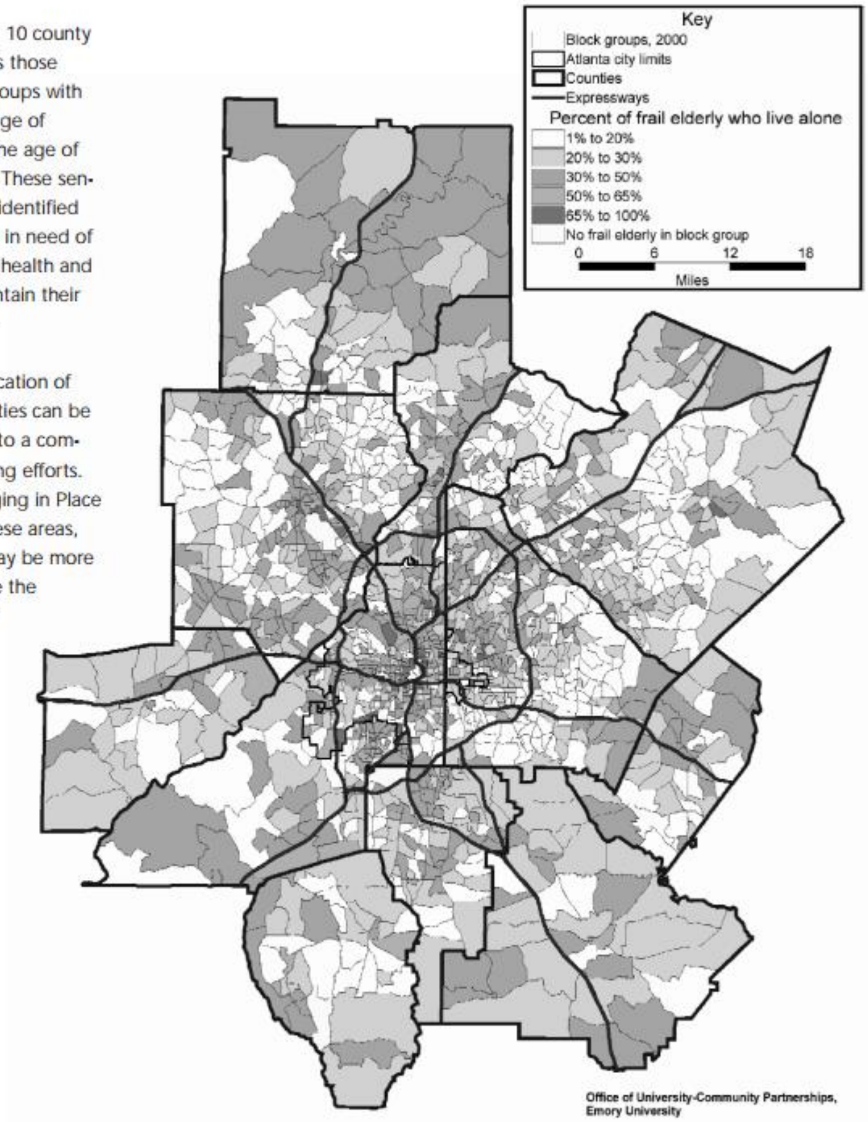


Figure 2.9 Identifying High Risk Seniors

2.8 Smart Home Technology

As technology moves quickly toward in-home monitoring, homeowners will be able to be closely monitored by their family members, caregivers, and healthcare providers while they remain in the comfort and convenience of their home. As reported in a recent Wall Street Journal article, doctors are now able to monitor blood pressure and blood oxygen remotely (Rockoff, 2015). Still in the early stages, remote monitoring is being used for serious conditions, but opportunities exist to provide more monitoring of factors which promote a healthy, independent quality of life.

Obstacles to realizing the goal of aging in place include the availability of health care services, personal security, social concerns, and issues related to mobility. It is expected that about 15 percent of persons age 65 and over have reported disabilities which could make living independently a challenge (Erickson & C. Lee, 2014). Many smart home technologies are being developed to provide a virtual umbrella of support to improve quality of life for those aging in place. The integration of products and services highlighting smart home technology is being achieved through various networking devices and can do much to protect the safety of the aging user. Many of these devices are based on the Internet of Things (IoT) and needs specific to the aging consumer (The Internet of Things, 2015). The devices allow various systems and appliances in a home to communicate with the central station and provide feedback to the independent senior, their adult children, and other caregivers. Being able to lock the house, turn on exterior lighting and security systems, prepare a hot cup of coffee, or adjust the ambient temperature in the home will support a person's effort to live independently. The integration of a smart home system can also assist in controlling environmental systems, adjusting lighting and privacy controls, retrieve medical (tele-health) products, access social support through social media and allow access to visitors and phone calls regardless of the user's strength or mobility.

The ***Internet of Things (IoT****) is the inclusion of electronics and software in any device not usually considered computerized in nature, to enable it to achieve greater value and service by giving it ability to network and communicate with other devices.*

A smart home, or a home which is equipped with technology that enhances safety of residents and monitors their health conditions, can empower an elderly person desiring to age independently (Hensel, 2008) (Demiris, 2008). A study conducted at TigerPlace – a retirement community designed according to the Aging in Place model included focus group sessions with fourteen residents to evaluate perceived advantages and concerns the participants had regarding sensor-generated information. Included information was being gathered regarding their activity levels, sleep patterns and potential emergencies. Focus group sessions were audio-taped, and the tapes were then transcribed to allow for the performance of a content analysis. Most of the applications the participants were testing were thought by them to be useful and something they would agree to have installed in their own homes. Their acceptance depended on the sensor's appearance as well as the residents' own level of fragility and perceived need. The study participants also had concerns specific to protection of their privacy when such equipment was monitoring their activities.

The findings of the study indicated an overall positive attitude toward sensor technology if the technology was non-obtrusive.

TigerPlace is an independent living center developed in affiliation with the Missouri University Sinclair School of Nursing (Rantz M. A.). The center is connected to campus by a 1.5-mile path. Research director Marilyn Rantz, PhD, Rn has led the sensor-based research of the center. Residents at the TigerPlace assisted living community in southeast Columbia get a virtual checkup every day. Wireless sensor systems installed in about half of the community's living spaces constantly monitor residents' vitals and calculate their risk of falling (Favignano, 2015). A follow up study to previous work conducted at TigerPlace apartments was aimed at investigating the following: older adults' perceptions of the specific smart home technologies used by the TigerPlace project (i.e., a bed sensor, gait monitor, stove sensor, motion sensor, and video sensor); perceived advantages and concerns associated with these types of technology; willingness to adopt such technologies in their own residence; and preferences about recipients of sensor-generated information pertaining to their activity levels, sleep patterns, and potential emergencies (Lee M. D., 2015) (McAllister Wilder D. K., 2017). The referenced study provides insight into older adult's attitudes toward specific sensor technologies and captures the level of willingness to allow installation of such technologies and to share associated personal data with other stakeholders.

Additional support can be provided by smart home technologies that measure the aging people's level of involvement in both activities of daily living (ADL) and instrumental activities of daily living (IADL), (Kwon H. B., Older adults in multifamily housing: Residential satisfaction and intent to move, 2013).

Focus group sessions with older adults were used to assess perceptions and expectations of specific smart home technologies. Perceived advantages and disadvantages were considered as was the degree of willingness to use such devices in their homes. The bed sensor was perceived as useful, primarily because it provided security of any unexpected situation during the night for those who lived alone. The stove sensor wasn't considered very helpful because few of the participants did any actual cooking because they lived in a center where they receive meals prepared by the staff. The gait monitor was perceived as most helpful because almost all the participants had a fear of falling. There was concern amongst the participants regarding their privacy and who might be given access to the data uncovered (Demiris, 2008).

Interest in empowering an elderly person to live independently and concern regarding stigmatization from the obviousness of the installed technology indicates the need for interior designers to work on discrete design elements. Participants of the Burin study (2012) commented on not feeling the need for such devices until something happened. Perhaps that is where the quality of life element comes in. If interior designers can implement an interior design driven smart home with the health, safety, and overall well-being of the inhabitants at the leading edge of the concern, a need not yet being addressed could be fulfilled.

The dwellSense suite of systems is designed to monitor different activities that are important for independence and are commonly used in clinical assessments. The activities monitored included making coffee, taking medication, and using the telephone.

Patient perception regarding proper taking of medication was an important finding. One patient felt she did a good job and it turned out she did. The other patient discovered she had missed many more doses than she expected. On the clinical side, the doctors felt if they had reliable information regarding taking of medication, they would be able to better treat their patients. However, they didn't feel they had the time to review the data that was retrieved by the sensors in every case. Both patients felt the information about medicine taking as well as coffee making and use of the telephone was helpful to them and empowered them to objectively look at the data collected and evaluate their own performance (Lee M. L., 2015).

How can improved telephone technology, such as voice commands make the incidence of wrong use of the telephone less problematic? How can interior designers create an environment, or design into an environment features which will support users as they go about their various routines? Perhaps designing a sort of station into a kitchen, bath and or bedroom space or into furniture would empower the homeowner to better function in their home. Regarding the burden of sorting through the data, this might provide an opportunity for a health coach, someone who is part of the user's team, just as an occupational therapist or aging in place designer would be. The burden seems to be on the older person to make a trip to the doctor if something is detected which would make it less empowering for the user and create a barrier between the homeowner and his or her goal to age in place. Lastly, how can interior designers use observations of daily living to monitor and assist in well-being of the aging client? Domestic functions such as the washing of clothes and dishes, emptying of trash and disposal of aged food from the pantry and refrigerator could all be monitored to better support the independent aging client. Sensor networks, passive monitoring, eldercare technology, and video sensor network, could combine into the creation of elder focused smart homes

Another study worked to identify and assesses problems while they are still small which can provide a window of opportunity for interventions that will alleviate problem areas of those aging independently before they become catastrophic. The goal was to capture patterns representing physical and cognitive health conditions and then recognize when activity patterns begin to deviate from the norm. The intent was to provide early detection of potential problems which may lead to serious health events if left unattended. A multidisciplinary team of faculty, staff and students monitored older adults through a network of passive sensors ranging from video to bed sensors which are placed in the living environment. Seventeen apartments were monitored over a period ranging from three months to three years (McAllister-Wilder, 2017).

Unlike the work done previously by this team in a lab, it was discovered that people care how their home looks and do not feel comfortable with a plethora of wires and sensors. Another challenge was getting the homeowners to forget they were being monitored. However, it was learned that sensor system technologies have the potential of assisting health care providers in anticipating periods of decline earlier. Residents who were monitored felt safer and family members felt more secure knowing their loved one was being monitored. A major challenge was in who would sort through all the data and find significant results. A huge advantage was discovered, that of empowering the aging in place person to take an active role in their own health (Skubic, 2009) (McAllister-Wilder, 2017).

2.8.1 Technology Acceptance and Aging

Within the elderly population, more than just physical and cognitive abilities affect technology acceptance. The interface between the user, the environment in which the user exists and the product itself influences the acceptance in a myriad of ways ((Kwon S. , 2016) (Fisk, 2009).

2.8.2 Models of Technology Acceptance

Theory of Reasoned Action (TRA)

In a seminal meta-analysis conducted in 1988 by Blair H. Sheppard of Duke University, Jon Hartwich of McGill University and Paul R. Warshaw of New York University, the group reflected on the work of Fishbein and Ajzen which predicted the performance of any voluntary act. Reasoned action predicts that behavioral intent is created or caused by a person’s attitudes combined with subjective norms. Fishbein and Ajzen call these the evaluation and the strength of a belief (Sheppard, 1988). Attitude can be defined as our beliefs about the outcome of behavior and our evaluation of the potential outcome. For the proposed study, an awareness of what attitudes participants might have about specific home modifications might influence their ranking of the success of the modification.

Technology Adoption Model (TAM)

TAM is thought to be one of the most influential allowances of the theory of reasoned action. It is basically an information systems theory which models how users accept and use a technology based on the perceived usefulness and the perceived ease of use (Ajzen, 1980). Usefulness is the degree to which a person believes using the technology would enhance their performance while ease of use is the extent a person believes that technology is free of effort.

Unified Theory of Acceptance and Use of Technology (UTAUT)

UTAUT considers perceived expectancy – the perception the technology will enhance performance, effort expectancy – the perception the technology will be free of effort, social influence – the perception of the degree to which other people approve or disapprove of the behavior, and facilitating conditions which is the degree to which a person believes they will find an organizational and technical infrastructure which will support their use of the technology.

Senior Technology Acceptance Model (STAM)

TAM has now been extended to include age-related health and ability characteristics of older adults and is known as STAM, or Senior Technology Acceptance Model.

A systematic literature review conducted by a research group in the Netherlands identified six themes that affected technology acceptance and age (Peek, 2014). They include concerns regarding the technology itself, such as high cost or stigmatization of use. Older users were also influenced by how useful they perceive the proposed technology to be to them, which includes such things as increased independence. They also weighed their need for the technology which includes their subjective health status and compared that need to alternatives such as help from a family member or spouse. Social influence involved if they knew any peers who were using the technology and lastly, the actual characteristics of the individual influenced their acceptance of available technology. Such characteristics include cultural background and familiarity with electronic technology.

When considering what defines stigmatization associated with age, things such as restrictions of autonomy remind older adults of their degree of dependence and their need of technology to deal with activities of daily living (ADLs) (Fisk, 2009) (Kwon S. , 2016). As older adults retire, they tend to lose work and social roles, as a result they need to avoid being isolated because social engagement plays an important role in life satisfaction and well-being. However, older adults may lack confidence in their knowledge, skills, and ability to utilize the resources need for high-tech applications. Lastly, older adults could be not supported to understand or be equipped with the latest technology.

2.8.3 Environmental Contexts

Environmental contexts which influence the existence of pervasive technologies such as cooking appliances, mobile devices, electronic banking, automated phone menus cannot realistically be avoided by older adults. While younger adults are likely to easily adapt to such pervasive technologies, older adults are more likely to avoid them due to being inappropriate users of the technology or performing poorly in front of others while using the technology, particularly in a public place such as self-check stations in retail stores. However, mass media can have a positive influence if the information and messages promote the belief that seniors have the physical and mental capability to use the technology. Such positive perceptions in the media lead to increased confidence, positivity and use of the devices and systems.

Other environmental influencers include an older adult's desire to gain status or power within social groups as well as social influence such as a perceived social pressure to perform a behavior. Older adults are more likely to accept a technology if she perceives it to enhance their image or social status. Because older adults tend to place high value on other's opinions, they accept innovations such as smartphones and tablets yet might reject assistive technologies such as hearing aids and monitoring devices if they are perceived by consumers as designed for frail or vulnerable people. If given access to macro-environmental context factors such as adequate knowledge, guidance and assistance from others and financial support older adults are more likely to accept and embrace the available technology. They also consider accessibility, impact on their leisure time, hardware and software capacity and compatibility with other technology they are currently using. Perhaps most significant to older adult's acceptance of technology is the training factor. Older adults want to be trained and such training can build self-confidence and reduce anxiety. However, training programs need to be designed to respond to older adults need for patience and slower-paced instructional approaches.

2.8.4 Considerations for Older Adults

A common myth says that older adults try to avoid new technology, while this myth is not true, the are less likely to use technology when compared to younger adults (Kwon S. , 2016) (Fisk, 2009). Age related difference in technology use is mediated by income disparities and the user's perception of their need to use the technology. Older adults are also often believing, and may be right, that products are too difficult to learn to use.

When designing, building, or specifying products for older adults, it is important to understand certain characteristics which impact their use of those products and systems. When considering attention, there are three categories, selected, divided, and focused (Kwon S. , 2016). Selective attention deals with the ability to select inputs for conscious processing. Divided attention deals with the ability to attend to several targets or inputs at the same time. Focused attention deals with the ability to suppress unwanted or irrelevant sources of input.

Large, bright, colorful, and changing objects draw attention. Humans tend to start at the upper left and edge of the field of vision. Adjacent elements are scanned more often, and attention is determined by cognitive goals, such as when an item matches your expectation.

Directing attention addresses difficulties with identifying, prioritizing, and responding to abnormal conditions. To support directed attention, use peripheral versus central cues, both visual and auditory. Also consider the use of highlighting but resist excessive reliance on cues. When considering the use of alarms, question if the signals attract attention and are discriminant from the background while also letting the user know that something happened. When potential innovativeness or interpretation of alarms, including the semantic aspect of the alarm. Also question if they help diagnose abnormalities and help distinguish between different abnormal conditions.

Some problems to be aware of with the use of alarms on smart home devices for older adults, is there a likelihood of nuisance alarms and false alarms? Is there a chance for ambiguous or underspecified alarms? Lastly, does the alarm indicate system status rather than the problem?

“Human error is defined as an inappropriate or undesirable human decision or behavior that reduces, or has the potential for reducing, effectiveness, safety, or system performance. It is also an action that led the task or system outside its acceptable limits or an action whose result was not desired by a set of rules or an external observer” (Kwon S. , 2016). Errors and violations are not the same; errors are unintended, informational and individual while violations are deliberate, indicate a motivational problem and have an organizational context.

Errors also must be looked at as either active errors or latent errors. Active errors are those of which effects are felt immediately by the operator. Latent errors are those of which the adverse consequences can lie dormant for a long time and the effects are felt by the designers and managers.

There is a common belief that memory gets worse with age. It is important to consider there are different types of memory, working versus short term (Fisk, 2009). Long term memory can be further divided into semantic and prospective. When considering semantic long-term memory, older adults may be slower to access stored information and sometimes experience retrieval difficulties such as when having a word on the tip of the tongue but being unable to retrieve it. When designing or building for older adults it is important to realize this information is generally not entirely lost. On the other hand, Prospective long-term memory, there are age related declines which are usually much greater for time based than event-based tasks. Procedural long-term memory deals with the situation when older adults have difficulty developing new automatic process which are conceptually like developing new habits. These are considered elastic rather than plastic – or set in ways - in some domains. However, for tasks and activities automatized prior to senescence, evidence suggests that these automatic behaviors remain intact.

There exists a translational stage between normal aging and dementia which is known as mild cognitive impairment (MCI).

2.8.5 Assistive Technology

Assistive technologies are defined as any device or system which allows an aging individual to perform a task that would otherwise be impossible, difficult, or unsafe to do (Kwon S. , 2016). Types of assistive technology thought to be relevant to aging in place include robots, telehealth, telecare, and wearable technology. Robots are defined as a (re)programmable device capable of performing a variety of operations to reach, grasp move or position. They are currently being developed to help aging adults as aiding robots by offering reminders, performing chores. They are also being developed as social robots which serve to reduce loneliness, provide security, monitor, and provide emotional reactions.

Why, while smart home technology has demonstrated the potential to improve home safety as well as foster members of the aging populations’ independence, it is so scarcely implemented (Ehrenhard, 2014). After studying the literature, the researchers derived key market barriers in Smart Home value networks. Those findings were then expanded on through a value network of a Dutch smart home implementation case, as well as through 14 interviews which provided more insight into the value network of specific smart home services. They found, primarily, the aging population needs to be convinced of the value of smart home technologies. In the interviews it was learned that lack of familiarity of the complex technology, fear of losing control and loss or privacy were primary concerns. However, the research outcomes point toward smart home technology can allow the elderly stay independent longer. Beyond maintaining independence, it was found, because the elderly tends to have more time for comfort technology as well as a desire to protect accumulated wealth, they are likely interested in smart home technology for reasons beyond safety. In conclusion, it was found that while some technology barriers exist, the elderly’s attitudes toward smart home technology are positive. Four key findings emerged from the study.

1. End user requirements need to be closely considered when designing a smart home platform.
2. Platform management is crucial as such platforms can only be successful its standards are set, and systems are reliably integrated.

3. While price has a strong influence on behavior, costs need to be contained. However, if additional value can be demonstrated a higher price can be accepted.
4. The role of government in regulating the market, enforcing standards, safeguarding privacy, or subsidizing pilot projects cannot be overlooked.

2.8.6 Current and Future Products

As the Amazon Echo and Google Home gain staying power in the market, there are more ways to incorporate their functions into older adults' lives. They can function as timers and alarms; they can add items to a grocery list or tasks to a to-do list that might otherwise be forgotten and can be set up to turn the home's lights or appliances off in case someone forgets. The popularity and function of these continue to rise.

Amazon Alexa

The first major commercial product hit the market Amazon Alexa, released in November of 2014. Alexa is Amazon's voice service and the brain behind millions of devices like the Amazon Echo. Alexa provides capabilities, or skills, that enable customers to create a more personalized experience. Customers can use Alexa to control smart home devices such as cameras, door locks, entertainment systems, lighting, and thermostats.

Google Home

Google has entered the smart home product industry with Google Home, a voice activated system which is able to answer questions, set timers and play music. However, its interaction with smart home products is where it really stands out. To get the most out of Google Home's home-automation capability, other products need to be added. Below are just a few of those products which can meet the needs of older adults aging in place while Google expands their products.

August Smart Lock

August smart lock assists when one tends to forget to lock the door or cannot remember is it is locked. The user can ask their google home device if the door is locked, and if is not, ask the device to lock it for them. This device is soon to be replaced by the same company's upgrade, Smart Lock Pro. This device supports security of aging in place individuals, a concern often shared during the data collection process of this project.

Anova Precision Cooker

Anova's precision cooker allows a user to use voice commands to raise and lower the cooking temperature, see how much time is left on the timer and ask how long something has been cooking. Such control assists in protection against burns.

Philips Hue Lights

Phillips Hue Lights work with Google Home to support different colors, color temperatures and lighting levels of the lighting system. Lighting and related colors are an important aspect of healthy aging in place.

Sony Bravia XBR-A1E

Sony Bravia XB-A1E is a smart television which not only delivers wonderful colors and sound but also offers a version of Android TV for its smart interface. That allows you to control it with your voice. This feature is especially helpful for those with physical limitations.

Wink Hub 2

Wink Hub 2 connects a variety of intelligent accessories with Google Home. There are compatible lighting products, including lamps, switches, dimmers, and outlets – as well as thermostats. Once set up it can be used to turn off lights or turn the heat up or down. Wink Hub 2 is compatible with many of the other products listed here. Again, an important contribution to safe living for those with physical limitations.

Nest Learning Thermostat

Google Home can be used to control your Nest thermostat. Voice activated commands can inform the user of the current temperature, what the thermostat is set to and even make it warmer or cooler by specifying several degrees, a specific temperature or merely asking it to make it warmer or cooler. If there are multiple thermostats in the home, they can be given nicknames and addressed individually. These thermostats allow the aging individual to customize their home environment.

Ring Video Doorbell

Once linked to Google Home you can use the ring video doorbell cam to start recordings, activate motion alerts and check up on the device itself. The camera has a high resolution, a wide field of view and cloud storage capabilities.

iRobot Roomba

iRobot Roomba 360 is the least expensive connected robot vacuum yet offers advanced features such as scheduling, a 3-stage cleaning system and an automatic return to the base to charge. It can be voice controlled or the user can use a smartphone app to start and stop cleanings or check on the device’s status. These vacuums help keep the floors clear from tripping hazards.

2.9 BIM and the Benefits of Sustainable Universal Design

A process of integrating different modules of a BIM model with the intent to provide a method to evaluate and build sustainable, universally designed homes can move design decisions forward at an early stage, especially when comparing different design alternatives. A study which looked at BIM and Benefits of Sustainable UD Homes UD means Universal Design, which is another term that is used to indicate an accessible or inclusive design that would support the needs of the elderly. This paper provides a nice connection between the simulations in this study as well as in my greater body of work. It also demonstrates that there is a gap between what industry believes is needed as far as accessible design and what is needed. (Ahmad Jrade, 2014)

2.9.1 Design Visualization

Design Visualization is a technique which involves creating images, diagrams, or animations to communicate a design solution with designers and end users (Munzer, 2015). The field of visualization is typically studied in computer graphics programs. The development of animation has advanced visualization and enhanced the usefulness for design presentations. A study conducted in 2011 by Wei Yan, Charles Culp, and Robert Graf sought a solution to address interoperability between games and building models. The intent was to enhance architectural visualization while allowing designers to play in their designed environments (Yan, 2011). In the proposed dissertation study, the ability for subjects in the study to be able to interact with the model of the environment in a play like manner is thought to be beneficial.

2.9.2 Immersive Visualization

Immersive visualization provides a realistic presentation of a design project by allowing the viewer to see how sunlight shines at different times of day, or even in different seasons and to experience how doors open and close as they would in the real world (Heimgartner, 2017). Including custom building materials in a model enables the creation of unique visualizations which accurately replicate the specified materials. Immersive visualization goes beyond a picture of the designed environment by providing an immersive experience, which is being developed for the Architecture, Engineering and Construction industry (AEC) based on technologies previously and currently being used in the film and gaming industries. Interactive architectural visualization is a type of Immersive Visualization which allows the user to interact with the visualized environment.

2.9.3 Real Time Visualization

A recently published paper highlights the complexity involved in visualizing large Building Information Models in real time (Johansson, 2015). The paper sought to analyze commonly used BIM viewers and to develop and validate a prototype BIM viewer which is can handle large BIM models without sacrificing visual accuracy. The authors looked at four commonly used BIM viewers, DDS CAD viewer, Tekla BIMsight, Autodesk Navisworks, and Solibri Model Viewer. Responding to the problem involved in being able to render a complex model in real time, which has led to either splitting the model into different sub-models.

2.9.4 Game Technologies and BIM

A project presented at the 34th International Symposium on Automation and Robotics in Construction (ISARC) in 2017, discussed how a BIM based Visualization and Interactive System (BIM-VIS) integrates with BIM, game engines and virtual reality (Huang, 2017). They explained that BIM-VIS is a real time rendering system that relates the spatial design and the building model. BIM-VIS can utilize wireless game controllers to make interacting with the components of the model easier. The project attempts to address the current problems caused by BIM software being limited in the ability to provide realistic visualization and simple interactive methods for stakeholders to imagine and understand the presented designs. Without the ability to understand, they are then unable to provide meaningful feedback to the design team. The authors are currently developing the BIM-VIS system to allow the designer to integrate the users experience from medical staff during the design phase to better ensure user requirements are met.

2.9.5 Architectural Simulation, Animation, and 3D Interior Walk Throughs

Architectural simulation allows designers to predict the performance, power efficiency and reliability of a proposed system (ExaScience life lab, 2017). Architectural Animation is created on a computer as a short movie to better demonstrate the spatial qualities of a building (Schnabel, 2017). Architectural renderings are often used with architectural animation. A virtual walkthrough is a moving representation of a building (Fusion, 2017). A walk through can be created of an existing building, a building under construction or a building in the planning stages. Virtual walkthrough is most commonly used as a marketing tool but is also useful for designers and end users. A virtual walkthrough feels to the viewer as if someone is walking through the space with a video camera. A walk through can be done with or without animation, which adds elements such as a fire burning in a fireplace or a curtain fluttering in the breeze of an open window.

2.10 Virtual Reality and Aging in Place

Utilizing a virtual reality simulation to quantify real-world reaction to home modifications is an encouraging substitute for visiting a show room or model home which closely duplicates realistic changes which could potentially be made to an older adult's existing residence.

A recent effort, conducted by designers at Fjord, a global design and innovation consultancy, experimented with virtual reality to assist first time wheelchair users navigate the world (Hao, 2017). The designers began to experiment with virtual reality with hopes the experience could help people better understand situations they are unfamiliar with. They conducted numerous user research interviews prior to building a VR experience to train people how to navigate the world using a wheelchair. Their initial prototype has two components, a 3D urban environment and wheelchair which, while stationery, has free-moving wheels equipped with motion detectors. The 3D, virtual urban environment simulates common spatial negotiation tasks and obstacles a first-time wheelchair user might encounter. Those common tasks and obstacles were derived after multiple interviews and forums as well as access to online resources for accessible design.

To experience the simulation, a user sits in the wheelchair and puts on a VR headset. As he or she rotates the wheels the sensors feed the actions to the simulator which updates the virtual environment in real time. Doing so allows the user to practice skills essential to wheelchair usage, such as steering, assessing spatial relationships and negotiating pedestrians and traffic. An effort was made on the part of the designers to avoid gamifying the experience in any way, which I also hope to do with my simulation. A design strategy executive at Fjord, John Jones, believes turning something into a game results in the opposite of inspiring empathy. According to Jones, "It trivializes the experience, and that is not what we wanted to do" (Hao, 2017, p. 2). Instead, the team focused less on rendering to keep the 3D model light, bright and airy which was thought to move the focus to more on the authenticity of the experience. Future efforts are geared toward making the simulation include sensations such as braking, navigating hills and going over bumps. There is also hope of collaborating with different clients to test out the effectiveness of the simulation and eventually bring it to market. Currently, Veterans Affairs and a handful of hospitals in New York have expressed an interest. The innovators are also interested in marketing the simulation to others with hope of helping non-wheelchair users empathize with wheelchair users, such as architects and designers.

2.10.1 Enhancing Quality of Life for People Living with Dementia

When considering a virtual reality empathy platform, an invention has been introduced which is designed to help architects and designers create dementia-friendly buildings by understanding how dementia can affect a person's vision (Turnball, 2017). Because people with dementia often see things very differently, with objects appearing dimmer and duller than in reality, this platform is meant to support a designers need to understand the users for which he or she is designing (Virtual Reality Empathy Platform, 2018). The virtual reality device is thought to be the first one designed for architectural design and is meant to allow the designers to view a conceptual or an existing building. The intent is for the designer to improve the quality of a person's life by being able to create comfortable, familiar feeling environments which could reduce accidents, lessen anxiety, and help users live more independently.

Conceived by architect David Burgher, the director at Scottish Borders-based Aitken Turnbull Architects, a firm with many years of experience designing for the elderly and for people living with dementia which has consequently developed a great deal of empathy for this population. Partners on the project include Glasgow CGI company Wireframe Immersive and HammondCare, a dementia center recognized as a world leader in dementia support, care, and design.

Evidence-based research and academic rigor to the project is provided by HammondCare while Wireframe Immersive has developed the virtual environment and will supply software and hardware. In a recent press release, Mr. Burgher said "As well as reducing anxiety, the improved design offers a better, safer and more independent quality of life. Dementia-friendly design doesn't have to cost more. In fact, by using VR-EP, designers will get it right the first time and therefore reduce costs."

The virtual reality system (Virtual Reality Empathy Platform, 2018)

The system is comprised of a laptop with high performance graphic and memory capability, Virtual Reality goggles, a game controller, camera, and bespoke software programming. Kevin Gordon, Business Development Manager at Wireframe Immersive believes VR-EP is leading edge technology being developed by Scottish companies and serves as a fantastic illustration of how virtual reality can be used to improve quality of life. He also sees an immense economic advantage, not just in the UK but across the globe. He stated in the press release issued by the venture that this new virtual reality, empathy platform has the potential to be adapted to simulate other sensory impairments and be used across a spectrum of disorders.

Senior Consultant at the HammondCare Dementia Centre's UK team Professor Mary Marshall shared in the same press release that conveying the experience of the environment for people living with dementia is a major challenge for researchers, trainers, and consultants in dementia design. This device has the potential to be immersive beneficial for all the above-mentioned stakeholders.

The VR-EP device was developed with funding from Scottish Enterprise (Dimentia Design and Empathy, 2019). A scoping exercise is currently being carried out by Aitken Turnbull Architects and Wireframe immersive with interest from Scottish Development International (SDI) to export this virtual reality device to Europe, China, and the United States.

Innovation Specialist David McHoul at Scottish Enterprise believes the project is a great example of Scotland's strength in innovation and that the support of SDI will help develop this ground-breaking dementia design and empathy platform to a globally underserved patient group, those suffering from dementia. A strong demand for this product on an international scale and the VR-EP device is anticipated to make a profound impact in improving the environment for those living with dementia.

A British nonprofit has launched an app that simulates life with Alzheimer's (Matchar, 2016). The British nonprofit Alzheimer's Research UK is working to help the public better understand what it is like to suffer with Alzheimer disease. A virtual simulation of the reality of living with AZ allows people to experience what an actual day is like; the group hopes to get them to better understand the disease. One of the created scenarios puts the user in a grocery store. Looking up, the user experiences how a sufferer of AD feels as the lights brighten to an uncomfortable level. AD sufferers often experience light sensitivity. While still in the grocery store, the user experiences the shelves rearranging themselves which gives the viewer the experience of special disorientation.

The app was created by Visyon, a technology company which specializes in virtual reality. An eight-month project, Visyon did it free of charge as part of its social mission. They used animation, 360-degree video and 3D game development tools to create the app. With post-production techniques, they edited the final video, with input from Alzheimer patients, to enhance the feelings of confusion by blurring details and morphing faces.

Visyon CEO, Pere Perez Ninou was pleased with the feedback received from AD sufferers. "I can't believe you were able to represent how we feel!" Alzheimer's Research UK in June of 2016 at London's launched the app historic Pancras station where they allowed passerby to stop and put on the headsets. They experienced very positive feedback from the launch with some people ending up in tears as they experienced what it is like for those suffering from AD. Future plans include using the app to help the public better understand and empathize with sufferers of what they say is shaping up to be one of the major health crisis of the 21st century as the number of dementia patients is expected to double every twenty years as the population ages.

2.10.2 Augmented Reality

Contrasted with virtual reality, where everything you see is replaced by a digital environment when you look through a virtual reality apparatus (Takahashi, Technical Lead, Envision Center Research Computer, Purdue University Information Technology, 2017), Augmented Reality is a direct or indirect view of a real-world environment with computer-generated input, such as sound, video, graphics, haptics or GPS data inputted into the scene.

2.10.3 Mixed Reality

Mixed reality merges physical environments with virtual environments (Cameron, 2017). A user can be physically in a location and witness it being transformed with virtual architectural modifications. Microsoft HoloLens is an example of MR technology. Nicholas Cameron, Director of digital practice and Perkins+Will sees mixed reality as a rapid virtual prototype system which will allow architects to create scaled models and view them instantaneously (Lau, 2017). Mr. Cameron believes HoloLens and mixed reality will be able to provide Perkins + Will designers and clients viewable, interactive results in a fraction of the time 3D printing is able to.

2.10.4 Microsoft HoloLens

Microsoft HoloLens is the first self-contained holographic computer. It enables users to engage with digital content and interact with holograms in the surrounding space (Mixed reality: Your world is the canvas, 2017).

2.10.5 Reality Capture

Reality capture is the process of using scanning, digital photography, and drones to create models of existing conditions. Such conditions might include an existing structure, a construction project being built, as well as projects in the design phase (Lau, 2017).

2.10.6 Cloud Services

Cloud services are being rapidly expanded to help in the visualization of a BIM model, free roam visualization on a desk top computer, mobile device or with VR with a headset such as Oculus Rift and GearVR (Gensler, 2016).

2.10.7 BIM Viewer Enhancements

DDS CAD viewer is a free tool used for viewing, analyzing, merging, and discussing BIM models is being advanced to better view, check, edit or create IFC, BCF, gbXML and DWG files (DDS-CAD Viewer, 2017). Improvements are also being made in the intuitive 3D navigation experience and visualization filters for analyzing model information (DDS-CAD Viewer, 2017).

Tekla BIMsight is also a free tool which is used for construction project collaboration. Clash detection capabilities are being enhanced to improve measurement of rebar and conflict checking, it is offering support of SketchUp, STEP and IGES and supporting five more languages (Tekla BIMsight 1.9, 2017).

Occulus Rift is currently rolling out Rift Core 2.0 Beta (Mitchell, 2017). Core 2.0 consists of three key parts: a complete overhaul of Home; a redesigned Oculus desktop app; and Dash, a brand-new system interface that brings the power of your PC into VR. Touch was a major milestone for Oculus and for VR. Hand presence unlocked an entirely new mode of input that made VR more natural, intuitive, and tactile. The next step was to rethink the core experience from the ground up. One of the main features of Dash is Oculus Desktop, letting you access your Windows desktop and traditional apps. This opens new creative possibilities for Rift, using Spotify to play music, YouTube to watch videos, Chrome to surf the web and check email, or Notepad to take notes—all from within VR.

2.11 Emerging Technologies

Created by David Kim, a U.K. Researcher at Microsoft Research and Newcastle University, a device called Digits is worn around the wrist and contains a motion sensor and infrared light source (Knight, 2012). Digits can follow arm and finger movements to replicate them on the screen and allow control of complex commands.

Dr. Hong Z. Tan, a professor of Electrical and Computer Sciences at Purdue University is currently working on projects utilizing sensory substitution, virtual and augmented reality, emotional communication, and tactile speech communication (Engineering at Purdue, 2017). Her work with sensory substitution involves developing multimodal interfaces to help the deaf and blind as well as those who are challenged by situational blindness, such as when a cyclist cannot safely look at their phone for navigation, runners for speed and drivers who should be watching the road. Her work with VR/AR is focused on providing haptic feedback to indicate collision with a virtual object such as when an athlete is training to catch a football. Her team is working with UX designers to explore ways for people to connect emotionally with others over a long distance and their work with tactile speech communication is working to devise ways for speech information to be received on the skin using wearable tactor arrays with the capacity to deliver more information than simple alert and warning signals.

Chris Harrison of Disney Research is working on ways to expand touch screen use by developing a way for devices to recognize swipes and presses of people. That could allow apps to track modifications to a document made by different people (Knight, 2012).

Effective March 1, 2018, Google Tango is being replaced by ARCore which is expected to bring augmented reality features to smart phones utilizing existing hardware. Google Tango was an augmented reality computing platform developed by Google to use computer vision to enable smart phones and tablets to detect their position in the world around them without using global positioning services (GPS). Tango uses computer vision to give mobile devices the type of understanding a user achieves by using their eyes to find their way around a space. Tango uses motion tracking, area learning and depth perception to achieve this objective (Tango Concepts, 2017).

Revit® Live cloud service turns Revit and Revit LT models into an immersive experience in one click, helping architects understand, explore, and share their designs (Revit Live, 2017).

2.12 Future Directions

When creating an accessible and technologically smart home, sustainability should be addressed in interest of creating a holistically healthy environment (McAllister-Wilder, 2017). A recent study attempted to identify space planning features to serve as guidelines when designing elderly care environments from a holistic health perspective (Lee Y. H., 2015). A content analysis technique employed physical, psychological, and social health criteria. The research is expected to assist construction and design experts in the creation of environments for the elderly which will improve the quality of life for seniors. In the past, in Korea, privacy has been given secondary importance behind safety. The researchers hope that by giving cognitive factors high significance, the psychological and mental health and social/socio-psychological health dimensions can be improved. Combining the efforts of psychologists, designers and construction professionals will have a positive impact on the finished product. It seems to follow the integrated construction management project management format that is gaining in prominence.

Often elderly persons are forced to leave the home they love for the convenience of the care givers as well as for their own safety. If we as design and construction professionals can tap into the technical information being uncovered and incorporate it into a fully accessible home, we can do much to assist the desire to age in place.

When looking deeper at quality of life for those aging in their communities, human well-being, outdoor visits, community parks, and accessibility, a study conducted by Rappe (Rappe, 2006) offers helpful information. The more often older people can go outside and enjoy nature, the better their self-rated health is. It is important to analyze how physical mobility and social isolation relate to the frequency of outdoor visits and whether those visits impact self-related health. A qualitative study involving 45 people was done using a questionnaire to ascertain the self- rated health of the participants using the choice of excellent, very good, good, fair, or poor. Those answers were then compared to the amount of time the participants spent outdoors. Without regard to the season of year, those who reported the most visits outdoors felt the frequency of their visits had a strong positive effect on their health (Rappe, 2006). As an interior designer it is important to provide access to the outdoors for elderly clients. Also, because the participants indicated simply observing nature was also beneficial it is important to provide views to natural settings.

2.13 Terms

For this paper, the term accessible design is being used to indicate a space which is designed with the principles of inclusive design, universal design, barrier free design, and ADA compliant design as well as spaces appropriate for aging in place (McAllister-Wilder, 2017). While the American's with Disabilities Act does not apply to detached single-family homes, there is a common misconception that an ADA compliant space meets the needs of those hoping to age in place. The ADA was passed to ensure public facilities and services be available to people with disabilities.

Accessible design is typically considered a design process which specifically considers the needs of people with disabilities. The term accessible (What is the difference between accessible, usable, and universal design? 2015). It is common to hear the word accessibility regarding the characteristics of products, services and spaces which can be used by people with a variety of disabilities without assistance.

Conversely, The Center for Universal Design at North Carolina State University have defined universal design as "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design." (The Center for Universal Design, 2008) Examples of universal design include curb cuts and doors that open automatically so a person holding a baby, or a load of groceries can move through without trouble. When considering universal design, the designer must keep in mind a variety of ages, gender, culture, and language.

While inclusive or universal design are terms which are currently more accepted within the construction and interior design industries, the use of accessible design was thought to be more widely understood by potential members of the sample population so will be used in the study.

2.14 Summary

Reviewed literature overviews the growing need for housing to support the growing numbers of elderly wishing to age independently in place in the United States. Unlike even ten years ago, vast offering in smart home technology is coming to market to support the health, safety, and welfare of elderly consumers living independently. Continuing Care Retirement Communities (CCRC's) offer a safe, secure option but one that is available only to those with significant financial means and no significant place attachment to their previous home. If many aging seniors were to move from their existing communities into institutional environments it would place a burden on the communities, they are abandoning and on financial resources of the state. Identifying the key amenities essential to successful aging in place if the first step, followed by surveying user's perceptions and finally educating the end user regarding the appropriateness of adding those amenities to the homes they inhabit.

In the survey, which you will find in Appendix A of this document, you will see the logic which took participants through the survey. They were asked a series of questions regarding their confidence when viewing the walkthrough and then viewed the 3D walkthrough of a 1970's suburban ranch home with aging in place modifications. After viewing the 1minute 21 second video they were asked the same questions. The logic presented was arrived at after extensive pilot testing. The pilot tests resulted in several iterations of the survey, making changes to verbiage, content and logic.

Specific gaps identified in this literature review are listed below.

Most of the research regarding home modifications for aging in place is done through a medical, rather than construction or interior design lens.

- New developments in smart home technology can provide support for aging in place.
- Typically, those design and non-design professionals recommending home modifications rely on guidelines provided by the American's with Disability Act. Other codes and standards are often more applicable.
- While emphasis on a holistically healthy home is increasing, research is not found though the design and construction lens.
- Methods used to communicate recommended home modifications are often not clearly communicating intent to end users.

CHAPTER 3. METHODOLOGY

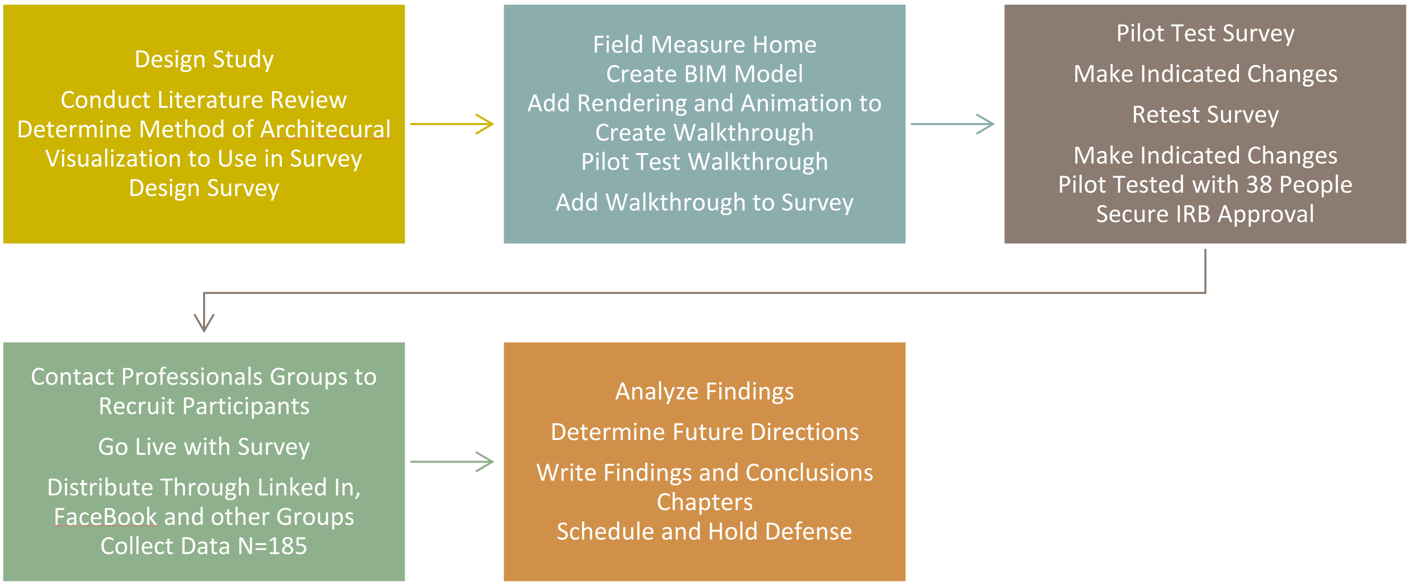


Figure 3.1 Research Process Chart

Developing and testing a system which includes a digital 3D fly-through, created with Building Information Modeling (BIM) software is the intent of this project. The fly-through was used to communicate structural and non-structural modifications, products and amenities which support safe aging in place to older adults, their families, caregivers, and medical stakeholders as well as to involved designers and builders. The underlying hypothesis is that the use of architectural visualizations tools combined with building information modeling software can communicate appropriate modifications which allow older adults to safely remain independent in their homes thus influencing confidence in those modifications.

Framework

The existing literature introduces numerous models used to assess users' perceptions of features presented as well as physiological reactions to those features (Bertoa, 2007). A process was developed and include a digital 3D fly-through, created with Building Information Modeling (BIM)software to communicate structural and non-structural modifications, products and amenities which support safe aging in place to older adults, their families, caregivers, and medical stakeholders as well as to involved designers and builders. Utilizing an architectural visualization tour, in the form of a 3D fly-though, of potential home modifications will allow a user to experience the impact products and home modifications strategies available to meet their specific needs could have on the safety of their built environment. The model was created using the same design process a construction or design professional would use; a program was written utilizing a persona representing an older adult, conceptual design drawings were made and tested and because of those tests, a final iteration of the BIM model was created. The completed model was then used to create a 3D fly-though for presentation to the studied population

3.1.1 Mixed Methods Approach

A quantitative approach was used to test the hypothesis using a digital 3D model combined with architectural visualization software, to create an immersive experience for participants of the study.

A qualitative approach was used to answer the research questions using interviews, observations and focus groups to get a deeper understanding of the needs and perceptions of the population.

3.1.2 Population Sample

The population sample includes older adults and their stakeholders who want to age in place, friends and family members of those who want to age in place as well as professional designers, professional constructors, and professional health care providers. Members of professional organizations, including the National Association of Home Builders, The American

Society of Interior Designers, The International Interior Design association, The National Kitchen and Bath Association as well as other related organizations were asked to participate as members of their professional associations. The survey and model were shared with the researchers' social media and email accounts, specifically targeting those who indicated involvement in design, construction and health care. Professional associations were reluctant or unwilling to distribute the survey directly. Distributing through Facebook and especially LinkIn proved to be the most effective recruitment method.

3.2 Mixed Methods Data Collection

An existing checklist developed by AARP regarding safe home modifications to support aging in place was used selectively combined with one developed by researchers H.J. Kwon and J.O. Beamish to guide the design modifications and create a digital walkthrough of an existing midwestern ranch home. Qualtrics software was used to create a survey into which the walkthrough was embedded at, approximately, the halfway point of the survey.

The digital walkthrough of the prepared model was then presented to older adults and related stakeholders, as well as industry professionals to determine their confidence in the comfort, usability, attractiveness and safety of the modifications. Quantitative data was collected through confidence questions using a six-point Likert scale. Identical questions were asked before and after participants viewed the walkthrough. Qualitative data was collected through multiple choice and text box opportunities in the same survey.

According to the Center for the Built Environment at Berkeley, occupant surveys can be used as an invaluable source of information regarding building performance. They can also help objectively gauge which design strategies are not working and help to determine which steps need to be taken to improve performance and satisfaction (Moddesette, 2016).

3.2.1 Hypothesis

The use of architectural visualizations tools combined with building information modeling software to create a digital walkthrough which can communicate appropriate modifications which allow older adults to safely remain independent in their homes thus influencing the confidence in those modifications.

3.2.2 Research Questions

RQ1: Does a digital walkthrough increase the confidence level of professionals and users in the potential of proposed home modifications to support safe aging in place?

RQ2: What differences in confidence level exist between studied groups. Group one includes older adults and their friends and family members. Group two includes professional designers, construction professionals and medical professionals.

3.2.3 Variables

Independent variables include the modifications made to the model which include wider egress, the addition of a ramp, grab bars and handrails, a curb less shower with a built-in seat, and comfort height and smart toilets and smart home assistive technology.

Dependent variables include the perceptions of attractiveness, constructability, ease of use and safety of the modifications before and after viewing the walkthrough.

3.2.4 Quantitative Assessment Instrument

A survey was designed and tested using Qualtrics software. A model of the selected home was created with BIM software. The modifications believed to make egress to and use of the master bath were made to the existing floor plan. The model was then exported into a rendering and animation software to create the walkthrough which was imbedded in the middle of the survey. Survey participants were then able to answer questions both before and after viewing the walkthrough.

The digital walkthrough of the prepared model was then presented to older adults and related stakeholders, as well as industry professionals to determine their confidence in the comfort, usability, attractiveness and safety of the modifications. Quantitative data was collected through confidence questions using a six-point Likert scale. Identical questions were asked before and after participants viewed the walkthrough. Qualitative data was collected through multiple choice and text box opportunities in the same survey. These questions were employed to look more deeply at the perceptions of the respondents.

3.2.5 Qualitative Assessment Instrument

Qualitative data was collected through multiple choice and text box opportunities in the same survey. These questions were employed to look more deeply at the perceptions of the respondents.

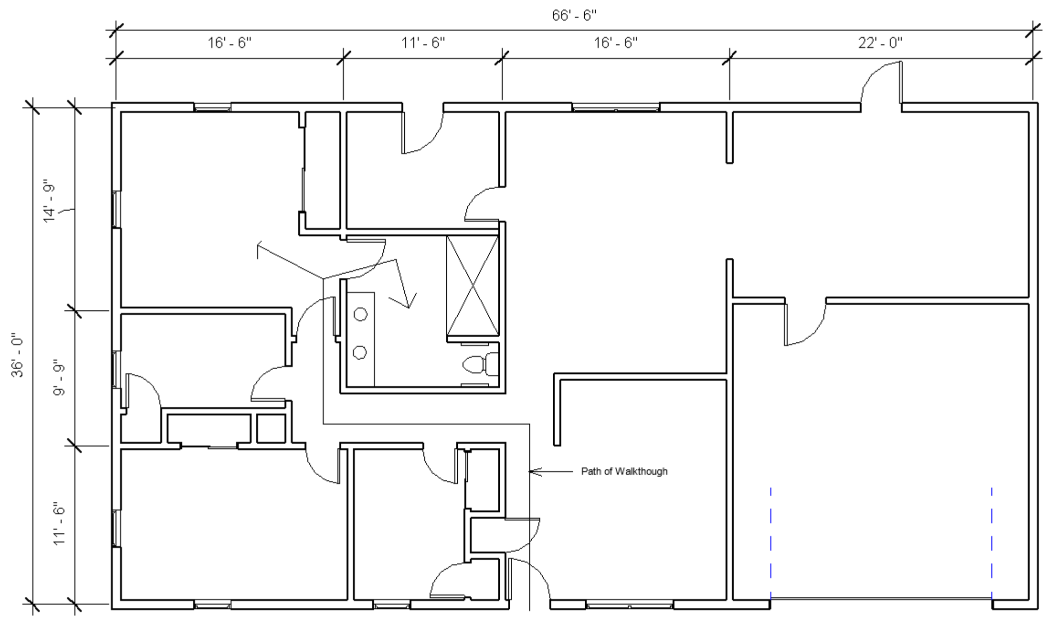


Figure 3.2 Floor Plan Showing the Intended Path of the Walkthrough

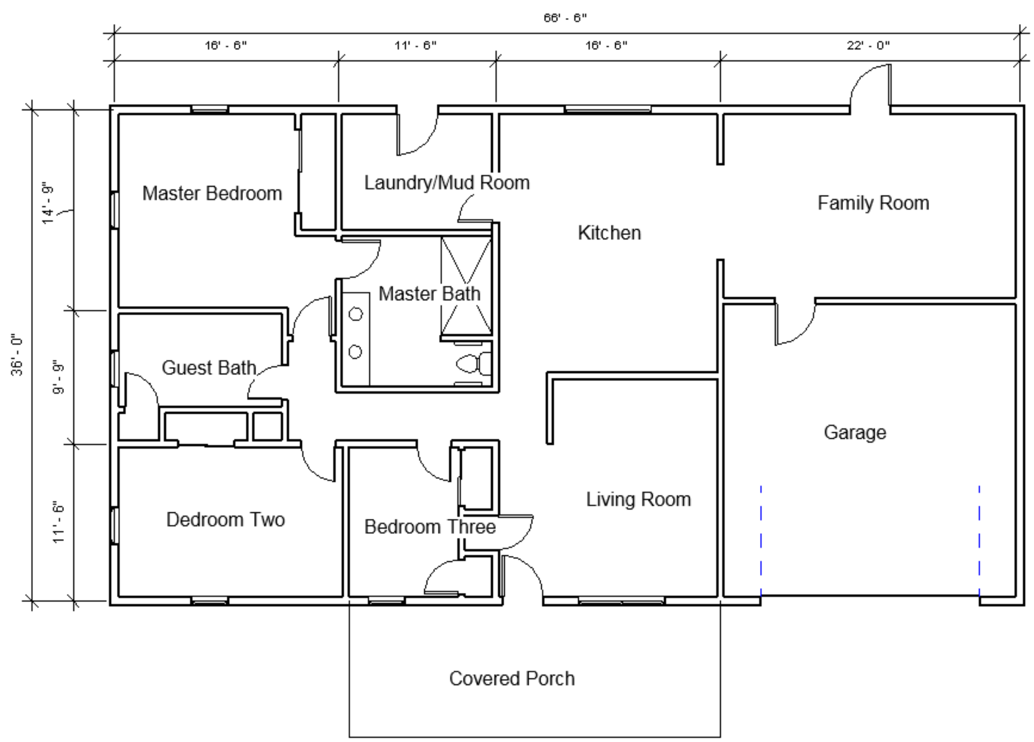


Figure 3.3 Floor Plan with Rooms Identified

Figure 3.4 Arrival at the Home

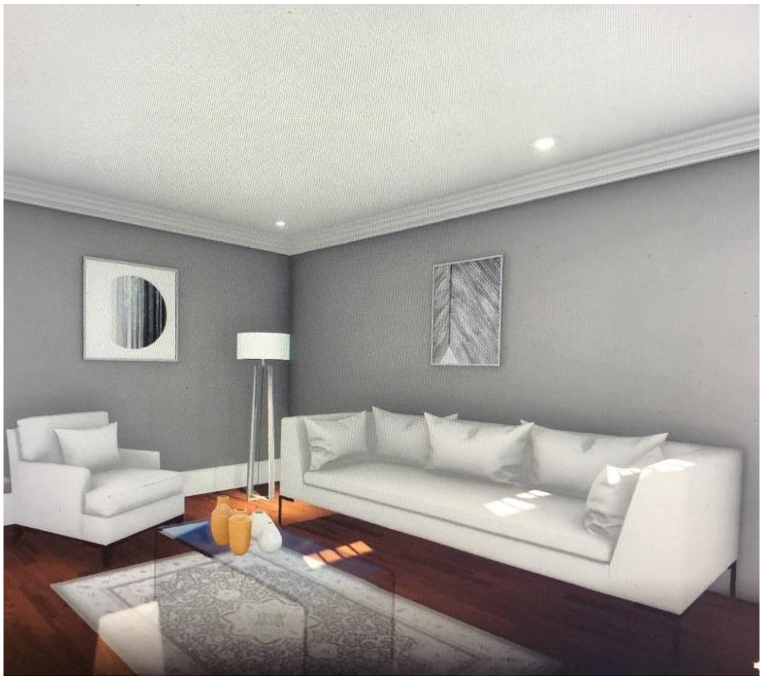


Figure 3.5 Entering the Living Room

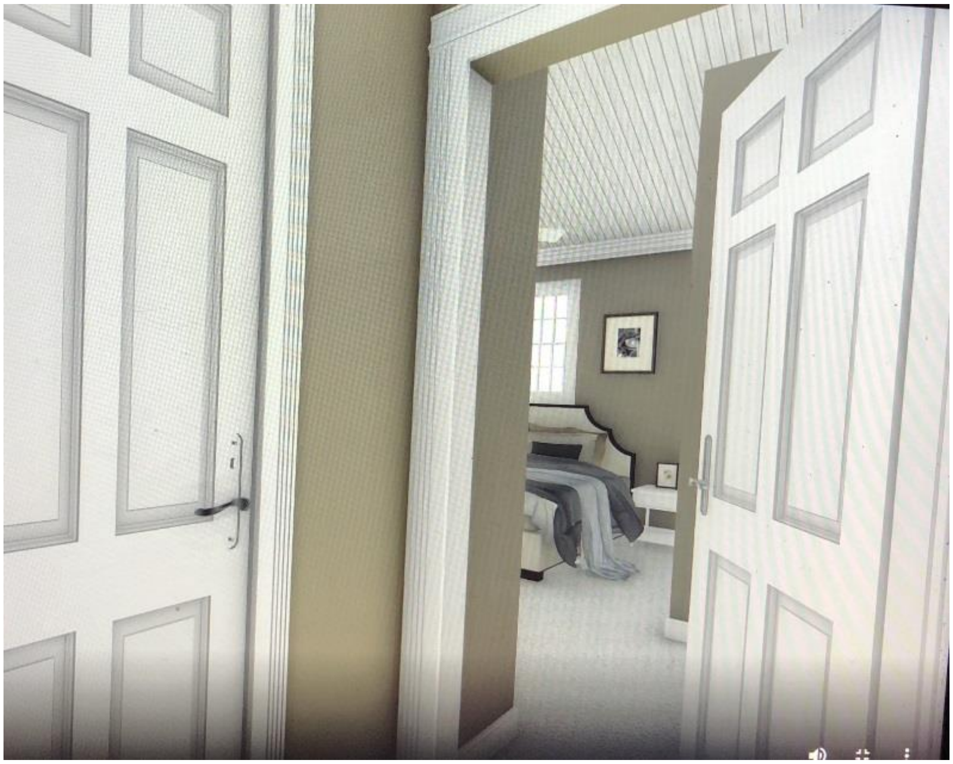


Figure 3.6 Entering the Master Suite

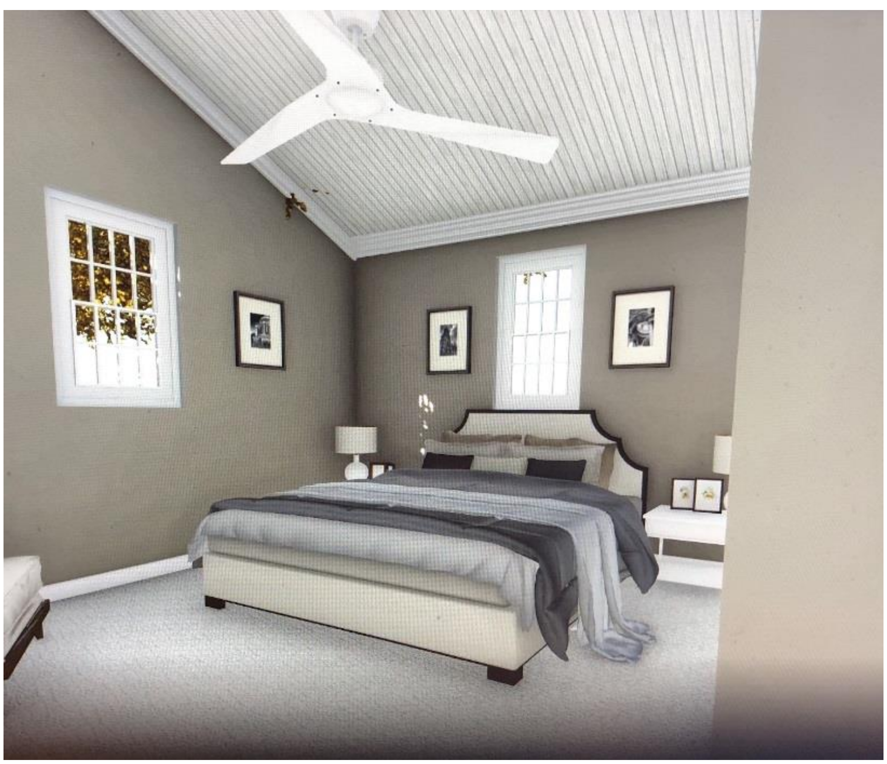


Figure 3.7 The Master Bedroom

Figure 3.8 Entering the Master Bath

Figure 3.9 Walk in Shower with Built in Seat

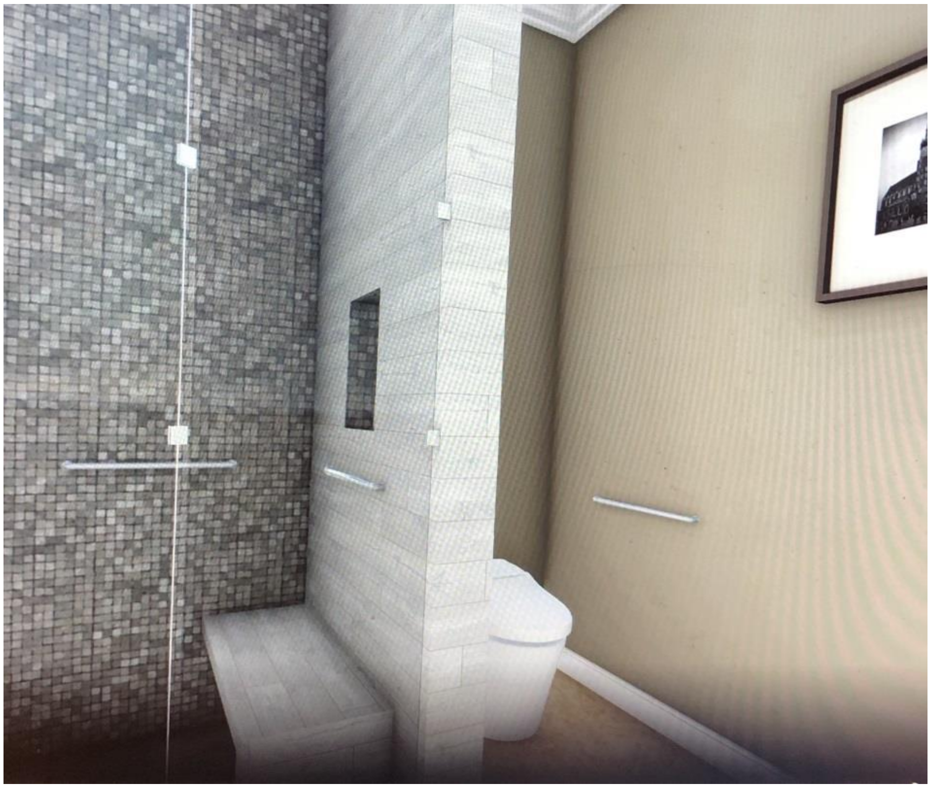


Figure 3.10 Smart Toilet with Grab Bars

Figure 3.11   Exiting the Master Bath

3.2.6 Demographics

Demographic questions included age, gender, educational level achieved, geographic location, and living arrangements. Also ascertained, in the event they live with someone else, is the caregiving qualities of the relationship. For example, they will be asked if they help with activities of daily living or if they receive such assistance. Participants were also asked what percentage of the value of their home they would consider investing to safely age in place. Lastly, they were asked if they currently have any concerns about safety for them self of a loved one, and characteristics of their current residential situation.

3.3 Pre-survey Evaluation of Survey Instrument

To ensure the validity of the research the following steps will be taken:

1. Other surveys which have considered consumer perception of safely in the interior environment were used to formulate this survey. To date such examples have been found regarding viewers perception to landscape environments.
2. Before a question was asked in the full-scale survey, it was tested to find out if the sample population understands the questions and can evaluate them as expected.
3. Three interviews were held prior to the launch of the survey to determine if the model is perceived as expected, and if not, how it was perceived. Additional iterations to the survey were made in response to input.
4. The survey was taken by 38 individuals to pilot the study and resolve any identified issues.

3.4 Study Logistics

The following steps were followed in pursuit of this study:

- Conduct literature review
- Conduct a site visit to field measure the home to be modeled
- Create the as built model
- Create a modified model
- Design the survey
- Test the instruments
- Proof of concept test
- Make indicated changes
- Proof of Concept test
- Make indicated changes
- Conduct pilot test
- Secure IRB approval
- Recruit participants
- Roll out survey
- Collect data
- Create Reports
- Analyze Report
- Create Additional Indicated Reports
- Analyze Additional Reports
- Report Findings
- Determine Items for Discussion
- Determine Items for Future Studies

3.5 Data Analysis

For the quantitative section of the study, descriptive statistics were used to begin analyzing the data collected from questions used in the survey. The mode method of central tendency informed of the most frequent response to each question which made the results easier to analyze and more meaningful (Blog Spot, 2011). T-tests were used to determine if statistical significance existed in the perceptions of suggested amenities before and then after viewing the walk through.

For the qualitative section of the study, card sorting was used to first identify the dominate themes occurring in the collected responses. The determined themes were then put into Nvivo software for further analysis. Word clouds were created to visually present the findings.

3.6 Summary

The above mixed methods approach was intended to gather information from survey participants regarding specific feelings about the level of fear experienced, the perception of safety and the willingness to accept proposed safety modifications. The modifications were presented to them utilizing a 3D walkthrough form of architectural visualization of a BIM model. The model patterned after an existing ranch home built in 1973 was shown to the study participants after the modifications were made.

CHAPTER 4. RESULTS ANALYSIS

4.1 Demographics

Study participants represent two groups which are broken down into five subgroups. The first group are the end users which identify either as interested in aging in place for themselves or for a friend or family member. The second group are the professionals who identify as either design professionals, construction professionals or health care professionals.

4.1.1 Number by Group, Gender, And Role

When considering the responses of all those who participated in the survey, 73.50% (n=136) indicated they were female, 23.78% (n=44) indicated they were male while 2.70 (n=5) preferred not to say.

Table 4. 1 Number of Participants by Gender

#	Gender	Percentage	Count
1	Female	73.51%	136
2	Male	23.78%	44
3	Prefer not to say	2.70%	5
			185

When those participating in the study were asked to define their role regarding aging in place, we found the information summarized in the following table.

Table 4. 2 Number of Participants by Identified Role

#	Selected Role	Choice	Count
1	I Am Interested in Aging in Place for Myself	29.17%	63
2	I Am Interested in Aging in Place for A Friend or Family Member	20.83%	45
3	I Am A Design Professional (Interior Designer, Architect, Engineer)	24.07%	52
4	I Am A Health Care Professional (Nurse, Occupational/Physical Therapist, Medical Doctor)	11.57%	25
5	I Am A Construction Professional	11.57%	36
6	I Am A Social Worker/Hospital Discharge Planner/Continuing Care Provider	2.78%	6
			216

NOTE: The numbers above indicate 216 persons because respondents could select more than one role when taking the survey. Not all persons who began the survey answered every question.

The group who indicated they were interested in aging in place for themselves is made up of 63 individuals; 76.19% (n=48) indicated they were female while fifteen, or 23.18% indicated they were male. No participant in this group declined to share their gender.

Table 4. 3 Gender of Those Interested in Aging in Place for Themselves

#	Gender	Percentage	Count
1	Female	76.19%	48
2	Male	23.81%	15
3	Prefer not to say	0.00%	0
			63

The group who indicated they were interested in aging in place for a friend or family member is made up of forty-five individuals; 82.22% (n=37) indicated they were female while 17.78% (n=8) indicated they were male.

Table 4. 4 Gender of Friends and Family Members

#	Gender	Percentage	Count
1	Female	82.22%	37
2	Male	17.78%	8
3	Prefer not to say	0.00%	0
			45

The group which indicated they were representing design professionals was made up of fifty-two individuals; When considering the responses participants of the survey, 79.63% (n=43) indicated they were female, 16.67% (n=1) indicated they were male while 2.70 (n=5) preferred not to say.

Table 4. 5 Gender of Design Professionals

#	Gender	Count
1	Female	43
2	Male	6
3	Prefer not to say	2
		52

The group which indicated they were representing construction professionals was made up of twenty-five persons; eight indicated they were female, sixteen indicated they were male while one preferred not to say.

Table 4. 6 Gender of Construction Professionals

#	Gender	Count
1	Female	8
2	Male	16
3	Prefer not to say	1
		25

The group which indicated they were representing health care professionals was made up of twenty-five individuals; 79.63% (n=43) indicated they were female, 16.67% (n=1) indicated they were male while 2.70 (n=5) preferred not to say.

Table 4. 7 Gender of Health Care Professionals

#	Gender	Count
1	Female	17
2	Male	6
3	Prefer not to say	2
		25

4.1.2 Respondent Ages

When looking at the entire sample group, most responses came from people between the ages of 35 – 50 (47.85% (n=89). Persons aged between 35 – 40, 21.51% (n=40) made up the next largest group. Those between the ages of 66 -80, followed with 19.35% (n=36) falling into that age group. Those aged 26 to 34 made up 8.05% (n=15), those 18 – 25 represented 2.15% (n=4) with only 1.08% (n=2) from those aged 80 and older.

When looking at the entire sample group, most responses came from people between the ages of 35 – 50 (47.85% (n=89). Persons aged between 35 – 40, 21.51% (n=40) made up the next largest group. Those between the ages of 66 -80, followed with 19.35% (n=36) falling into that age group. Those aged 26 to 34 made up 8.05% (n=15), those 18 – 25 represented 2.15% (n=4) with only 1.08% (n=2) from those aged 80 and older.

Table 4. 8 Ages Represented in the Study

#	Age Group	Percentage	Count
1	18-25	2.15%	4
2	26-34	8.06%	15
3	35-50	21.51%	4
4	51-65	47.85%	89
5	66-80	19.35%	36
6	Over 80	1.08%	2
			186

Most responses in the group interested in aging in place for themselves came from people between the ages of 51-65 (52.38% (n=33). Persons aged between 66-80, 31.75% (n=40) made up the next largest group. Those between the ages of 35-50, followed with 9.52% (n=6) falling into that age group. Those aged 26 to 34 made up 1.59% (n=1), those 18 – 25 also represented 1.59% (n=1) with only 3.17% (n=2) from those aged 80 and older.

Table 4. 9 Ages of Those Interested in Aging in Place Themselves

#	Age Group	Percentage	Count
1	18-25	1.59%	1
2	26-34	1.59%	1
3	35-50	9.52%	6
4	51-65	52.38%	33
5	66-80	31.75%	20
6	Over 80	3.17%	2
			63

Most respondents who indicated they were interested in aging in place for a friend or a family member were between the ages of 51-65 (49% (n=22). Persons aged between 35-50, 22% (n=10) made up the next largest group. Those between the ages of 26 - 34, followed with 13% (n=6) falling into that age group. Those aged 66 to 80 made up 9% (n=4), those 18 – 25 also represented 7% (n=3) with only no one representing the group aged 80 and older.

Table 4. 10 Ages of Those Interested in Aging in Place for a Friend or Family Member

#	Age Group	Percentage	Count
1	18-25	6.67%	3
2	26-34	13.33%	6
3	35-50	22.22%	10
4	51-65	48.89%	22
5	66-80	8.89%	4
6	Over 80	0.00%	0
			45

The largest group of respondents indicating they are design professionals represent people between the ages of 51 – 65, (n=26). Thirteen design professionals indicated their age group as 35 – 50, (n=13). Nine design professionals represented the age group between 66 – 80 (n=9) while three were between 26 – 34 and 1 was between 18 – 25.

Table 4. 11 Ages of Design Professionals

#	Age Group	Count
1	18-25	1
2	26-34	3
3	35-50	13
4	51-65	26
5	66-80	9
6	Over 80	0
		52

Respondents who reported they were construction professionals, most responses regarding construction professionals' age group came from people between the ages of 51 – 65, (n=13). Six construction professionals were aged 35 – 50, (n=6). Four represented the age group between 66 – 80 (n=4) while two were between 26 – 34 and none were between 18 – 25 or over 80.

Table 4. 12 Ages of Construction Professionals

#	Age Group	Count
1	18-25	0
2	26-34	2
3	35-50	6
4	51-65	13
5	66-80	4
6	Over 80	0
		25

Lastly, when considering health care professionals, most responses regarding age group came from people between the ages of 51 – 65, (n=26). Thirteen design professionals were aged 35 – 50, (n=13). Nine represented the age group between 66 – 80 (n=9) while three were between 26 – 34 and 1 was between 18 – 25.

Table 4. 13 Ages of Health Care Professionals

#	Age Group	Count
1	18-25	0
2	26-34	4
3	35-50	10
4	51-65	8
5	66-80	3
6	Over 80	0
		25

4.1.3 Education Level

Table 4. 14 Education Level of Sample Participants

#	Education	Choice	Count
1	Less Than A High School Diploma	2.15%	4
2	High School Graduate (or GED)	8.06%	15
3	Some College	21.51%	4
4	Bachelor’s Degree	47.85%	89
5	Graduate Degree	19.35%	36
			186

When those interested in aging in place for themselves were asked about education level, most respondents had a graduate degree with 44.44% (n=28 reporting they have a graduate degree. The next largest group reported holding a bachelor’s degree, consisting of 34.92% (n=22) of the participants. Nine persons interested in aging in place for themselves have a Hight School Diploma or GED with 6.35% (n=4). None of the respondents in this group had less than a high school diploma.

Table 4. 15 Education Level of Those Interested in Aging in Place for Themselves

#	Education	Choice	Count
1	Less Than A High School Diploma	0.00%	0
2	High School Graduate (or GED)	6.35%	4
3	Some College	14.29%	9
4	Bachelor’s Degree	34.92%	22
5	Graduate Degree	44.44%	28
			63

When friends and family members were asked about education level, we again found most respondents having college degrees with almost an equal number holding graduate and undergraduate degrees.

Table 4. 16 Education Level of Friends and Family Members

#	Education	Choice	Count
1	Less Than A High School Diploma	0.00%	0
2	High School Graduate (or GED)	4.44%	2
3	Some College	26.67%	12
4	Bachelor’s Degree	35.56%	16
5	Graduate Degree	33.33%	15
			45

When asked about education level, twelve design professional participants had a graduate degree, 34 had a bachelor’s degree, and 3 had some college.

Table 4. 17 Education Level of Design Professionals

#	Education	Count
1	Less Than A High School Diploma	0
2	High School Graduate (or GED)	0
3	Some College	6
4	Bachelor’s Degree	34
5	Graduate Degree	12
		52

When construction professionals were asked about education level, thirteen participants had a graduate degree, ten had a bachelor's degree, one had some college and one held a high school diploma or GED.

Table 4. 18 Education Level of Construction Professionals

#	Education	Count
1	Less Than A High School Diploma	0
2	High School Graduate (or GED)	1
3	Some College	1
4	Bachelor's Degree	10
5	Graduate Degree	13
		25

Lastly, when health care professionals were asked about education level, twelve participants had a graduate degree, 34 had a bachelor's degree, and 3 had some college.

Table 4. 19 Education Level of Health Care Professionals

#	Education	Count
1	Less Than A High School Diploma	0
2	High School Graduate (or GED)	0
3	Some College	2
4	Bachelor's Degree	11
5	Graduate Degree	12
		25

4.1.4 Regarding Geographic Location i.e. State

Twenty-five states were represented in the study, with one participant residing outside of the United States.

Table 4. 20 Geographic Locations by US State

#	Location	Percentage	Count
1	Alabama		2
2	Arizona		4
3	California		9
4	Colorado		2
5	Florida		3
6	Illinois		3
7	Indiana		119
8	Kansas		1
9	Kentucky		2
10	Louisiana		1
11	Maryland		1
12	Massachusetts		1
13	Minnesota		3
14	Missouri		3
15	New Jersey		1
16	New Mexico		1
17	New York		2
18	North Carolina		3
19	Ohio		5
20	Oregon		1
21	Pennsylvania		1
22	Texas		3
23	Virginia		2
24	Washington		5
25	I don’t live in the USA		1

Twenty-five states were represented by those interested in aging in place for themselves.

Table 4. 21 Aging Individuals by State

#	Location	Percentage	Count
1	Alabama	1.64	1
3	California		3
6	Illinois		1
7	Indiana		49
9	Kentucky		1
14	Missouri		1
17	New York		1
18	North Carolina		1
19	Ohio		1
21	Pennsylvania		1

Friends and Family Members came from sixteen states.

Table 4. 22 States Represented by Friends and Family Members

#	Location	Percentage	Count
1	Alabama	2.22%	1
2	California	2.22%	1
3	Florida	2.22%	1
4	Illinois	4.44%	2
5	Indiana	57.78%	26
6	Kansas	2.22%	1
7	Kentucky	2.22%	1
8	Louisiana	2.22%	1
9	Minnesota	2.22%	1
10	Missouri	4.44%	2
11	New York	2.22%	1
12	North Carolina	2.22%	1
13	Oregon	2.22%	1
14	Texas	2.22%	1
15	Washington		3
16	Wisconsin	2.22%	1

Design professionals represented fourteen states in the study, with twenty-nine participants indicating they reside in Indiana, three each in Arizona, California and Ohio. Two designers were from Colorado and Minnesota while there was one designer Florida, Kansas, Massachusetts, New Jersey, New Mexico, New York, North Carolina, Texas and Washington State.

Table 4. 23 States Represented by Design Professionals

#	Location	Count
1	Indiana	29
2	Arizona	3
3	California	3
4	Ohio	3
5	Colorado	2
6	Minnesota	2
7	Florida	1
8	Kansas	1
9	Massachusetts	1
10	New Jersey	1
11	New Mexico	1
12	New York	1
13	North Carolina	1
14	Texas	1
15	Washington	1
		52

Ten states were represented by construction professionals in the study, with thirteen participants indicating they reside in Indiana, two in California, two in Ohio and one each in Florida, Maryland, New Mexico, Texas and Virginia. Two construction professionals indicated they do not reside in the United States.

Table 4. 24 States Represented by Construction Professionals

#	Location	Count
1	Indiana	13
2	Arizona	1
3	California	2
4	Ohio	2
5	Florida	1
6	Maryland	1
7	New Mexico	1
8	Texas	1
9	Virginia	1
10	Do not reside in the US	2

Ten states were represented by health care professionals in the study, with eighteen participants indicating they reside in Indiana, two in California, three in Ohio, two in Colorado and one each in Missouri, New York, Virginia, Texas and Washington.

Table 4. 25 States Represented by Health Care Professionals

#	Location	Count
1	Indiana	18
3	California	2
4	Ohio	3
5	Colorado	2
6	Missouri	1
7	New York	1
8	Virginia	1
9	Texas	1
10	Washington	1
		25

4.1.5 Regarding Locale – Urban, Rural, Suburban or Combination

When asked how a participant would describe the area in when they live or work, 41% (n=76) indicated suburban, 26% (n=49) indicated urban, 21% (n=38) indicated a combination of types while the remaining 12% (n=22) indicated they lived or worked in a rural location. Those persons answering the survey from the perspective of aging in place themselves or for a friend or family member were asked where they lived. Those in the professional groups answered from the perspective of where they worked.

Table 4. 26 Locale of Participants

#	Location	Percentage	Count
1	Urban	26.49%	49
2	Rural	11.89%	22
3	Suburban	41.08%	76
4	A combination of area types	20.54%	38
			185

When aging individuals were asked how they would describe the area in when they live or work, 51% (n=32) indicated suburban, 27% (n=11) indicated urban, 19% (n=12) indicated a combination of types while the remaining 13% (n=8) indicated they lived or worked in a rural location. Those persons answering the survey from the perspective of aging in place themselves or for a friend or family member were asked where they lived. Those in the professional groups answered from the perspective of where they worked.

Table 4. 27 Locale of Aging Individuals

#	Location	Percentage	Count
1	Urban	17.46%	11
2	Rural	12.70%	8
3	Suburban	50.79%	32
4	A combination of area types	19.05%	12
			63

When friends and family were asked how they would describe the area in when their friend of family member lived, 36% (n=16) indicated suburban, 32% (n=14) indicated urban, 14% (n=6) indicated a combination of types while the remaining 18% (n=8) indicated they lived or worked in a rural location. Those persons answering the survey from the perspective of aging in place themselves or for a friend or family member were asked where they lived. Those in the professional groups answered from the perspective of where they worked.

Table 4. 28 Locale of Friends and Family

#	Location	Percentage	Count
1	Urban	31.82%	14
2	Rural	18.18%	8
3	Suburban	36.36%	16
4	A combination of area types	13.64	6
			44

When design professionals were asked how they would describe the area in when they live or work, 20 designers indicated suburban, 15 indicated urban, 15 indicated a combination of types while the remaining 2 indicated they lived or worked in a rural location. Those persons answering the survey from the perspective of aging in place themselves or for a friend or family member were asked where they lived. Those in the professional groups answered from the perspective of where they worked.

Table 4. 29 Locale of Design Professionals

#	Location	Percentage	Count
1	Urban	16.67%	15
2	Rural	16.67%	2
3	Suburban	50.00%	20
4	A combination of area types	16.67%	15
			52

When construction professionals were asked When asked how a participant would describe the area in when they live or work, nine indicated they worked in a suburban area, eight indicated they worked in an urban area, six indicated a combination of types while the remaining 2 indicated they worked in a rural location.

Table 4. 30 Locale of Construction Professionals

#	Location	Percentage	Count
1	Urban	16.67%	8
2	Rural	16.67%	2
3	Suburban	50.00%	9
4	A combination of area types	16.67%	8
			25

When health care professionals were asked When asked how a participant would describe the area in when they live or work, nine indicated suburban, eight indicated urban, six indicated a combination of types while the remaining 2 indicated they lived or worked in a rural location. Those persons answering the survey from the perspective of aging in place themselves or for a friend or family member were asked where they lived. Those in the professional groups answered from the perspective of where they worked.

Table 4. 31 Locale of Health Care Professionals

#	Location	Percentage	Count
1	Urban	16.00%	4
2	Rural	16.00%	4
3	Suburban	52.00%	13
4	A combination of area types	16.00%	4
			25

4.1.6 Professional Certifications Represented

When considering design professionals participating in the study, 42 of the respondents indicated they held certifications which included, National Council for Interior Design Certifications (NCIDQ), 19 % (n=8); NCARB 5% (n=2), Certified Kitchen and Bath Specialist (NKBA), 9% (n=4), Leadership in Environmental Design (LEED) 17% (n=7), Certified Living in Place Professional (CLIPP) 19% (n=8), Certified Aging in Place Specialist (CAPS) 7% (n=3) while 23% (n=10) indicated they were members of an organization not listed. None of the participants indicated they were WELL Building Certified.

When considering construction professionals participating in the study, 18 of the respondents indicated they held certifications which included Certified Aging in Place (CAPS) n=4, Leadership in Environmental Design (LEED) n= 3, Construction Manager Certification Institute (CMCI) n= 2, American Institute of Constructors (AIC) n=2, Green Business Certification Inc n=2 and Certified Aging in Place specialist (CLIPP) n=1. Lastly four construction participants reported they were associated with an organization which was not listed.

Health Care participants included the following certifications. Clinical Social Worker in Gerontology (CSW-G), Social Worker in Gerontology (SW-G) and Certified Social Worker in Health Care (C-SWHC).

Certifications available for selection by survey participants included Social Worker in Gerontology (SW-G), Clinical Social Worker in Gerontology (CSW-G), Advanced Social Worker in Gerontology (ASW-G), Certified Social Worker in Health Care (C-SWHC), Certified Aging in Place Specialist (CAPS), Certified Living in Place Professional (CLIPP), Discharge Planner and other.

4.1.7 Professional Associations Represented

Thirty-six design professionals indicated they were members of professional organizations. The largest group was nine design professionals who were members of the American Society of Interior Designers (ASID) which included 25% (n=9) of those responding positively to being members of an organization. Six design professionals were members of the International Interior Design Association (IIDA) which made up 16.67% (n=6). Five, 13.89% (n=5) were members of the National Kitchen and Bath Association (NKBA) while four, 11.11% (n=4) were members of the American Institute of Architects (AIA) and four (11.11%) (n=4) were members of the National Association of Home Builders (NAHB). Eight respondents 22.22% (n=8) indicated they were members of a professional organization which was not listed.

Only the International Well Building Standard (WELL) was not represented amongst the certification organizations listed in the survey while all the professional associations listed were represented in the respondent population.

Fourteen construction professionals indicated they were members of professional organizations. The largest group was five construction professionals who were members of the

National Association of Home Builders. Three construction professionals were members of the United States Green Building Council (USGBC)). Two were members of the Associated General Contractors of America (AGC), one was a member of the American Institute of Contractors (AIC); another one was a member of American Subcontractors Association (ASA) while two construction professionals mentioned another organization.

They were also members of professional associations including the Association of Social Work Boards (n=1) and the National Association of Social Workers (n=3) which indicates one member of the population was a member of both organizations.
Professional organizations available included the American Board of Social Work Examiners in Social Work, the American Sociological Association, the Association for the Advancement of Social Work with Groups, the Association of Social Work Boards, the Clinical Social Work Federation, the Council on Social Work Education, the National Association of Black Social Workers, the National Association of Social Workers, the American Geriatrics Association, The Gerontological Society of America, the National Association of Geriatric Care Managers, the National Council of the Aging, and the Discharge Planning Association.

4.1.8 Current Living Situation

Current living situation (only includes group one) i.e. not the professionals
Those who indicated they were interested in aging in place for themselves were asked to describe their current living situation. Most respondents,58 % (n=35) indicated they live with a spouse or significant other while 32 % (n=35) live alone and 10% (n=6) live with a roommate or other family member.

Table 4. 32 Living Situation of Aging Individuals

#	Living Situation	Percentage	Count
1	I live alone	31.67%	19
2	I live with a spouse or significant other	58.33%	35
3	I live with a roommate or other family member	100.00%	6
			60

How would you describe your friend or family members' current living situation?

Table 4. 33 Living Situation of Friends and Family Members

#	Living Situation	Percentage	Count
1	He/she lives alone	43.18%	19
2	I live with a spouse or significant other	43.18%%	19
3	I live with a roommate or other family member	13.64%	6
			44

4.1.9 Care Giving Status

Care giving status (only includes group one – aging individuals and friends and family members)

Of those aging individuals indicating they live with someone else, the vast majority, 74.42% (n=32) reported they live independently with neither one providing personal care for the other. Seven participants, 16.28% (n=7) share equally in the personal care giving responsibilities, helping each other out with personal care as required. Three persons, or 6.98% (n=3) primarily cares for the other person while one person, 2.33% (n=1) is cared for by the person they live with.

Table 4. 34 Care Giving Status of Aging Individuals

#	Living Situation	Percentage	Count
1	I primarily provide personal care for the other person	6.98%	3
2	The other person provides personal care for me	2.33%	1
3	We share equally in the personal care giving responsibilities, helping each other out with personal care as required	16.28%	7
4	We live independently with neither one providing personal care for the other	74.42%	32
			43

When friends and family members of individuals who live with someone else, they were they were asked to define the role played by each person. Personal care giving was defined as participating in activities of daily living.

Table 4. 35 Care Giving Status of Friends and Family Members

#	Living Situation	Percentage	Count
1	He/she primarily provides personal care for the other person	27.27%	6
2	The other person provides personal care for him/her	22.73%	5
3	They share equally in the personal care giving responsibilities, helping each other out with personal care as required	18.18%	4
4	They live independently with neither one providing personal care for the other	31.82%	7
			22

Level of concern was recorded while performing specific activities of daily living from those who identified as interested in aging in place for themselves or interested in aging in place for a friend or family member. Activities included were moving about the home, personal hygiene which includes oral care, skin, and hair care, showering or bathing, and toileting.

4.1.10 Egress Safety

Q11 How concerned are you about your safety when moving yourself from seated to standing, getting in and out of bed and walking independently from one location to another?

Table 4. 36 Concern for Safety When Moving Around the House by Aging Individuals

Field	Minimum	Maximum	Mean	Standard Deviation	Variance	Count
Level of concern	1.00	5.00	1.59	1.00	1.00	58

When friends and family members were asked the same question about the person they were concerned about we saw a greater level of concern. Question 23 asked, “How concerned are you about your friend of family members safety when moving from seated to standing, getting in and out of bed and walking independently”?

Table 4. 37 Concern for Safety When Moving Around the House by Friends and Family

Field	Minimum	Maximum	Mean	Standard Deviation	Variance	Count
Level of concern	1.00	6.00	3.66	1.44	2.07	38

Statistical significance of the difference in the level of concern between aging individuals and friends and family members regarding safety when moving from seated to standing, getting in and out of bed and walking independently was found to be significant

Table 4. 38 StatSig re: LC Between AI and FF re: Safety During Egress

Two sample T- test and CI				
	Descriptive Statistics			
	N	Mean	StDev	Se Mean
Before Walkthrough	58	1.59	1.00	0.13
After Walkthrough	38	3.66	1.44	0.23
		Estimation for Difference		
	Difference	95% CI for Difference		
	-2.070	(-2.606, -1.534)		
	T Value	DF	P-Value	
	-7.72	60	0.000	

4.1.11 Personal Hygiene

Q12 How concerned are you about your safety when providing personal hygiene, oral care, and grooming (skin and hair care) for yourself in your home?

Table 4. 39 Concern re: Personal Hygiene by Aging Individuals

Field	Minimum	Maximum	Mean	Standard Deviation	Variance	Count
Level of concern	1.00	6.00	1.50	1.25	1.00	46

When friends and family members were asked the same question about the person they were concerned about we saw a greater level of concern Question 24 asked, “How concerned are you about your friend of family members safety when providing personal hygiene, oral care, and grooming”.

Table 4. 40 Concern re: Personal Hygiene by Friends and Family Members

Field	Minimum	Maximum	Mean	Standard Deviation	Variance	Count
Level of concern	1.00	6.00	3.66	1.44	2.07	38

Statistical significance of the difference in the level of concern between aging individuals and friends and family members regarding safety when preforming personal hygiene, oral care, and grooming (which includes skin and hair care) was found to be significant

Table 4. 41 StatSig re: LC Between AI and FF re: Safety Performing Personal Hygiene

Two sample T- test and CI				
Descriptive Statistics				
	N	Mean	StDev	Se Mean
Before Walkthrough	46	1.50	1.25	0.18
After Walkthrough	38	3.66	1.44	0.23
Estimation for Difference				
	Difference	95% CI for Difference		
	-2.160	(-2.753, -1.567)		
	T Value	DF	P-Value	
	-7.26	73	0.000	

4.1.12 Showering Safety

Q 13 How concerned are you about your safety when showering or bathing in your home?

Table 4. 42 Concern for Safety When Showering by Aging Individuals

Field	Minimum	Maximum	Mean	Standard Deviation	Variance	Count
Level of concern	1.00	6.00	2.09	1.38	1.90	45

When friends and family members were asked the same question about the person they were concerned about we saw a greater level of concern. Question 25 asked, "how concerned are you about your friend and family members safety when showering or bathing in his/her home"?

Table 4. 43 Concern for Safety when Showering by Aging Individuals

Field	Minimum	Maximum	Mean	Standard Deviation	Variance	Count
Level of concern	1.00	6.00	4.45	1.48	2.20	40

Statistical significance of the difference in the level of concern between aging individuals and friends and family members regarding safety when showering or bathing was found to be significant

Table 4. 44 StatSig re: LC Between AI and FF re: Safety when Showering or Bathing

Two sample T- test and CI				
		Descriptive Statistics		
	N	Mean	StDev	Se Mean
Before Walkthrough	45	2.09	1.38	0.21
After Walkthrough	40	4.45	1.48	0.23
		Estimation for Difference		
	Difference	95% CI for Difference		
	-2.360	(-2.980, -1.740)		
	T Value	DF	P-Value	
	-7.57	80	0.000	

4.1.13 Toileting Safety

Q14 How concerned are you about your safety when toileting, which includes getting on and off the toilet and cleaning yourself in your home?

Table 4. 45 Aging Individuals Level of Concern When Toileting

Field	Minimum	Maximum	Mean	Standard Deviation	Variance	Count
Level of concern	1.00	5.00	1.57	1.18	1.39	42

Q26 How concerned are you about your friend or family member's safety when toileting, which includes getting on/off the toilet and cleaning him/herself at home.

Table 4. 46 Friend and Family Members Level of Concern Regarding Toileting

Field	Minimum	Maximum	Mean	Standard Deviation	Variance	Count
Level of concern	1.00	6.00	3.84	1.40	1.97	37

Statistical significance of the difference in the level of concern between aging individuals and friends and family members regarding safety when toileting, which includes getting on/off and cleaning him/herself at home was found to be significant

Table 4. 47 StatSig Re: LC Between AI and FF re: Safety when Showering

Two sample T- test and CI				
		Descriptive Statistics		
	N	Mean	StDev	Se Mean
Aging Individuals	42	2.09	1.38	0.21
Friends and Family	37	4.45	1.48	0.23
		Estimation for Difference		
	Difference	95% CI for Difference		
	-2.270	(-2.855, -1.685)		
	T Value	DF	P-Value	
	-7.74	70	0.000	

4.1.14 Current Bath Types

(only includes group one – aging individuals and friends and family members)

The types of bathrooms used primarily by respondents were identified as medium to large with both a shower stall and a bathtub in 19 cases. Twelve respondents indicated they had a small bathroom with a shower in the bathtub. Eleven indicated a medium or large bathroom with the shower in the bathtub while nine identified their bathrooms as small with a shower stall only and nine claimed a medium/large bathroom with a shower stall only.

Table 4. 48 Types of Bathrooms Reported by AI

#	Field	Count
1	Small bathroom with a shower stall only	9
2	Small bathroom with a shower in the bathtub	12
3	Small bathroom with both a shower stall and a bathtub	0
4	Medium/large bathroom with a shower stall only	9
5	Medium or large bathroom with a shower in the bathtub	11
6	Medium or large bathroom with both a shower stall and a bathtub	19
	TOTAL	60

Those interested in aging in place for a friend of a family member were asked what kind of bathroom their friend or family member currently use as their primary space. Photographs were provided to insure clarity between the textual description and the physical characteristics of the space. The majority, 31.67% (n=19) indicated they had a medium or large bathroom with both a shower stall and a bathtub. Twenty percent (n=12) indicated they had a small bathroom with the shower inside a bathtub. Fifteen percent (n=9) had a small bathroom with a shower stall only while another fifteen percent (n=12) had a medium to large bathroom with a shower stall only. A medium or large bathroom with a shower in the bathtub was reported by 18.33% (n=11). None of the respondents indicated they had a small bathroom with both a shower stall and a bathtub.

Table 4. 49 Types of Bathrooms Reported by FF

#	Type of primary bathroom used	Percentage	Count
1	Small bathroom with a shower stall only	41.18%	14
2	Small bathroom with a shower in the bathtub	26.47%	9
3	A small bathroom with shower stall and bathtub	11.76%	4
4	Med/large bathroom with shower stall only	5.88%	2
5	Medium or large bathroom with shower in the bathtub	8.82%	3
6	Medium or large bathroom with both a shower and a bathtub	5.88%	2
			34

4.2 Home Assessments

Regarding home assessments, when considering the responses of design professionals, 45% (n=13) indicated they provide home assessment for clients intending to age in place while 55% (n=16) indicated they do not. The members of this group indicated they used all the offered methods of communicating recommended home modifications to inform their clients of suggested modifications. Hand drawn sketches, floor plans, elevations and/or perspectives were used by 13 design professionals. Computer generated floor plans, elevations and/or perspectives were used by 25 design professionals. Manufacturers specifications and cut sheets where shared by 18 with their clients while 20 design professionals provided clients with an estimate or quote of anticipated cost. Finally, 19 design professionals provided clients with a verbal description of recommendations.

When considering the responses of construction professionals, 50%, (n=7) seven indicated they provide home assessments for clients intending to age in place while 50% (n=7) indicated they do not. The members of this group indicated they used all the offered methods of communicating recommended home modifications to inform their clients of suggested modifications. Hand drawn sketches, floor plans, elevations and/or perspectives were used by two of construction professionals. Computer generated floor plans, elevations and/or perspectives were used by two construction professionals. Manufacturers specifications and cut sheets where shared by one with their clients while one construction professional provided clients with an estimate or quote of anticipated cost. Finally, one construction professional provided clients with a verbal description of recommendations.

When considering the responses of health care professionals, 52.38% (n=11) indicated they provide home assessment for clients intending to age in place while 47.62% (n=10) indicated they do not. The members of this group indicated they used all the offered methods of communicating recommended home modifications to inform their clients of suggested modifications. Hand drawn sketches of floor plans, elevations and/or perspectives were used by were used by 18.52% (n=5) of health care professionals. Computer generated floor plans, elevations and/or perspectives were used by 11.11%(n=3) of health care professionals. Manufacturers specifications and cut sheets where shared by only 3.70% (n=1) with their clients while 11.11% (n=3) of health care professionals provided clients with an estimate or quote of anticipated cost. Finally, 55.56% (n=15) of health care professionals provided clients with a verbal description of recommendations.

4.3 Impact of Watching the Walkthrough

4.3.1 Widening the Doorways

The study measured the effect on confidence level of the impact of widening the doorways from the perspective of a person interested in aging in place for themselves. Question 49 asked, if you were told verbally to widen the doorways in your home, how confident would you be in the attractiveness, the ability to construct, the ease of maneuvering through your home and the level of safety provided by the wider doorways.

Table 4. 50 CL of AI re: Doorways Before WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.32	1.62	2.64	38
2	Constructability	1.00	6.00	4.30	1.47	2.15	37
3	Ease of maneuvering through the home with wider doorways	1.00	6.00	4.44	1.52	2.30	36
4	Level of safety provided by wider doorways	1.00	6.00	4.15	1.80	3.24	34

Q70 After watching a walkthrough of your home with wider doorways, how confident would you be in the attractiveness, the constructability, the ease of maneuvering through the home with wider doorways and the level of safety provided by the wider doorways?

Table 4. 51 CL of AI re: Doorways After WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	5.09	1.04	1.08	34
2	Constructability	1.00	6.00	4.73	1.35	1.83	33
3	Ease of maneuvering through the home with wider doorways	2.00	6.00	5.03	1.24	1.54	33
4	Level of safety provided by wider doorways	1.00	6.00	5.16	1.20	1.44	32

Statistical significance of the attractiveness of widening doorways from the perspective of a person interested in aging in place for themselves was found to be significant

Table 4. 52 StatSig re: Attractiveness of Wider Doorways Before and After WT by AI

	Two sample T- test and CI				% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	38	4.32	1.62	0.26	55%
After Walkthrough	34	5.09	1.04	0.18	
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.770	(-1.405, -1.135)			
	T Value	DF	P-Value		
	-2.42	63	0.018		

Statistical significance of the constructability of wider doorways from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 53 StatSig re: Constructability of Wider Doorways Before and After WT by AI

	Two sample T- test and CI				% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	37	4.30	1.47	0.24	0%
After Walkthrough	33	4.73	1.35	0.24	
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.430	(-1.103, -0.243)			
	T Value	DF	P-Value		
	-1.28	67	0.206		

Statistical significance of the ease of maneuvering through the wider doorways from the perspective of a person interested in aging in place for themselves was found to be not significant T test – constructability of wider doorways before and after was found to be not significant

Table 4. 54 StatSig re: Ease of Use of Wider Doorways Before and After WT by AI

	Two sample T- test and CI				% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	36	4.44	1.52	0.25	22%
After Walkthrough	33	5.03	1.24	0.22	
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.590	(-1.255, -1.685.)75			
	T Value	DF	P-Value		
	-1.77	66	0.081		

Statistical significance of the safety of the wider doorways from the perspective of a person interested in aging in place for themselves was found to be significant

Table 4. 55 StatSig re: Safety of Wider Doorways Before and After WT by AI

	Two sample T- test and CI				% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	24%
Before Walkthrough	34	4.15	1.80	0.31	
After Walkthrough	32	5.16	1.20	0.21	
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.010	(-1.760, -0.260)			
	T Value	DF	P-Value		
	-2.70	57	0.009		

Perspective of widening doorways from the perspective of a friend or family member

Q49 If your friend or family member were told verbally to widen the doorways in his/her home, how confident would you be in the attractiveness, the ability to construct, the ease of maneuvering through your home and the level of safety provided by the wider doorways.

Table 4. 56 Confidence of FF of Wider Doorways Before Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.00	1.46	2.13	31
2	Constructability	1.00	6.00	3.42	1.50	2.24	31
3	Ease of maneuvering through the home with wider doorways	1.00	6.00	4.03	1.51	2.29	31
4	Level of safety provided by wider doorways	2.00	6.00	4.26	1.24	1.55	31

Q70 After watching a walkthrough of your friend/family members home with wider doorways, how confident would you be in the attractiveness, the constructability, the ease of maneuvering through the home with wider doorways and the level of safety provided by the wider doorways?

Table 4. 57 Confidence of FF of Wider Doorways After Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	5.36	0.97	1.94	28
2	Constructability	1.00	6.00	5.00	1.36	1.85	27
3	Ease of maneuvering through the home with wider doorways	2.00	6.00	4.96	1.32	1.75	28
4	Level of safety provided by wider doorways	1.00	6.00	5.00	1.25	1.57	28

Statistical significance of the attractiveness of widening doorways from the perspective of a friend or family member was found to be significant

Table 4. 58 StatSig re: Attractiveness of Wider Doorways Before and After WT by FF

	Two sample T- test and CI				% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	31	4.00	1.46	0.26	50%
After Walkthrough	28	5.36	0.97	0.18	
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.360	(-2.002, -0.718)			
	T Value	DF	P-Value		
	-4.25	52	0.000		

Statistical significance of the constructability of wider doorways from the perspective of friend or family member was found to be significant

Table 4. 59 StatSig re: Constructability of Wider Doorways Before and After WT by FF

	Two sample T- test and CI				%
			Descriptive Statistics		
	N	Mean	StDev	Se Mean	
Before Walkthrough	31	3.42	1.50	0.27	
After Walkthrough	27	5.00	1.36	0.26	-10%
			Estimation for Difference		
	Difference	95% CI for Difference			
	-1.580	(-2.333, -0.827)			
	T Value	DF	P-Value		
	-4.21	55	0.000		

Statistical significance of the ease of maneuvering through the wider doorways from the perspective of a friend or family member was found to be significant

Table 4. 60 StatSig re: Ease of Use of Wider Doorways Before and After WT by FF

	Two sample T- test and CI				% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	31	4.03	1.51	0.27	23 %
After Walkthrough	28	4.96	1.32	0.25	
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.930	(-1.168, -0.192)			
	T Value	DF	P-Value		
	-2.52	56	0.014		

Significance of the difference to friends and family members of wider doorways before and after viewing the walkthrough was found to be significant.

Table 4. 61 StatSig re: Safety of Wider Doorways Before and After WT by FF

Two sample T- test and CI					% Difference
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	31	4.26	1.24	0.22	17 %
After Walkthrough	28	5.00	1.25	0.24	
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.740	(-1.390, -0.090)			
	T Value	DF	P-Value		
	-2.28	56	0.026		

Statistical significance of the safety of the wider doorways from the perspective of a design professional was found to be significant

Table 4. 62 StatSig re: Safety of Wider Doorways Before and After WT by DP

Two sample T- test and CI					% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	31	4.26	1.24	0.22	17 %
After Walkthrough	28	5.00	1.25	0.24	
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.740	(-1.390, -0.090)			
	T Value	DF	P-Value		
	-2.28	56	0.026		

Perspective of widening doorways from the perspective of a design professional

Q50: If you were to use your standard method of communicating design suggestions to a client to recommend widening the doorways in his/her home, how confident do you think your client would be in the attractiveness, ability of a contractor to successfully widen them (construct-ability), support in maneuvering through the house, and level of safety of the widened doorways?

Table 4. 63 Confidence of DP of Wider Doorways Before Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.93	1.14	1.31	29
2	Constructability	2.00	6.00	4.57	1.35	1.82	28
3	Ease of maneuvering through the home	2.00	6.00	5.24	1.19	1.42	29
4	Level of safety provided by wider doorways	1.00	6.00	4.72	1.48	2.20	29

Q71. If you were able to show your client a walkthrough of his/her own home with wider doorways, how confident do you think your client would you be in the attractiveness, constructability, support in maneuvering through the house, and level of safety with the wider hallways?

Table 4. 64 Confidence of DP of Wider Doorways After Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	5.30	0.97	0.95	27
2	Constructability	2.00	6.00	4.85	1.23	1.51	26
3	Ease of maneuvering through the home with wider doorways	2.00	6.00	5.56	0.87	0.77	27
4	Level of safety provided by wider doorways	2.00	6.00	5.15	1.04	1.09	27

Statistical significance of the attractiveness of widening doorways from the perspective of a design professional was found to be not significant

Table 4. 65 StatSig re: Attractiveness of Wider Doorways Before and After WT by DP

	Two sample T- test and CI				% Difference
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	4.93	1.14	0.21	17 %
After Walkthrough	27	5.30	0.97	0.19	
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.370	(-0.936, -0.196)			
	T Value	DF	P-Value		
	-1.31	53	0.196		

Statistical significance of the constructability of wider doorways from the perspective of a design professional was found to be not significant

Table 4. 66 StatSig re: Constructability of Wider Doorways Before and After WT by DP

	Two sample T- test and CI				% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	28	4.58	1.35	0.26	6 %
After Walkthrough	26	4.85	1.23	0.24	
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.280	(-0.985, - 0.425)			
	T Value	DF	P-Value		
	-0.80	51	0.429		

Statistical significance of the ease of movement of wider doorways from the perspective of a design professional was found to be not significant

Table 4. 67 StatSig re: Ease of Movement of Wider Doorways Before and After WT by DP

	Two sample T- test and CI				% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	5.24	1.19	0.22	6 %
After Walkthrough	27	5.56	0.87	0.17	
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.320	(-0.877, 0.237)			
	T Value	DF	P-Value		
	-1.15	51	0.254		

Statistical significance of the safety of wider doorways from the perspective of a design professional was found to be not significant

Table 4. 68 StatSig re: Safety of Wider Doorways Before and After WT by DP

	Two sample T- test and CI				% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	4.72	1.48	0.27	
After Walkthrough	27	5.15	1.04	0.20	9 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.430	(-1.133, 0.253)			
	T Value	DF	P-Value		
	-1.26	50	0.212		

Perspective of widened doorways from a construction professional's perspective

Q50: If you were to use your standard method of communicating design suggestions to a client to recommend widening the doorways in his/her home, how confident do you think your client would be in the attractiveness, ability of a contractor to successfully widen them (construct-ability), support in maneuvering through the house, and level of safety of the widened doorways?

Table 4. 69 Confidence of CP of Wider Doorways Before Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.93	1.14	1.31	29
2	Constructability	2.00	6.00	4.57	1.35	1.82	28
3	Ease of maneuvering through the home	2.00	6.00	5.24	1.19	1.42	29
4	Level of safety provided by wider doorways	1.00	6.00	4.72	1.48	2.20	29

Q71. If you were able to show your client a walkthrough of his/her own home with wider doorways, how confident do you think your client would you be in the attractiveness, constructability, support in maneuvering through the house, and level of safety with the wider hallways?

Table 4. 70 Confidence Level of CP re: Doorways after Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	5.30	0.97	0.95	27
2	Constructability	2.00	6.00	4.85	1.23	1.51	26
3	Ease of maneuvering through the home with wider doorways	2.00	6.00	5.56	0.87	0.77	27
4	Level of safety provided by wider doorways	2.00	6.00	5.15	1.04	1.09	27

Statistical significance of the attractiveness of widening doorways from the perspective of a construction professional before and after was found to be significant

Table 4. 71 StatSig re: Attractiveness of Wider Doorways Before and After WT by CP

	Two sample T- test and CI				% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	4.50	1.24	0.33	
After Walkthrough	14	5.36	0.89	0.24	19 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.860	(-1.704, -0.016)			
	T Value	DF	P-Value		
	-2.11	23	0.046		

Statistical significance of the constructability of wider doorways from the perspective of a construction professional was found to be not significant

Table 4. 72 StatSig re: Constructability of Wider Doorways Before and After WT by CP

	Two sample T- test and CI				% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	13	4.51	1.65	0.46	
After Walkthrough	14	5.21	1.03	0.28	16 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.670	(-1.788, 0.448)			
	T Value	DF	P-Value		
	-1.25	90	0.225		

Statistical significance of the ease of use of wider doorways from the perspective of a construction professional was found to be not significant

Table 4. 73 StatSig re: Ease of Use of Wider Doorways Before and After WT by CP

	Two sample T- test and CI				% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	4.93	1.33	0.36	
After Walkthrough	14	5.36	0.89	0.24	8 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.430	(-1.317, -0.457)			
	T Value	DF	P-Value		
	-1.01	22	0.33		

Statistical significance of the safety of wider doorways from the perspective of a construction professional was found to be not significant

Table 4. 74 StatSig re: Safety of Wider Doorways Before and After WT by CP

	Two sample T- test and CI				% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	4.79	1.21	0.32	
After Walkthrough	14	5.21	0.94	0.25	9 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.420	(-1.265, -0.425)			
	T Value	DF	P-Value		
	-1.03	24	0.315		

Perspective of wider doorways from a health care professional's perspective

Q50: If you were to use your standard method of communicating design suggestions to a client to recommend widening the doorways in his/her home, how confident do you think your client would be in the attractiveness, ability of a contractor to successfully widen them (construct-ability), support in maneuvering through the house, and level of safety of the widened doorways?

Table 4. 75 Confidence of Design HCP of Wider Doorways Before Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	4.56	0.86	0.75	16
2	Constructability	2.00	6.00	4.44	1.17	1.37	16
3	Ease of maneuvering through the home	3.00	6.00	5.19	1.07	1.15	16
4	Level of safety provided by wider doorways	3.00	6.00	5.13	0.99	0.98	16

Q72. If you were able to show your client a walkthrough of his/her own home with wider hallways, how confident do you think your client would you be in the attractiveness, constructability, support in maneuvering through the house, and level of safety with the wider hallways?

Table 4. 76 Confidence Level of HCP re: Doorways after Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.33	1.70	2.89	3
2	Constructability	4.00	6.00	5.00	1.00	1.00	2
3	Ease of maneuvering through the home with wider doorways	3.00	6.00	4.67	1.25	1.56	2
4	Level of safety provided by wider doorways	1.00	6.00	4.00	2.16	4.67	3

Statistical significance of the attractiveness of widening doorways from the perspective of a health care professional was found to be not significant

Table 4. 77 StatSig re: Attractiveness of Wider Doorways Before and After WT by HCP

Two sample T- test and CI				
Descriptive Statistics				
	N	Mean	StDev	Se Mean
Before Walkthrough	16	4.56	0.86	0.21
After Walkthrough	3	4.33	1.70	0.98
Estimation for Difference				
	Difference	95% CI for Difference		
	-0.230	(-4.090, -4.55)		
	T Value	DF	P-Value	
	-0.23	2	0.840	

Statistical significance of the constructability of wider doorways from the perspective of a health care professional was found to be not significant

Table 4. 78 StatSig re: Attractiveness of Wider Doorways Before and After WT by HCP

Two sample T- test and CI					% Change
Descriptive Statistics					
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	4.44	1.17	0.29	
After Walkthrough	2	5.00	0.00	0.71	13%
Estimation for Difference					
	Difference	95% CI for Difference			
	-0.560	(-10.283, -9.163)			
	T Value	DF	P-Value		
	-0.73	1	0.598		

Statistical significance of the ease of use of wider doorways from the perspective of a health care professional was found to be not significant

Table 4. 79 StatSig re: Ease of Use of Wider Doorways Before and After WT by HCP

	Two sample T- test and CI				% Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	5.19	1.07	0.27	11%
After Walkthrough	2	4.67	1.25	0.88	
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.520	(-1.214, -1.254)			
	T Value	DF	P-Value		
	-0.56	1	0.674		

Statistical significance of the safety of wider doorways from the perspective of a health care professional was found to be not significant

Table 4. 80 StatSig re: Safety of Wider Doorways Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	5.13	0.99	0.25	
After Walkthrough	3	4.00	2.16	0.12	28 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.13	(-4.34, -6.60)			
	T Value	DF	P-Value		
	-0.89	2	0.468		

4.3.2 Widen Hallways

Perspective of widening hallways on a person aging in place for themselves.

Q52 If you were told verbally to widen the hallways in your home, how confident would you be in the attractiveness, the ability to construct, the ease of maneuvering through your home and the level of safety provided by the wider hallways?

Table 4. 81 Confidence Level of AI re: Hallways Before Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.09	1.52	2.32	34
2	Constructability	1.00	6.00	4.00	1.70	2.88	34
3	Ease of maneuvering through the home with wider doorways	1.00	6.00	4.27	1.40	1.96	33
4	Level of safety provided by wider doorways	1.00	6.00	4.06	1.63	2.66	33

Q72 After watching a walkthrough of your own home with wider hallways, how confident would you be in the attractiveness, the ability to construct, the ease of maneuvering through your home and the level of safety provided by the wider hallways?

Table 4. 82 Confidence Level of AI re: Hallways After Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.70	1.53	2.33	33
2	Constructability	1.00	6.00	4.47	1.52	2.32	30
3	Ease of maneuvering through the home with wider doorways	1.00	6.00	4.77	1.54	2.37	31
4	Level of safety provided by wider doorways	1.00	6.00	4.68	1.57	2.48	31

Statistical significance of the attractiveness of widening hallways from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 83 StatSig re: Attractiveness of Wider Hallways Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	34	4.09	1.52	0.26	
After Walkthrough	33	4.70	1.53	0.27	15 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.610	(-1.355, -0.135)			
	T Value	DF	P-Value		
	-1.64	64	0.107		

Statistical significance of the constructability of wider hallways from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 84 StatSig re: Constructability of Wider Hallways Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	34	4.00	1.70	0.29	
After Walkthrough	30	4.47	1.52	0.28	12 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.470	(-1.275, -0.335)			
	T Value	DF	P-Value		
	-1.17	61	0.247		

Statistical significance of the ease of use of wider hallways from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 85 StatSig re: Ease of Use of Wider Hallways Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	33	4.27	1.40	0.24	
After Walkthrough	31	4.77	1.54	0.28	12 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.500	(-1.237, -0.237)			
	T Value	DF	P-Value		
	-1.36	60	0.180		

Statistical significance of the ease of use of wider hallways from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 86 StatSig re: Safety of Wider Hallways Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	33	4.06	1.63	0.28	
After Walkthrough	31	4.68	1.57	0.28	15 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.620	(-1.420, -0.180)			
	T Value	DF	P-Value		
	-1.55	61	0.126		

Perspective of widening hallways on friend and family members was found to be not significant

Table 4. 87 Perspective of widening hallways on friend and family members

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	33	4.06	1.63	0.28	
After Walkthrough	31	4.68	1.57	0.28	15 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.620	(-1.420, -0.180)			
	T Value	DF	P-Value		
	-1.55	61	0.126		

Q52 If your friend or family member were told verbally to widen the hallways in his/her home, how confident would you be in the attractiveness, the ability to construct, the ease of maneuvering through your home and the level of safety provided by the wider hallways?

Table 4. 88 Confidence Level of FF re: Hallways Before Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	3.71	1.58	2.49	28
2	Constructability	1.00	6.00	3.22	1.64	2.69	27
3	Ease of maneuvering through the home with wider doorways	1.00	6.00	4.17	1.37	1.87	29
4	Level of safety provided by wider doorways	1.00	6.00	4.26	1.46	27	33

Q72 After watching a walkthrough of your friend or family member's home with wider hallways, how confident would you be in the attractiveness, the ability to construct, the ease of maneuvering through your home and the level of safety provided by the wider hallways?

Table 4. 89 Confidence Level of FF re: Hallways Before Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.93	1.25	1.57	28
2	Constructability	1.00	6.00	4.46	1.59	2.53	28
3	Ease of maneuvering through the home with wider doorways	2.00	6.00	4.89	1.32	1.74	28
4	Level of safety provided by wider doorways	2.00	6.00	4.75	1.35	1.83	28

Statistical significance of the attractiveness of widening hallways doorways from the perspective of a friend or family member was found to be significant

Table 4. 90 StatSig re: Attractiveness of Wider Hallways Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	28	3.71	1.58	0.30	
After Walkthrough	28	4.93	1.25	0.24	33 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.220	(-1.984, -0.456)			
	T Value	DF	P-Value		
	-3.20	51	0.002		

Statistical significance of the constructability of wider hallways from the perspective of a friend or family member was found to be significant

Table 4. 91 StatSig re: Constructability of Wider Hallways Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	3.22	1.64	0.32	
After Walkthrough	28	4.46	1.59	0.30	38 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.240	(-2.114, -0.366)			
	T Value	DF	P-Value		
	-2.85	52	0.006		

Statistical significance of the ease of use of wider hallways from the perspective of a friend or family member was found to be significant

Table 4. 92 StatSig re: Ease of Use of Wider Hallways Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	4.17	1.37	0.25	
After Walkthrough	28	4.89	1.32	0.25	17 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.720	(-1.434, -0.006)			
	T Value	DF	P-Value		
	-2.02	54	0.048		

Statistical significance of the safety of wider hallways from the perspective of a friend or family member was found to be not significant

Table 4. 93 StatSig re: Safety of Wider Hallways Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	33	4.26	1.46	0.25	
After Walkthrough	28	4.75	1.35	0.26	12 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.490	(-1.211, -0.231)			
	T Value	DF	P-Value		
	-1.36	58	0.179		

Perspective of widening hallways on design professionals.

Q 49: If you were to use your standard method of communicating design suggestions to a client to recommend ***widening the hallways*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully widen them (constructability), the ease in maneuvering through the house, and the level of safety of the ***widened hallways***?

Table 4. 94 Confidence of DP of Wider Hallways Before Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.52	1.55	0.67	29
2	Constructability	1.00	6.00	3.83	1.49	2.25	29
3	Ease of maneuvering through the home	3.00	6.00	5.18	0.86	0.89	28
4	Level of safety provided by wider hallways	2.00	6.00	5.00	1.50	1.56	28

Q 71 Wider hallways after: If you were able to show your client a walkthrough of his/her own home with ***wider hallways***, how confident do you think your client would you be in the attractiveness, the constructability, the ease in maneuvering through the house, and the level of safety with the ***wider hallways***?

Table 4. 95 Confidence of DP of Wider Hallways After Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	5.30	0.97	0.95	27
2	Constructability	2.00	6.00	4.85	1.23	1.51	26
3	Ease of maneuvering through the home	2.00	6.00	5.56	0.87	0.77	27
4	Level of safety provided by wider hallways	2.00	6.00	5.15	1.04	1.09	27

Statistical significance of the attractiveness of widening hallways from the perspective of a design professional was found to be significant

Table 4. 96 StatSig re: Attractiveness of Wider Hallways Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	4.52	1.55	0.29	
After Walkthrough	27	5.53	0.97	0.19	22 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.780	(-1.470, -0.090)			
	T Value	DF	P-Value		
	-2.27	47	0.028		

Statistical significance of the constructability of wider hallways from the perspective of a design professional was found to be significant

Table 4. 97 StatSig re: Constructability of Wider Hallways Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	3.83	1.49	0.28	
After Walkthrough	26	4.85	1.23	0.24	27%
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.020	(-1.757, -0.283)			
	T Value	DF	P-Value		
	-2.78	52	0.008		

Statistical significance of the ease of use of wider hallways from the perspective of a design professional was found to be not significant

Table 4. 98 StatSig re: Ease of Use of Wider Hallways Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	28	5.18	0.86	0.16	
After Walkthrough	27	5.56	0.87	0.17	7 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.380	(-0.848, -0.088)			
	T Value	DF	P-Value		
	-1.63	52	0.109		

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	28	5.00	1.50	0.28	
After Walkthrough	27	5.15	1.04	0.20	3 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.150	(-0.848, -0.548)			
	T Value	DF	P-Value		
	-0.43	48	0.667		

Statistical significance of the safety of wider hallways from the perspective of a design professional was found to be not significant

Table 4. 99 StatSig re: Safety of Wider Hallways Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	28	5.00	1.50	0.28	
After Walkthrough	27	5.15	1.04	0.20	3 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.150	(-0.848, -0.548)			
	T Value	DF	P-Value		
	-0.43	48	0.667		

Perspective of widening hallways on construction professionals.

Q 51: If you were to use your standard method of communicating design suggestions to a client to recommend ***widening the hallways*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully widen them (constructability), the ease in maneuvering through the house, and the level of safety of the ***widened hallways***?

Table 4. 100 Confidence of CP of Wider Hallways Before Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	3.85	1.61	2.59	13
2	Constructability	1.00	6.00	4.09	1.44	2.08	11
3	Ease of maneuvering through the home	2.00	6.00	5.08	1.14	1.30	13
4	Level of safety provided by wider hallways	2.00	6.00	4.62	1.44	2.08	13

Q 71 Wider hallways after: If you were able to show your client a walkthrough of his/her own home with ***wider hallways***, how confident do you think your client would you be in the attractiveness, the constructability, the ease in maneuvering through the house, and the level of safety with the ***wider hallways***?

Table 4. 101 Confidence of CP of Wider Hallways After Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	5.36	0.89	0.80	14
2	Constructability	3.00	6.00	5.21	1.01	1.03	14
3	Ease of maneuvering through the home	3.00	6.00	5.36	0.89	0.80	14
4	Level of safety provided by wider hallways	3.00	6.00	5.21	0.94	0.88	14

Statistical significance of the attractiveness of widening hallways from the perspective of a construction professional was found to be significant

Table 4. 102 StatSig re: Attractiveness of Wider Hallways Before and After WT by CP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
Sample	N	Mean	StDev	Se Mean	
Before Walkthrough	13	3.85	1.61	0.45	
Sample After Walkthrough	14	5.36	0.89	0.24	39 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.510	(-2.573, -0.447)			
	T Value	DF	P-Value		
	-2.98	18	0.008		

Statistical significance of the constructability of wider hallways from the perspective of a construction professional was found to be significant

Table 4. 103 StatSig re: Constructability of Wider Hallways Before and After WT by CP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	11	4.09	1.44	0.43	
After Walkthrough	14	5.21	1.01	0.27	27 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.120	(-2.199, -0.041)			
	T Value	DF	P-Value		
	-2.19	17	0.043		

Statistical significance of the ease of use of wider hallways from the perspective of a construction professional was found to be not significant

Table 4. 104 StatSig re: Ease of Use of Wider Hallways Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	13	5.08	1.14	0.32	
After Walkthrough	14	5.36	0.89	0.24	6 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.280	(-1.101, -0.541)			
	T Value	DF	P-Value		
	-0.71	22	0.487		

Statistical significance of the safety of wider hallways from the perspective of a construction professional was found to be not significant

Table 4. 105 StatSig re: Safety of Wider Hallways Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	13	4.62	1.44	0.40	
After Walkthrough	14	5.21	0.94	0.25	13 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.590	(-1.574, -0.394)			
	T Value	DF	P-Value		
	-1.25	20	0.226		

Perspective of widening hallways on health care professionals.

Q 52: If you were to use your standard method of communicating design suggestions to a client to recommend ***widening the hallways*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully widen them (constructability), the ease in maneuvering through the house, and the level of safety of the ***widened hallways***?

Table 4. 106 Confidence of HCP of Wider Hallways Before Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	4.25	1.09	1.19	4
2	Constructability	3.00	6.00	4.25	1.09	1.19	4
3	Ease of maneuvering through the home	2.00	5.00	4.00	1.22	1.50	4
4	Level of safety provided by wider hallways	3.00	5.00	4.50	1.50	0.75	4

Q 71 Wider hallways after: If you were able to show your client a walkthrough of his/her own home with ***wider hallways***, how confident do you think your client would you be in the attractiveness, the constructability, the ease in maneuvering through the house, and the level of safety with the ***wider hallways***?

Table 4. 107 Confidence of HCP of Wider Hallways After Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	5.13	1.02	1.05	15
2	Constructability	4.00	6.00	5.27	0.77	0.60	15
3	Ease of maneuvering through the home	2.00	6.00	5.47	1.02	1.05	15
4	Level of safety provided by wider hallways	3.00	6.00	5.27	0.85	0.73	15

Statistical significance of the attractiveness of widening hallways from the perspective of a health care professional was found to be not significant

Table 4. 108 StatSig re: Attractiveness of Wider Hallways Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	4	4.25	1.09	0.55	
After Walkthrough	15	5.13	1.02	0.26	21 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.880	(-2.561, - 0.80)			
	T Value	DF	P-Value		
	-1.45	4	0.220		

Statistical significance of the constructability of wider hallways from the perspective of a health care professional was found to be not significant

Table 4. 109 StatSig re: Constructability of Wider Hallways Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	4	4.25	1.09	0.55	
After Walkthrough	15	5.27	0.77	0.20	24 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.020	(-2.866, - 0.826)			
	T Value	DF	P-Value		
	-1.76	3	0.177		

Statistical significance of the ease of use of wider hallways from the perspective of a health care professional was found to be not significant

Table 4. 110 StatSig re: Ease of Use of Wider Hallways Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	4	4.00	1.22	0.61	
After Walkthrough	15	5.47	1.02	0.26	36 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.470	(-3.315, -0.375)			
	T Value	DF	P-Value		
	-2.21	4	0.091		

Statistical significance of the safety of wider hallways from the perspective of a health care professional was found to be not significant

Table 4. 111 StatSig re: Safety of Wider Hallways Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	4	4.50	1.50	0.75	
After Walkthrough	15	5.27	0.85	0.22	17 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.770	(-3.257, -1.717)			
	T Value	DF	P-Value		
	-0.99	3	0.397		

Perspective of adding handrails to stairs and other changes in level on persons interested in aging in place for themselves.

Q53: If you were to verbally told to ***add handrails to stairways and other areas with change in level*** inside your home, how confident do you think you would be in the attractiveness, the ability of a contractor to successfully install them (constructability), the support in climbing the stairs, and the level of safety of the stairs with the ***new handrails?***

Table 4. 112 Confidence of AI of Wider Hallways Before Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	3.97	1.66	2.75	36
2	Constructability	1.00	6.00	4.63	1.48	2.18	35
3	Ease of climbing the stairs	1.00	6.00	4.34	1.53	2.34	35
4	Level of safety provided by the added handrails	1.00	6.00	4.74	1.40	1.96	35

Q 75: If you were shown a walkthrough of your home with ***handrails added to stairways and other areas with change in level*** inside your home, how confident do you think your client would be in the attractiveness, the constructability, the ease of climbing the stairs, and the level of safety of the stairs with the ***new handrails?***

Table 4. 113 Confidence of AI of Wider Hallways After Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.36	1.79	3.20	33
2	Constructability	1.00	6.00	4.91	1.42	2.02	32
3	Ease of maneuvering through the home with added handrails	1.00	6.00	4.94	1.37	1.87	32
4	Level of safety provided by added handrails	1.00	6.00	5.24	1.28	1.63	29

Statistical significance of the attractiveness of handrails at stairs and other change of level from the perspective of a person interested in aging in place for themselves was found to be significant

Table 4. 114 StatSig re: Attractiveness of Handrails Before and After WT by AI

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	33	4.06	1.63	0.28	
After Walkthrough	31	4.68	1.57	0.28	15 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.620	(-1.420, -0.180)			
	T Value	DF	P-Value		
	-1055	61	0.126		

Statistical significance of the constructability of handrails at stairs and other change of level from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 115 StatSig re: Constructability of Handrails Before and After WT by AI

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	35	4.63	1.48	0.25	
After Walkthrough	32	4.91	1.40	0.25	6 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.280	(-0.983, -0.423)			
	T Value	DF	P-Value		
	-0.80	64	0.429		

Statistical significance of the ease of use of handrails at stairs and other change of level from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 116 StatSig re: Ease of Use of Handrails Before and After WT by AI

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	35	4.34	1.53	0.26	
After Walkthrough	32	4.94	1.37	0.24	14 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.600	(-1.308, -0.108)			
	T Value	DF	P-Value		
	-1.69	64	0.095		

Statistical significance of the safety of handrails at stairs and other change of level from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 117 StatSig re: Safety of Handrails Before and After WT by AI

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	35	4.74	1.40	0.24	
After Walkthrough	29	5.24	1.28	0.24	10 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.500	(-1.171, -0.171)			
	T Value	DF	P-Value		
	-1.49	61	0.141		

Q53: If your friend or family member were to verbally told to ***add handrails to stairways and other areas with change in level*** inside his/her home, how confident do you think you would be in the attractiveness, the ability of a contractor to successfully install them (constructability), the support in climbing the stairs, and the level of safety of the stairs with the ***new handrails?***

Table 4. 118 Confidence of FF of Wider Hallways Before Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.19	1.65	2.74	31
2	Constructability	1.00	6.00	4.90	1.30	1.30	31
3	Ease of climbing the stairs	1.00	6.00	4.48	1.61	1.61	29
4	Level of safety provided by the added handrails	2.00	6.00	5.03	1.10	1.10	29

Q 75: If you friend or family member were shown a walkthrough of his/her home with ***handrails added to stairways and other areas with change in level*** inside the home, how confident do you think you would be in the attractiveness, the constructability, the ease of climbing the stairs, and the level of safety of the stairs with the ***new handrails?***

Table 4. 119 Confidence of FF of Wider Hallways Before Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.50	1.50	2.25	33
2	Constructability	2.00	6.00	4.75	1.64	2.69	32
3	Ease of maneuvering through the home with added handrails	2.00	6.00	4.75	1.64	2.69	32
4	Level of safety provided by added handrails	2.00	6.00	4.75	1.64	2.69	29

Statistical significance of the attractiveness of handrails at stairs and other change of level from the perspective of a friend or family member was found to be not significant

Table 4. 120 StatSig re: Attractiveness of Handrails Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	31	4.19	1.65	0.30	
After Walkthrough	33	4.50	1.50	0.26	7 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.310	(-1.100, -0.480)			
	T Value	DF	P-Value		
	-0.78	60	0.436		

Statistical significance of the constructability of handrails at stairs and other change of level from the perspective of a friend or family member was found to be not significant

Table 4. 121 StatSig re: Constructability of Handrails Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	31	4.90	1.30	0.23	
After Walkthrough	32	4.75	1.64	0.29	3 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.150	(-0.595, -0.895)			
	T Value	DF	P-Value		
	-0.40	58	0.688		

Statistical significance of the ease of use of handrails at stairs and other change of level from the perspective of a friend or family member was found to be not significant

Table 4. 122 StatSig re: Ease of Use of Handrails Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	4.48	1.61	0.30	
After Walkthrough	32	4.75	1.64	0.29	6 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.270	(-1.104, -0.564)			
	T Value	DF	P-Value		
	-0.65	58	0.519		

Statistical significance of the safety of handrails at stairs and other change of level from the perspective of a friend or family member was found to be not significant

Table 4. 123 StatSig re: Safety of Handrails Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	5.03	1.10	0.20	
After Walkthrough	29	4.75	1.64	0.30	6 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.280	(-0.457, -1.017)			
	T Value	DF	P-Value		
	-0.76	48	0.449		

Q54: If you were to use your standard method of communicating design suggestions to a client to recommend ***adding handrails to stairways and other areas with change in level*** inside their home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install them (constructability), the support in climbing the stairs, and the level of safety of the stairs with the ***new handrails?***

Table 4. 124 Confidence of DP of Wider Hallways Before Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	4.85	1.18	1.39	27
2	Constructability	3.00	6.00	5.14	1.06	1.12	28
3	Ease of climbing the stairs	3.00	6.00	5.32	0.97	0.93	28
4	Level of safety provided by the added handrails	2.00	6.00	5.25	1.12	1.26	28

Q 75: If you were able to show your client a walkthrough of his/her home with ***handrails added to stairways and other areas with change in level*** inside your home, how confident do you think your client would be in the attractiveness, the constructability, the ease of climbing the stairs, and the level of safety of the stairs with the ***new handrail?***

Table 4. 125 Confidence of DP of Wider Hallways After Walkthrough

	Two-Sample T-test				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	4.85	1.18	0.23	
After Walkthrough	27	5.11	1.31	0.25	5 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.260	(-0.941, -0.421)			
	T Value	DF	P-Value		
	-0.77	51	0.447		

Statistical significance of the constructability of handrails at change of level from the perspective of a design professional was found to be not significant

Table 4. 126 StatSig re: Constructability of Handrails Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	28	5.14	1.06	0.20	
After Walkthrough	27	5.33	0.94	0.18	4 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-2.270	(-2.855, -1.685)			
	T Value	DF	P-Value		
	-0.70	52	0.485		

Statistical significance of the ease of use of handrails at stairs and change of level from the perspective of a design professional was found to be not significant

Table 4. 127 StatSig re: Ease of Use of Handrails Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	28	5.32	0.97	0.18	
After Walkthrough	27	5.44	0.92	0.18	2 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.120	(-0.631, -0.391)			
	T Value	DF	P-Value		
	-0.47	52	0.640		

Statistical significance of the safety of handrails at stairs and change of level from the perspective of a design professional was found to be not significant

Table 4. 128 StatSig re: Safety of Handrails Before and After WT by DP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	28	5.25	1.12	0.21	
After Walkthrough	27	5.22	1.10	0.21	- 1 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.030	(-0.571, -0.631)			
	T Value	DF	P-Value		
	0.10	52	0.921		

Q54: If you were to use your standard method of communicating design suggestions to a client to recommend ***adding handrails to stairways and other areas with change in level*** inside their home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install them (constructability), the support in climbing the stairs, and the level of safety of the stairs with the ***new handrails?***

Table 4. 129 Confidence of CP in Handrails Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.29	1.39	1.92	14
2	Constructability	2.00	6.00	4.79	1.32	1.74	14
3	Ease of climbing the stairs	3.00	6.00	5.43	0.82	0.67	14
4	Level of safety provided by the added handrails	2.00	6.00	5.46	1.08	1.17	13

Q 75: If you were able to show your client a walkthrough of his/her home with ***handrails added to stairways and other areas with change in level*** inside your home, how confident do you think your client would be in the attractiveness, the constructability, the ease of climbing the stairs, and the level of safety of the stairs with the ***new handrails?***

Table 4. 130 Confidence of CP in Constructability of Handrails After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	4.00	6.00	5.29	0.70	0.49	14
2	Constructability	4.00	6.00	5.57	0.62	0.39	14
3	Ease of maneuvering through the home with added handrails	3.00	6.00	5.36	0.89	0.80	14
4	Level of safety provided by added handrails	4.00	6.00	5.50	0.73	0.54	14

Statistical significance of the attractiveness of handrails at stairs and change of level from the perspective of a construction professional was found to be significant

Table 4. 131 StatSig re: Attractiveness of Handrails Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	4.29	1.39	0.37	
After Walkthrough	14	5.29	0.70	0.19	23 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.000	(-1.871, -0.129)			
	T Value	DF	P-Value		
	-2.40	19	0.027		

Statistical significance of the constructability of handrails at stairs and change of level from the perspective of a construction professional was found to be not significant

Table 4. 132 StatSig re: Constructability of Handrails Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	4.79	1.32	0.35	
After Walkthrough	14	5.57	0.62	0.17	16 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.780	(-1.599, -0.039)			
	T Value	DF	P-Value		
	-2.00	18	0.061		

Statistical significance of the ease of use of a handrails at stairs and change of level from the perspective of a construction professional was found to be not significant

Table 4. 133 StatSig re: Ease of Use of Handrails Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	5.43	0.82	0.22	
After Walkthrough	14	5.36	0.89	0.24	1 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.070	(-0.596, -0.736)			
	T Value	DF	P-Value		
	0.22	25	0.830		

Statistical significance of the safety of handrails at stairs and change of level from the perspective of a construction professional was found to be not significant

Table 4. 134 StatSig re: Safety of Handrails Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	5.46	1.08	0.29	
After Walkthrough	14	5.50	0.73	0.20	1 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.040	(-0.763, 0.683)			
	T Value	DF	P-Value		
	-0.11	22	0.910		

Q54: If you were to use your standard method of communicating design suggestions to a client to recommend ***adding handrails to stairways and other areas with change in level*** inside their home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install them (constructability), the support in climbing the stairs, and the level of safety of the stairs with the ***new handrails?***

Table 4. 135 Confidence of HCP in Handrails Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.13	1.17	1.36	16
2	Constructability	3.00	6.00	5.00	1.06	1.13	16
3	Ease of climbing the stairs	3.00	6.00	5.13	0.93	0.86	16
4	Level of safety provided by the added handrails	3.00	6.00	5.31	0.85	0.71	16

Q 75: If you were able to show your client a walkthrough of his/her home with ***handrails added to stairways and other areas with change in level*** inside your home, how confident do you think your client would be in the attractiveness, the constructability, the ease of climbing the stairs, and the level of safety of the stairs with the ***new handrails?***

Table 4. 136 Confidence of HCP in Handrails After the Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	5.20	1.11	1.23	15
2	Constructability	2.00	6.00	5.27	1.12	1.26	15
3	Ease of maneuvering through the home with added handrails	4.00	6.00	5.47	0.72	0.52	15
4	Level of safety provided by added handrails	3.00	6.00	5.60	0.80	0.64	15

Statistical significance of the attractiveness of handrails at stairs and change of level from the perspective of a health care professional was found to be significant

Table 4. 137 StatSig re: Attractiveness of Handrails Before and After WT by HCP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	4.13	1.17	0.29	
After Walkthrough	15	5.20	1.11	0.29	26 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.070	(-1.909, -0.231)			
	T Value	DF	P-Value		
	-2.61	28	0.014		

Statistical significance of the constructability of handrails at stairs and change of level from the perspective of a health care professional was found to be not significant

Table 4. 138 StatSig re: Constructability of handrails Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	5.00	1.06	0.27	
After Walkthrough	15	5.27	1.12	0.29	5 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.270	(-1.073, 0.533)			
	T Value	DF	P-Value		
	-0.69	28	0.497		

Statistical significance of the ease of use of handrails at stairs and change of level from the perspective of a health care professional was found to be not significant

Table 4. 139 StatSig re: Ease of Use of Handrails Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	5.13	0.930	0.23	
After Walkthrough	15	5.40	0.720	0.19	5 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.340	(-0.950, 0.270)			
	T Value	DF	P-Value		
	-1.17	28	0.263		

Statistical significance of the safety of handrails at stairs and change of level from the perspective of a health care professional was found to be not significant

Table 4. 140 StatSig re: Safety of Handrails Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	5.31	0.85	0.21	
After Walkthrough	15	5.60	0.80	0.21	5 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.290	(-0.897, -0.317)			
	T Value	DF	P-Value		
	-0.98	28	0.336		

4.3.3 Impact of the Walkthrough on Confidence in a Ramp

As an individual interested in aging in place for yourself; Q 56: If you were told to ***add a ramp*** to the entrance of your home, how confident do you think you would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the ease in entering the house, and the level of safety provided by ***the ramp***?

Table 4. 141 Confidence of AI in Adding a Ramp Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	3.21	1.57	2.64	34
2	Constructability	1.00	6.00	4.47	1.52	2.30	36
3	Ease of maneuvering through the home with added handrails	1.00	6.00	4.43	1.44	2.08	37
4	Level of safety provided by added handrails	1.00	6.00	4.27	1.45	2.09	37

Q 76: Ramp After If you were shown a walk through of your home with a ***ramp to the entrance*** to your home, how confident would you be in the attractiveness, the constructability, the ease of maneuvering into the house, and the level of safety of the ***entrance ramp***?

Table 4. 142 Confidence of AI in Adding a Ramp After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	3.70	1.59	2.54	30
2	Constructability	2.00	6.00	4.74	1.32	1.74	31
3	Ease of maneuvering through the home with added handrails	2.00	6.00	4.93	1.18	1.40	30
4	Level of safety provided by added handrails	1.00	6.00	4.81	1.38	1.90	31

Statistical significance of the attractiveness of a ramp from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 143 StatSig re: Attractiveness of Added Ramp Before and After WT by AI

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	34	3.21	1.57	0.27	
After Walkthrough	30	3.70	1.59	0.29	15 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.490	(-1.282, -0.302)			
	T Value	DF	P-Value		
	-1.24	60	0.221		

Statistical significance of the constructability of a ramp from the perspective of a person interested in aging in place for themselves. was found to be not significant

Table 4. 144 StatSig re: Constructability of Added Ramp Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	36	4.47	1.52	0.25	
After Walkthrough	31	4.74	1.32	0.24	6 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.270	(-0.963, -0.423)			
	T Value	DF	P-Value		
	-0.78	64	0.439		

Statistical significance of the ease of use of a ramp from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 145 StatSig re: Ease of Use of Added Ramp Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	42	2.09	1.38	0.21	
After Walkthrough	37	4.45	1.48	0.23	112 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-2.270	(-2.855, -1.685)			
	T Value	DF	P-Value		
	-7.74	70	0.000		

Statistical significance of the safety of a ramp from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 146 StatSig re: Safety of Added Ramp Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	37	4.27	1.45	0.24	
After Walkthrough	31	4.81	1.38	0.25	13 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.540	(-1.127, -0.147)			
	T Value	DF	P-Value		
	-1.57	64	0.121		

Q 56: If your friend or family member were told to ***add a ramp*** to the entrance of his/her home, how confident do you think you would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the ease in entering the house, and the level of safety provided by ***the ramp***?

Table 4. 147 Confidence of FF in Adding a Ramp Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	3.26	1.58	2.49	27
2	Constructability	1.00	6.00	4.23	1.43	2.05	31
3	Ease of maneuvering through the home with added handrails	1.00	6.00	4.59	1.19	1.41	29
4	Level of safety provided by added handrails	1.00	6.00	4.69	1.12	1.25	29

Q 76: If you were shown a walk through of your friend or family member’s home with a ***ramp to the entrance*** to their home, how confident would you be in the attractiveness, the constructability, the ease of maneuvering into the house, and the level of safety of the ***entrance ramp***?

Table 4. 148 Confidence of FF in Adding a Ramp after the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	3.85	1.53	2.35	27
2	Constructability	2.00	6.00	4.78	1.34	1.80	27
3	Ease of maneuvering through the home with added handrails	2.00	6.00	4.93	1.18	1.40	27
4	Level of safety provided by added handrails	2.00	6.00	4.81	1.18	1.39	26

Statistical significance of the attractiveness of a ramp from the perspective of a friend or family member was found to be not significant

Table 4. 149 StatSig re: Attractiveness of Added Ramp Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	3.26	1.58	0.30	
After Walkthrough	27	3.85	1.53	0.29	18 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.590	(-1.440, -0.260)			
	T Value	DF	P-Value		
	-1.39	51	0.169		

Statistical significance of the constructability of a ramp from the perspective of a friend or family member was found to be not significant

Table 4. 150 StatSig re: Constructability of Added Ramp Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	31	4.23	1.43	0.26	
After Walkthrough	27	4.78	1.34	0.26	13 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.550	(-1.279, 0.179)			
	T Value	DF	P-Value		
	-1.51	55	0.136		

Statistical significance of the ease of use of a ramp from the perspective of a friend or family member was found to be not significant

Table 4. 151 StatSig re: Ease of use of Added Ramp Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	4.59	1.19	0.22	
After Walkthrough	27	4.93	1.18	0.23	7 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.340	(-0.976, 0.296)			
	T Value	DF	P-Value		
	-1.07	53	0.288		

Statistical significance of the safety of a ramp from the perspective of a friend or family member was found to be not significant

Table 4. 152 StatSig re: Safety of Added Ramp Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	4.69	1.12	0.21	
After Walkthrough	26	4.81	1.39	0.27	2 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.120	(-0.809, 0.569)			
	T Value	DF	P-Value		
	-0.35	48	0.728		

Q 55: If you were to use your standard method of communicating design suggestions to a client to recommend ***adding a ramp*** to the entrance in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the ease in entering the house, and the level of safety provided by ***the ramp***?

Table 4. 153 Confidence of DP in Adding a Ramp Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	3.86	1.53	2.34	28
2	Constructability	2.00	6.00	4.69	1.18	1.39	29
3	Ease of maneuvering through the home with added handrails	3.00	6.00	5.00	1.02	1.03	29
4	Level of safety provided by added handrails	2.00	6.00	4.97	1.16	1.34	29

Q 76: Ramp After If you were shown a walk through of your home (or the home of a friend or family member) with a ***ramp to the entrance*** to your home, how confident would you be in the attractiveness, the constructability, the ease of maneuvering into the house, and the level of safety of the ***entrance ramp***?

Table 4. 154 Confidence of DP in Adding a Ramp After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	4.00	3.00	1.00	1.00	2
2	Constructability	4.00	5.00	4.67	0.47	0.22	3
3	Ease of maneuvering through the home with added handrails	4.00	5.00	4.67	0.47	0.22	3
4	Level of safety provided by added handrails	4.00	5.00	4.33	0.47	0.22	3

Statistical significance of the attractiveness of a ramp from the perspective of a design professional was found to be not significant.

Table 4. 155 StatSig re: Attractiveness of Added Ramp Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	28	3.86	1.53	0.29	
After Walkthrough	2	3.00	1.00	0.71	28 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.860	(-8.847, 10.567)			
	T Value	DF	P-Value		
	1.13	1	0.462		

Statistical significance of the constructability of a ramp from the perspective of a design professional was found to be not significant.

Table 4. 156 StatSig re: Constructability of Added Ramp Before and After WT by DP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	28	4.69	1.18	0.22	
After Walkthrough	3	4.67	0.470	0.27	0 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.020	(-0.833, 0.923)			
	T Value	DF	P-Value		
	0.06	5	0.957		

Statistical significance of the ease of use of a ramp from the perspective of a design professional was found to be not significant.

Table 4. 157 StatSig re: Ease of Use of Added Ramp Before and After WT by DP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	5.0	1.02	0.19	
After Walkthrough	3	4.67	0.47	0.27	7 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.330	(-0.579, 1.249)			
	T Value	DF	P-Value		
	1.00	4	0.375		

Statistical significance of the safety of a ramp from the perspective of a design professional was found to be not significant.

Table 4. 158 StatSig re: Safety of Added Ramp Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	4.97	1.16	0.22	
After Walkthrough	3	4.33	0.47	0.27	15 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.640	(-0.251, 1.531)			
	T Value	DF	P-Value		
	1.85	5	0.124		

Q 55: If you, as a construction professional, were to use your standard method of communicating design suggestions to a client to recommend ***adding a ramp*** to the entrance in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the ease in entering the house, and the level of safety provided by ***the ramp***?

Table 4. 159 Confidence of CP in Adding a Ramp Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	3.58	1.55	2.41	12
2	Constructability	2.00	6.00	4.62	1.55	2.39	13
3	Ease of maneuvering through the home with added handrails	2.00	6.00	4.69	1.32	1.75	13
4	Level of safety provided by added handrails	2.00	6.00	4.85	1.35	1.82	13

Q 76: Ramp After If you were shown a walk through of your home (or the home of a friend or family member) with a ***ramp to the entrance*** to your home, how confident would you be in the attractiveness, the constructability, the ease of maneuvering into the house, and the level of safety of the ***entrance ramp***?

Table 4. 160 Confidence of CP in Adding a Ramp After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.00	1.63	2.67	3
2	Constructability	2.00	6.00	4.67	1.89	3.56	3
3	Ease of maneuvering through the home with added handrails	2.00	6.00	4.33	1.70	2.89	3
4	Level of safety provided by added handrails	2.00	6.00	4.67	1.89	3.56	3

Statistical significance of the attractiveness of a ramp from the perspective of a construction professional was found to be not significant.

Table 4. 161 StatSig re: Attractiveness of Added Ramp Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	12	3.06	1.55	0.45	
After Walkthrough	3	4.00	1.63	0.94	31 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.42	(-4.90, 4.06)			
	T Value	DF	P-Value		
	-0.40	2	0.726		

Statistical significance of the constructability of a ramp from the perspective of a construction professional was found to be not significant.

Table 4. 162 StatSig re: Constructability of Added Ramp Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	13	4.62	1.55	0.43	
After Walkthrough	3	4.67	1.89	1.10	1 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.05	(-5.10, 5.10)			
	T Value	DF	P-Value		
	-0.04	2	0.970		

Statistical significance of the ease of use of a ramp from the perspective of a construction professional was found to be not significant.

Table 4. 163 StatSig re: Ease of Use of Added Ramp Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	13	4.69	1.32	0.37	
After Walkthrough	3	4.33	1.70	0.98	8 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.36	(-4.15, 4.87)			
	T Value	DF	P-Value		
	0.34	2	0.764		

Statistical significance of the safety of a ramp from the perspective of a construction professional was found to be not significant.

Table 4. 164 StatSig re: Safety of Added Ramp Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	13	4.85	1.35	0.37	
After Walkthrough	3	4.45	1.89	1.10	9 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.18	(-4.78, 5.14)			
	T Value	DF	P-Value		
	0.16	2	0.890		

Q 55: If you were to use your standard method of communicating design suggestions to a client to recommend ***adding a ramp*** to the entrance in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the ease in entering the house, and the level of safety provided by ***the ramp***?

Table 4. 165 Confidence of HCP in Adding a Ramp Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	3.58	1.55	2.41	12
2	Constructability	2.00	6.00	4.62	1.55	2.39	13
3	Ease of maneuvering through the home with added handrails	2.00	6.00	4.69	1.32	1.75	13
4	Level of safety provided by added handrails	2.00	6.00	4.85	1.35	1.82	13

Q 76: Ramp After If you were shown a walk through of your home (or the home of a friend or family member) with a ***ramp to the entrance*** to your home, how confident would you be in the attractiveness, the constructability, the ease of maneuvering into the house, and the level of safety of the ***entrance ramp***?

Table 4. 166 Confidence of HCP in Adding a Ramp After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.00	1.63	2.67	3
2	Constructability	2.00	6.00	4.67	1.89	3.56	3
3	Ease of maneuvering through the home with added handrails	2.00	6.00	4.33	1.70	2.89	3
4	Level of safety provided by added handrails	2.00	6.00	4.67	1.89	3.56	3

Statistical significance of the attractiveness of a ramp from the perspective of a health care professional was found to be not significant

Table 4. 167 StatSig re: Attractiveness of Added Ramp Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	3.81	1.38	0.34	
After Walkthrough	3	3.67	1.00	0.58	4 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.140	(-2.000, 2.280)			
	T Value	DF	P-Value		
	0.21	3	0.848		

Statistical significance of the constructability of a ramp from the perspective of a health care professional was found to be not significant

Table 4. 168 StatSig re: Constructability of Added Ramp Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	4.81	1.07	0.27	
After Walkthrough	3	4.67	0.47	0.27	3 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.140	(-0.792, 1.072)			
	T Value	DF	P-Value		
	0.37	6	0.726		

Statistical significance of the ease of use of a ramp from the perspective of a health care professional was found to be not significant

Table 4. 169 StatSig re: Ease of Use of Added Ramp Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	5.31	0.92	0.23	
After Walkthrough	3	5.55	0.47	0.27	4 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.190	(-1.104, 0.724)			
	T Value	DF	P-Value		
	-0.53	5	0.616		

Statistical significance of the safety of a ramp from the perspective of a health care professional was found to be not significant

Table 4. 170 StatSig re: Safety of Added Ramp Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	4.31	0.77	0.19	
After Walkthrough	3	4.00	0.47	0.27	- 8 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	.310	(-0.614, 1.234)			
	T Value	DF	P-Value		
	0.93	4	0.404		

4.3.4 Impact of Walkthrough on Confidence in a Walk-in Shower

Impact of viewing the walk through on perceptions of adding a walk-in shower with a built-in seat.

Q58: If you were told to add a ***walk in shower with a built in seat*** in your home, how confident do you think you would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the comfort of showering, and the level of safety provided by ***the walk in shower with a built in seat***?

Table 4. 171 Confidence of AI in Adding Walk in Shower Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.50	1.52	2.31	36
2	Constructability	1.00	6.00	4.51	1.57	2.47	37
3	Comfort of showering in a walk in shower	1.00	6.00	4.92	1.35	1.81	39
4	Level of safety provided by the walk in shower with a built in seat	1.00	6.00	4.97	1.40	1.97	38

Q78 If you were shown your home with a ***walk in shower with a built in seat*** in your primary bathroom, how confident do you think you would be in the attractiveness, the constructability, the comfort when performing the activities related to showering, and level of safety of the ***walk in shower***?

Table 4. 172 Confidence of AI in Adding Walk in Shower After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.88	1.61	2.59	33
2	Constructability	1.00	6.00	4.88	1.45	2.11	33
3	Comfort when showering	1.00	6.00	5.13	1.36	1.86	32
4	Level of safety provided by the walk in shower with a built in seat	2.00	6.00	5.35	1.03	1.07	31

Statistical significance of the attractiveness of adding a walk-in shower with a built-in seat from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 173 StatSig re: Attractiveness of Walk in Shower Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	36	4.50	1.52	0.25	
After Walkthrough	33	4.88	1.61	0.28	8 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.380	(-1.135, 0.375)			
	T Value	DF	P-Value		
	-1.01	65	0.318		

Statistical significance of the constructability of adding a walk-in shower with a built-in seat from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 174 StatSig re: Constructability of Walk in Shower Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	37	4.51	1.52	0.25	
After Walkthrough	33	4.88	1.45	0.25	8 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.370	(-1.079, 0.339)			
	T Value	DF	P-Value		
	-1.04	67	0.301		

Statistical significance of the ease of use of a walk-in shower with a built-in seat from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 175 StatSig re: Ease of Use of Walk in Shower Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	39	4.92	1.35	0.22	
After Walkthrough	32	5.13	1.36	0.24	4 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.210	(-0.856, 0.436)			
	T Value	DF	P-Value		
	-0.65	66	0.518		

Statistical significance of the safety of a walk-in shower with a built-in seat from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 176 StatSig re: Safety of Walk in Shower Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	38	4.97	1.40	0.23	
After Walkthrough	31	5.35	1.03	0.18	8 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.380	(-0.965, 0.205)			
	T Value	DF	P-Value		
	-1.30	66	0.199		

Q57: If your friend of family member were told to add a ***walk in shower with a built in seat*** in his/herhome, how confident do you think you would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the comfort of showering, and the level of safety provided by ***the walk in shower with a built in seat***?

Table 4. 177 Confidence of FF in Adding Walk in Shower Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.43	1.41	2.31	30
2	Constructability	2.00	6.00	4.63	1.35	2.47	30
3	Comfort of showering in a walk in shower	2.00	6.00	4.93	1.06	1.81	30
4	Level of safety provided by the walk in shower with a built in seat	2.00	6.00	5.10	0.92	1.97	29

Q78 If your friend or family member were shown your home with a ***walk in shower with a built in seat*** in his/her primary bathroom, how confident do you think you would be in the attractiveness, the constructability, the comfort when performing the activities related to showering, and level of safety of the ***walk in shower***?

Table 4. 178 Confidence of FF in Adding Walk in Shower After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	5.39	0.86	0.74	28
2	Constructability	2.00	6.00	5.25	1.15	1.33	28
3	Comfort when showering	2.00	6.00	5.32	1.14	1.29	28
4	Level of safety provided by the walk in shower with a built in seat	2.00	6.00	5.29	1.10	1.20	28

Statistical significance of the attractiveness of a walk-in shower with a built-in seat from the perspective of a friend or family member was found to be significant

Table 4. 179 StatSig re: Attractiveness of Walk in Shower Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	30	4.43	1.41	0.26	
After Walkthrough	28	5.39	0.86	0.16	22 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.960	(-1.572, -0.348)			
	T Value	DF	P-Value		
	-0.960	48	0.003		

Statistical significance of the constructability of a walk-in shower with a built-in seat from the perspective of a friend or family member was found to be not significant.

Table 4. 180 StatSig re: Constructability of Walk in Shower Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	30	4.63	1.35	0.25	
After Walkthrough	28	5.25	1.15	0.22	13 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.620	(-1.279, 0.039)			
	T Value	DF	P-Value		
	-1.89	55	0.064		

Statistical significance of the ease of use of a walk-in shower with a built-in seat from the perspective of a friend or family member was found to be not significant

Table 4. 181 StatSig re: Ease of Use of Walk in Shower Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	30	4.93	1.06	0.19	
After Walkthrough	28	5.32	1.14	0.22	7 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.390	(-0.971, 0.191)			
	T Value	DF	P-Value		
	-1.35	54	0.184		

Statistical significance of the safety of a walk-in shower with a built-in seat from the perspective of a friend or family member was found to be not significant

Table 4. 182 StatSig re: Safety of Walk in Shower Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	5.10	0.92	0.17	
After Walkthrough	28	5.29	1.10	0.21	4 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.190	(-0.730, 0.350)			
	T Value	DF	P-Value		
	-0.71	52	0.483		

Q58: If you were to use your standard method of communicating design suggestions to a client to recommend adding a ***walk in shower with a built in seat*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the comfort of showering, and the level of safety provided by ***the walk in shower with a built in seat***?

Table 4. 183 Confidence of DP in Adding Walk in Shower Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	5.19	1.12	1.26	27
2	Constructability	2.00	6.00	4.89	1.23	1.52	28
3	Comfort when showering	2.00	6.00	5.14	1.12	1.29	28
4	Level of safety provided by the walk in shower with a built in seat	2.00	6.00	5.21	1.05	1.20	28

Q79 If your were able to show your client a walkthrough of his/her home with a walkin shower with a built in seat in their primary bathroom, how confident do you think they would be in the attractiveness, the constructability, the comfort and the level of safety when performing activities related to showering?

Table 4. 184 Confidence of DP in Adding Walk in Shower After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	5.37	1.25	1.57	27
2	Constructability	2.00	6.00	5.22	1.03	1.06	28
3	Comfort when showering	2.00	6.00	5.33	1.09	1.19	28
4	Level of safety provided by the walk in shower with a built in seat	2.00	6.00	5.19	1.19	1.41	28

Statistical significance of the attractiveness of a walk-in shower with a built-in seat from the perspective of a design professional was found to be not significant

Table 4. 185 StatSig re: Attractiveness of Walk in Shower Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	5.19	1.12	0.22	
After Walkthrough	27	5.37	1.25	0.24	3 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.180	(-0.828, 0.468)			
	T Value	DF	P-Value		
	-0.56	51	0.580		

Statistical significance of the constructability of a walk-in shower with a built-in seat from the perspective of a design professional was found to be not significant

Table 4. 186 StatSig re: Constructability of Walk in Shower Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	4.89	1.23	0.24	
After Walkthrough	27	5.22	1.03	0.20	7 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.333	(-0.950, -0.290)			
	T Value	DF	P-Value		
	-1.07	50	0.290		

Statistical significance of the ease of use of a walk-in shower with a built-in seat from the perspective of a design professional was found to be not significant

Table 4. 187 StatSig re: Ease of Use of Walk in Shower Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	5.14	1.12	0.22	
After Walkthrough	27	5.33	1.09	0.21	4 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.190	(0.794, 0.414)			
	T Value	DF	P-Value		
	-0.63	51	0.530		

Statistical significance of the safety of a walk-in shower with a built-in seat seat from the perspective of a design professional was found to be not significant

Table 4. 188 StatSig re: Safety of Walk in Shower Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	5.21	1.05	0.20	
After Walkthrough	27	5.19	1.19	0.23	0 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.020	(-0.593, 0.633)			
	T Value	DF	P-Value		
	0.07	51	0.948		

Q58: If you were to use your standard method of communicating design suggestions to a client to recommend adding a ***walk in shower with a built in seat*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the comfort of showering, and the level of safety provided by ***the walk in shower with a built in seat***?

Table 4. 189 Confidence of CP in Adding Walk in Shower Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	5.15	1.03	1.05	13
2	Constructability	3.00	6.00	4.85	1.35	1.82	13
3	Comfort of showering in a walk in shower	3.00	6.00	5.31	0.82	0.67	13
4	Level of safety provided by the walk in shower with a built in seat	4.00	6.00	5.58	0.64	0.41	12

Q79 If you were able to show your client a walk through of his/her home with a ***walk in shower with a built in seat*** in their primary bathroom, how confident do you think they would be in the attractiveness, the constructability, the comfort when performing the activities related to showering, and level of safety of the ***walk in shower***?

Table 4. 190 Confidence of CP in Adding Walk in Shower After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	5.50	0.82	0.68	14
2	Constructability	3.00	6.00	5.36	1.11	1.23	14
3	Comfort when showering	3.00	6.00	5.14	1.12	1.27	14
4	Level of safety provided by the walk in shower with a built in seat	3.00	6.00	5.29	1.03	1.06	14

Statistical significance of the attractiveness of a walk-in shower with a built-in seat from the perspective of a construction professional was found to be not significant

Table 4. 191 StatSig re: Attractiveness of Walk in Shower Before and After WT by CP

Two sample T- test and CI				
		Descriptive Statistics		
	N	Mean	StDev	Se Mean
Before Walkthrough	13	5.15	1.03	0.29
After Walkthrough	14	5.50	0.82	0.22
		Estimation for Difference		
	Difference	95% CI for Difference		
	-0.350	(-1.097, -0.397)		
	T Value	DF	P-Value	
	-0.97	22	0.342	

Statistical significance of the constructability of a walk-in shower with a built-in seat from the perspective of a construction professional was found to be not significant

Table 4. 192 StatSig re: Constructability of Walk in Shower Before and After WT by CP

Two sample T- test and CI					% of Change
		Descriptive Statistics			
	N	Mean	StDev	Se Mean	
Before Walkthrough	13	4.85	1.35	0.37	
After Walkthrough	14	5.36	1.11	0.30	10 %
		Estimation for Difference			
	Difference	95% CI for Difference			
	-0.510	(-1.498, 0.478)			
	T Value	DF	P-Value		
	-1.07	23	0.297		

Statistical significance of the ease of use of a walk-in shower with a built-in seat from the perspective of a construction professional was found to be not significant

Table 4. 193 StatSig re: Ease of Use of Walk in Shower Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	13	5.31	0.82	0.23	
After Walkthrough	14	5.14	1.12	0.30	- 3 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.170	(-0.608, 0.948)			
	T Value	DF	P-Value		
	0.45	23	0.665		

Statistical significance of the safety of a walk-in shower with a built-in seat from the perspective of a construction professional was found to be not significant

Table 4. 194 StatSig re: Safety of Walk in Shower Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	12	5.58	0.64	0.18	
After Walkthrough	14	5.29	1.03	0.28	0 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.290	(-0.398, 0.978)			
	T Value	DF	P-Value		
	0.87	22	0.391		

Q58: If you were to use your standard method of communicating design suggestions to a client to recommend adding a ***walk in shower with a built in seat*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the comfort of showering, and the level of safety provided by ***the walk in shower with a built in seat***?

Table 4. 195 Confidence of HCP in Adding Walk in Shower Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	4.44	1.22	1.50	16
2	Constructability	3.00	6.00	4.88	1.11	1.23	16
3	Comfort of showering in a walk in shower	3.00	6.00	5.13	0.93	1.86	16
4	Level of safety provided by the walk in shower with a built in seat	3.00	6.00	5.25	0.97	1.94	16

Q79 If you were able to show your client a walk through of his/her home with a ***walk in shower with a built in seat*** in their primary bathroom, how confident do you think they would be in the attractiveness, the constructability, the comfort when performing the activities related to showering, and level of safety of the ***walk in shower***?

Table 4. 196 Confidence of HCP in Adding Walk in Shower After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	4.00	6.00	5.47	0.62	0.38	15
2	Constructability	4.00	6.00	5.33	0.79	0.62	15
3	Comfort when showering	4.00	6.00	5.47	0.72	0.72	15
4	Level of safety provided by the walk in shower with a built in seat	4.00	6.00	5.47	0.72	0.72	15

Statistical significance of the attractiveness of a walk-in shower with a built-in seat from the perspective of a health care professional was found to be significant

Table 4. 197 StatSig re: Attractiveness of Walk in Shower Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	4.44	1.22	0.21	
After Walkthrough	15	5.47	0.62	0.23	23 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.030	(-1.744, -0.316)			
	T Value	DF	P-Value		
	-2.99	22	0.007		

Statistical significance of the constructability of a walk-in shower with a built-in seat from the perspective of a health care professional was found to be not significant

Table 4. 198 StatSig re: Constructability of Walk in Shower Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	4.88	1.11	0.28	
After Walkthrough	15	5.33	0.79	0.20	9 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.450	(-1.157, 0.257)			
	T Value	DF	P-Value		
	-1.31	27	0.202		

Statistical significance of the ease of use of a walk-in shower with a built-in seat from the perspective of a health care professional was found to be not significant

Table 4. 199 StatSig re: Ease of Use of Walk in Shower Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	5.13	0.93	0.23	
After Walkthrough	15	5.40	0.720	0.19	5 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.340	(-0.950, 0.270)			
	T Value	DF	P-Value		
	-1.14	28	0.263		

Statistical significance of the safety of a walk-in shower with a built-in seat from the perspective of a health care professional was found to be not significant

Table 4. 200 StatSig re: Safety of Walk in Shower Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	5.25	0.97	0.24	
After Walkthrough	15	5.47	0.72	0.19	4 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.220	(-0.847, 0.407)			
	T Value	DF	P-Value		
	-0.72	27	0.478		

4.3.5 Impact of Walkthrough on Perceptions of Grab Bars by Toilet

Q59. If you were told verbally to ***add grab bars next to the toilet***, how confident would you be in the attractiveness, the ability of a contractor to successfully install it (constructability), the comfort of using the toilet, and the level of safety of the ***grab bars***?

Table 4. 201 Confidence of AI in Adding GB by Toilet Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	3.75	1.39	1.94	32
2	Constructability	1.00	6.00	4.46	1.59	2.53	35
3	Level of comfort provided by the grab bars	1.00	6.00	4.74	1.25	1.56	35
4	Level of safety provided by the grab bars next to the toilet	1.00	6.00	4.89	1.28	1.64	35

Q80 If you were shown a walk through of your home with ***grab bars placed next to their toilet***, how confident do your think you would you be in the attractiveness, the constructibility, the level of comfort, and the level of safety of the ***grab bars***?

Table 4. 202 Confidence of AI in Adding GB by Toilet After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.10	1.42	2.02	29
2	Constructability	2.00	6.00	4.94	1.29	1.67	31
3	Level of comfort provided by the grab bars	2.00	6.00	5.19	1.09	1.19	31
4	Level of safety provided by the grab bars next to the toilet	2.00	6.00	5.39	1.01	1.01	31

Statistical significance of the attractiveness of grab bars by the toilet from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 203 StatSig re: Attractiveness of GB by Toilet Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	32	3.75	1.39	0.25	
After Walkthrough	29	4.10	1.42	0.26	9 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.350	(-1.071, 0.371)			
	T Value	DF	P-Value		
	-0.97	58	0.336		

Statistical significance of the constructability of grab bars by the toilet from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 204 StatSig re: Constructability of GB by Toilet Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	35	4.46	1.59	0.27	
After Walkthrough	29	4.94	1.29	0.24	11 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.480	(-1.200, 0.240)			
	T Value	DF	P-Value		
	-1.33	61	0.187		

Statistical significance of the ease of use of grab bars by the toilet from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 205 StatSig re: Ease of Use of GB by Toilet Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	35	4.74	1.25	0.21	
After Walkthrough	31	5.19	1.09	0.20	9 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.450	(-1.026, 0.126)			
	T Value	DF	P-Value		
	-1.56	63	0.123		

Statistical significance of the safety of grab bars by the toilet from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 206 StatSig re: Safety of GB by Toilet Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	35	4.89	1.28	0.22	
After Walkthrough	31	5.39	1.01	0.18	10 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.500	(-1.064, 0.064)			
	T Value	DF	P-Value		
	-1.77	63	0.081		

Q59. If your friend or family member were told verbally to ***add grab bars next to the toilet***, how confident would you be in the attractiveness, the ability of a contractor to successfully install it (constructability), the comfort of using the toilet, and the level of safety of the ***grab bars***?

Table 4. 207 Confidence of FF in Adding GB by Toilet Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	3.72	1.39	2.06	29
2	Constructability	2.00	6.00	4.45	1.93	1.93	31
3	Level of comfort provided by the grab bars	2.00	6.00	4.68	1.09	1.17	31
4	Level of safety provided by the grab bars next to the toilet	2.00	6.00	4.87	1.07	1.14	31

Q80 If you were shown a walk through of your friend or family members' home with ***grab bars placed next to their toilet***, how confident do your think you would you be in the attractiveness, the constructibility, the level of comfort, and the level of safety of the ***grab bars***?

Table 4. 208 Confidence of FF in Adding GB by Toilet after the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.82	1.20	1.43	28
2	Constructability	2.00	6.00	5.32	1.14	1.29	28
3	Level of comfort provided by the grab bars	2.00	6.00	5.39	0.94	0.88	28
4	Level of safety provided by the grab bars next to the toilet	2.00	6.00	5.43	0.98	0.96	28

Statistical significance of the attractiveness of grab bars by the toilet from the perspective of a friend or family member was found to be significant

Table 4. 209 StatSig re: Attractiveness of GB by Toilet Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	3.72	1.39	0.26	
After Walkthrough	28	4.82	1.20	0.23	30 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.100	(-1.789, -0.411)			
	T Value	DF	P-Value		
	-3.20	54	0.002		

Statistical significance of the constructability of grab bars by the toilet from the perspective of a friend or family member was found to be significant

Table 4. 210 StatSig re: Constructability of GB by Toilet Before and After WT by FF

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	31	4.45	1.93	0.35	
After Walkthrough	28	5.32	1.14	0.22	20 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.870	(-1.690, 0.050)			
	T Value	DF	P-Value		
	-2.13	49	0.038		

Statistical significance of the ease of use of grab bars by the toilet from the perspective of a friend or family member was found to be significant

Table 4. 211 StatSig re: Ease of Use of GB by Toilet Before and After WT by FF

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	31	4.68	1.09	0.20	
After Walkthrough	28	5.39	0.94	0.18	15 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.710	(-1.240, -0.180)			
	T Value	DF	P-Value		
	-2.69	56	0.010		

Statistical significance of the safety of grab bars by the toilet from the perspective of a friend or family member was found to be significant

Table 4. 212 StatSig re: Safety of GB by Toilet Before and After WT by FF

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	31	4.87	0.07	0.19	
After Walkthrough	28	5.43	0.98	0.19	11 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.560	(-1.095, -0.025)			
	T Value	DF	P-Value		
	-2.10	56	0.040		

59. If you were told verbally to ***add grab bars next to the toilet***, how confident would you be in the attractiveness, the ability of a contractor to successfully install it (constructability), the comfort of using the toilet, and the level of safety of the ***grab bars***?

Table 4. 213 Confidence of DP in Adding GB by Toilet Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	3.00	2.67	0.47	0.22	3
2	Constructability	3.00	4.00	3.75	0.43	0.19	4
3	Level of comfort provided by the grab bars	3.00	5.00	4.25	0.83	0.69	4
4	Level of safety provided by the grab bars next to the toilet	3.00	6.00	4.75	1.09	1.19	4

Q81 If your client were shown a walk through of his/her home with ***grab bars placed next to their toilet***, how confident do your think your client would you be in the attractiveness, the constructibility, the level of comfort, and the level of safety of the ***grab bars***?

Table 4. 214 Confidence of DP in Adding GB by Toilet After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.65	1.44	2.07	26
2	Constructability	1.00	6.00	4.96	1.27	1.61	28
3	Level of comfort provided by the grab bars	2.00	6.00	5.33	0.90	0.81	27
4	Level of safety provided by the grab bars next to the toilet	2.00	6.00	5.26	1.14	1.3	27

Statistical significance of the attractiveness of grab bars by the toilet from the perspective of a design professional

Table 4. 215 StatSig re: Attractiveness of GB by Toilet Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	3	2.67	0.44	0.25	
After Walkthrough	28	4.65	1.44	0.27	74 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.980	(-2.838, -1.122)			
	T Value	DF	P-Value		
	-5.32	8	0.001		

Statistical significance of the constructability of a grab bars by the toilet from the perspective of a design professional

Table 4. 216 StatSig re: Constructability of GB by Toilet Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	4	3.75	0.43	0.21	
After Walkthrough	37	4.96	1.27	0.24	32 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.210	(-1.913, -0.507)			
	T Value	DF	P-Value		
	-3.72	13	0.003		

Statistical significance of the ease of use of grab bars by the toilet from the perspective of a design professional

Table 4. 217 StatSig re: Ease of Use of GB by Toilet Before and After WT by DP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
e	N	Mean	StDev	Se Mean	
Before Walkthrough	4	4.25	0.83	0.41	
After Walkthrough	27	5.33	0.90	0.17	25 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.080	(-2.329, -0.169)			
	T Value	DF	P-Value		
	-2.40	4	0.074		

Statistical significance of the safety of grab bars by the toilet from the perspective of a design professional

Table 4. 218 StatSig re: Safety of GB by Toilet Before and After WT by DP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	4	4.75	1.09	0.55	
After Walkthrough	27	5.26	1.14	0.22	11 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.510	(-2.141, 1.121)			
	T Value	DF	P-Value		
	-0.87	4	0.434		

59. If you were told verbally to ***add grab bars next to the toilet***, how confident would you be in the attractiveness, the ability of a contractor to successfully install it (constructability), the comfort of using the toilet, and the level of safety of the ***grab bars***?

Table 4. 219 Confidence of CP in Adding GB by Toilet Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	4.00	3.00	0.82	0.67	3
2	Constructability	2.00	600	3.67	1.70	2.89	3
3	Level of comfort provided by the grab bars	2.00	5.00	4.00	2.00	0.69	3
4	Level of safety provided by the grab bars next to the toilet	2.00	6.00	4.33	2.89	1.19	3

Q81 If your client were shown a walk through of his/her home with ***grab bars placed next to their toilet***, how confident do your think your client would you be in the attractiveness, the constructibility, the level of comfort, and the level of safety of the ***grab bars***?

Table 4. 220 Confidence of CP in Adding GB by Toilet After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	4.58	1.04	1.08	12
2	Constructability	3.00	6.00	5.33	1.11	1.22	12
3	Level of comfort provided by the grab bars	3.00	6.00	5.00	0.91	0.83	12
4	Level of safety provided by the grab bars next to the toilet	4.00	6.00	5.33	0.85	0.72	12

Statistical significance of the attractiveness of grab bars by the toilet from the perspective of a construction professional = ALMOST SIGNIFICANT

Table 4. 221 StatSig re: Attractiveness of GB by Toilet Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	3	3.00	0.82	0.47	
After Walkthrough	14	4.58	1.04	0.28	53 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.580	(-3.327, 0.167)			
	T Value	DF	P-Value		
	-2.88	3	0.064		

Statistical significance of the constructability of grab bars by the toilet from the perspective of a construction professional was found to be not significant

Table 4. 222 StatSig re: Constructability of GB by Toilet Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	3	3.67	1.70	0.98	
After Walkthrough	14	5.33	1.11	0.30	45 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.66	-6.07, 275)			
	T Value	DF	P-Value		
	-1.62	2	0.247		

Statistical significance of the ease of use of grab bars by the toilet from the perspective of a construction professional was found to be not significant

Table 4. 223 StatSig re: Ease of Use of GB by Toilet Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
Sample	N	Mean	StDev	Se Mean	
Before Walkthrough	3	4.00	2.00	1.2	
Sample After Walkthrough	14	5.00	0.91	0.24	25 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.00	(-6.08, 4.08)			
	T Value	DF	P-Value		
	-0.85	2	0.486		

Statistical significance of the safety of grab bars by the toilet from the perspective of a construction professional was found to be not significant

Table 4. 224 StatSig re: Safety of GB by Toilet Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	3	4.33	2.89	1.7	
After Walkthrough	12	5.33	0.85	0.25	23 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.0	(-8.26, 6.26)			
	T Value	DF	P-Value		
	-0.59	2	0.613		

59. If you were told verbally to ***add grab bars next to the toilet***, how confident would you be in the attractiveness, the ability of a contractor to successfully install it (constructability), the comfort of using the toilet, and the level of safety of the ***grab bars***?

Table 4. 225 Confidence of HCP in Adding GB by Toilet Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	5.00	3.75	0.83	0.69	4
2	Constructability	2.00	6.00	4.00	1.58	2.50	4
3	Level of comfort provided by the grab bars	3.00	6.00	4.25	1.30	1.69	4
4	Level of safety provided by the grab bars next to the toilet	2.00	6.00	4.00	1.58	2.50	4

Q81 If your client were shown a walk through of his/her home with ***grab bars placed next to their toilet***, how confident do your think your client would you be in the attractiveness, the constructibility, the level of comfort, and the level of safety of the ***grab bars***?

Table 4. 226 Confidence of HCP in Adding GB by Toilet After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.60	1.50	2.24	15
2	Constructability	2.00	6.00	5.13	1.26	1.58	15
3	Level of comfort provided by the grab bars	5.00	6.00	5.40	0.88	0.88	15
4	Level of safety provided by the grab bars next to the toilet	5.00	6.00	5.60	0.49	0.49	15

Statistical significance of the attractiveness of grab bars by the toilet from the perspective of a health care professional was found to be not significant

Table 4. 227 StatSig re: Attractiveness of GB by Toilet Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	4	3.75	0.83	0.41	
After Walkthrough	15	4.60	1.50	0.39	23 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.850	(-2.134, -0.434)			
	T Value	DF	P-Value		
	-1.50	9	0.169		

Statistical significance of the constructability of grab bars by the toilet from the perspective of a health care professional was found to be not significant

Table 4. 228 StatSig re: Constructability of GB by Toilet Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	4	4.00	1.58	0.791	
After Walkthrough	15	5.13	1.26	0.33	28 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.130	(-3.502, 1.242)			
	T Value	DF	P-Value		
	-1.32	4	0.257		

Statistical significance of the ease of use of grab bars by the toilet from the perspective of a health care professional was found to be not significant

Table 4. 229 StatSig re: Ease of Use of GB by Toilet Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	4	4.25	1.30	0.65	
After Walkthrough	15	5.40	0.88	0.23	27 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.150	(-3.341, -1.041)			
	T Value	DF	P-Value		
	-1.67	3	0.193		

Statistical significance of the safety of grab bars by the toilet from the perspective of a health care professional was found to be not significant

Table 4. 230 StatSig re: Safety of GB by Toilet Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	4	4.00	1.58	0.79	
After Walkthrough	15	5.60	1.49	0.13	40 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.600	(-4.146, 0.946)			
	T Value	DF	P-Value		
	-2.00	3	0.139		

4.3.6 Impact of the Walkthrough on Perceptions of Grab Bars in the Shower

Q61 If you were verbally told to ***add grab bars in the shower/bath area,*** how confident do you think you would in the attractiveness, the ability of a contractor to successfully install them (constructability), the comfort of showering and the level of safety provided by the ***grab bars***?

Table 4. 231 Confidence of AI in Adding GB in Shower Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	3.77	1.51	2.29	35
2	Constructability	1.00	6.00	4.68	1.53	2.33	37
3	Ease of maneuvering through the home	2.00	6.00	5.16	1.03	1.05	37
4	Level of safety provided by the grab bars in the shower/bath area	1.00	6.00	5.11	1.29	1.66	37

Q82 If you were shown a walk through of your home with ***grab bars placed in the shower/bath area***, how confident do your think your client would you be in the attractiveness, the constructibility, the level of comfort, and the level of safety of the ***grab bars***?

Table 4. 232 Confidence of AI in Adding GB in Shower After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.23	1.41	1.98	30
2	Constructability	2.00	6.00	5.16	1.09	1.19	32
3	Ease of maneuvering through the home	2.00	6.00	5.19	0.96	0.93	31
4	Level of safety provided by the grab bars in the shower/bath area	2.00	6.00	5.39	1.97	0.95	31

Statistical significance of the attractiveness of grab bars in the shower from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 233 StatSig re: Attractiveness of GB in Shower Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	35	3.77	1.51	0.26	
After Walkthrough	30	4.23	1.41	0.26	12 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.460	(-1.185, 0.265)			
	T Value	DF	P-Value		
	-1.27	62	0.209		

Statistical significance of the constructability of grab bars in the shower from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 234 StatSig re: Constructability of GB in Shower Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	37	4.68	1.53	0.25	
After Walkthrough	32	5.16	1.09	0.19	10 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.480	(-1.113, 0.153)			
	T Value	DF	P-Value		
	-1.51	64	0.135		

Statistical significance of the ease of use of grab bars in the shower from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 235 StatSig re: Ease of Use of GB in Shower Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
e	N	Mean	StDev	Se Mean	
Before Walkthrough	37	5.16	1.03	0.17	
After Walkthrough	31	5.19	1.97	0.35	0 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.030	(-0.821, 0.761)			
	T Value	DF	P-Value		
	-0.08	43	0.939		

Statistical significance of the safety of grab bars in the shower from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 236 StatSig re: Safety of GB in Shower Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	37	5.11	1.29	0.21	
After Walkthrough	31	5.39	1.97	0.35	5 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.282	(-1.109, 0.549)			
	T Value	DF	P-Value		
	-0.68	50	0.500		

Q61 If your friend or family member were verbally told to ***add grab bars in the shower/bath area,*** how confident do you think you would in the attractiveness, the ability of a contractor to successfully install them (constructability), the comfort of showering and the level of safety provided by the ***grab bars***?

Table 4. 237 Confidence of FF in Adding GB in Shower Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.14	1.41	1.98	29
2	Constructability	2.00	6.00	4.87	1.24	1.53	31
3	Ease of maneuvering through the home	2.00	6.00	4.97	1.09	1.19	137
4	Level of safety provided by the grab bars in the shower/bath area	1.00	6.00	5.23	0.97	0.95	31

Q82 If you were shown a walk through of your friend or family members' home with ***grab bars placed in the shower/bath area***, how confident do your think you would you be in the attractiveness, the constructibility, the level of comfort, and the level of safety of the ***grab bars***?

Table 4. 238 Confidence of FF in Adding GB in Shower After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.86	1.25	1.55	28
2	Constructability	2.00	6.00	5.15	1.21	1.46	27
3	Ease of maneuvering through the home	2.00	6.00	5.29	1.06	1.13	28
4	Level of safety provided by the grab bars in the shower/bath area	2.00	6.00	5.54	0.94	0.89	28

Statistical significance of the attractiveness of grab bars in the shower from the perspective of a friend or family member was found to be significant

Table 4. 239 StatSig re: Attractiveness of GB in Shower Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	4.14	1.41	0.26	
After Walkthrough	28	4.86	1.25	0.24	17 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.720	(-1.427, -0.013)			
	T Value	DF	P-Value		
	-2.04	54	0.046		

Statistical significance of the constructability of grab bars in the shower from the perspective of a friend or family member was found to be not significant

Table 4. 240 StatSig re: Constructability of GB in Shower Before and After WT by FF

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	31	4.87	1.24	0.22	
After Walkthrough	27	5.15	1.21	0.23	6 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.280	(-0.926, 0.366)			
	T Value	DF	P-Value		
	-0.87	55	0.389		

Statistical significance of the ease of use of grab bars in the shower from the perspective of a friend or family member was found to be not significant

Table 4. 241 StatSig re: Ease of Use of GB in Shower Before and After WT by FF

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	31	4.97	1.09	0.20	
After Walkthrough	28	5.29	1.06	0.20	6 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.320	(-0.881, 0.241)			
	T Value	DF	P-Value		
	-1.14	56	0.258		

Statistical significance of the safety of grab bars in the shower from the perspective of a friend or family member was found to be not significant

Table 4. 242 StatSig re: Safety of GB in Shower Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	31	5.23	0.97	0.17	
After Walkthrough	28	5.54	0.94	0.18	0 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.310	(-0.808, 0.188)			
	T Value	DF	P-Value		
	-1.25	56	0.218		

Q60 If you were to use your standard method of communicating design suggestions to a client to recommend ***adding grab bars in the shower/bath area,*** how confident do you think they would they be in the attractiveness, the ability of a contractor to successfully install them (constructability), the comfort of showering and the level of safety provided by the ***grab bars***?

Table 4. 243 Confidence of DP in Adding GB in Shower Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.58	1.36	1.86	26
2	Constructability	3.00	6.00	4.96	1.07	1.15	27
3	Ease of maneuvering through the home	3.00	6.00	5.30	1.01	1.02	27
4	Level of safety provided by the grab bars in the shower/bath area	3.00	6.00	5.26	1.07	1.16	27

Q83 If your client were shown a walk through of his/her home with ***grab bars placed in the shower/bath area***, how confident do your think your client would you be in the attractiveness, the constructibility, the level of comfort, and the level of safety of the ***grab bars***?

Table 4. 244 Confidence of DP in Adding GB in Shower After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	5.04	1.28	1.64	25
2	Constructability	2.00	6.00	5.27	0.94	0.89	26
3	Ease of maneuvering through the home	2.00	6.00	5.31	0.95	0.91	26
4	Level of safety provided by the grab bars in the shower/bath area	2.00	6.00	5.36	1.09	1.19	25

Statistical significance of the attractiveness of grab bars in the shower from the perspective of a design professional was found to be not significant

Table 4. 245 StatSig re: Attractiveness of GB in Shower Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	26	4.89	1.36	0.27	
After Walkthrough	25	5.04	1.28	0.26	3 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.150	(-0.893, 0.593)			
	T Value	DF	P-Value		
	-0.41	48	0.687		

Statistical significance of the constructability of grab bars in the shower from the perspective of a design professional was found to be not significant

Table 4. 246 StatSig re: Constructability of GB in Shower Before and After WT by DP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	4.96	1.07	0.21	
After Walkthrough	26	5.27	0.94	0.18	6 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.310	(-0.865, 0.245)			
	T Value	DF	P-Value		
	-1.12	50	0.267		

Statistical significance of the ease of use of grab bars in the shower from the perspective of a design professional was found to be not significant

Table 4. 247 StatSig re: Ease of Use of GB in Shower Before and After WT by DP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	5.30	1.01	0.19	
After Walkthrough	26	5.31	0.95	0.19	0 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.010	(-0.551, 0.531)			
	T Value	DF	P-Value		
	-0.04	50	0.971		

Statistical significance of the safety of grab bars in the shower from the perspective of a design professional was found to be not significant

Table 4. 248 StatSig re: Safety of GB in Shower Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	5.26	1.07	0.21	
After Walkthrough	26	5.36	1.09	0.21	1 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.100	(-0.696, 0.496)			
	T Value	DF	P-Value		
	-0.34	50	0.738		

Q60 If you were to use your standard method of communicating design suggestions to a client to recommend ***adding grab bars in the shower/bath area,*** how confident do you think they would they be in the attractiveness, the ability of a contractor to successfully install them (constructability), the comfort of showering and the level of safety provided by the ***grab bars***?

Table 4. 249 Confidence of CP in Adding GB in Shower Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	3.86	1.51	2.27	14
2	Constructability	2.00	6.00	4.50	1.45	2.11	14
3	Ease of maneuvering through the home	2.00	6.00	4.93	1.06	1.35	14
4	Level of safety provided by the grab bars in the shower/bath area	2.00	6.00	5.07	1.22	1.49	14

Q83 If your client were shown a walk through of his/her home with ***grab bars placed in the shower/bath area***, how confident do your think your client would you be in the attractiveness, the constructibility, the level of comfort, and the level of safety of the ***grab bars***?

Table 4. 250 Confidence of CP in Adding GB in Shower After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	4.77	0.97	0.95	13
2	Constructability	3.00	6.00	5.23	1.12	1.25	13
3	Ease of maneuvering through the home	3.00	6.00	4.71	1.03	1.06	14
4	Level of safety provided by the grab bars in the shower/bath area	3.00	6.00	5.15	1.03	1.05	13

Statistical significance of the attractiveness of grab bars in the shower from the perspective of a construction professional was found to be not significant

Table 4. 251 StatSig re: Attractiveness of GB in Shower Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	3.86	1.51	0.40	
After Walkthrough	13	4.77.	0.97	0.27	23 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.910	(-1.916, 0.096)			
	T Value	DF	P-Value		
	-1.88	22	0.074		

Statistical significance of the constructability of grab bars in the shower from the perspective of a construction professional was found to be not significant

Table 4. 252 StatSig re: Constructability of GB in Shower Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	4.50	1.45	0.39	
After Walkthrough	13	5.23	1.12	0.31	16 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.730	(-1.755, 0.295)			
	T Value	DF	P-Value		
	-1.47	24	0.155		

Statistical significance of the ease of use of a walk-in shower with built in seat from the perspective of a construction professional was found to be not significant

Table 4. 253 StatSig re: Ease of Use of GB in Shower Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	4.93	1.06	0.28	
After Walkthrough	14	4.71	1.03	0.28	-4 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.220	(-0.594, 1.034)			
	T Value	DF	P-Value		
	0.56	25	0.583		

Statistical significance of the safety of grab bars in the shower from the perspective of a construction professional was found to be not significant

Table 4. 254 StatSig re: Safety of GB in Shower Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	5.07	1.22	0.33	
After Walkthrough	14	5.15	1.03	0.28	1 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.080	(-0.959, 0.799)			
	T Value	DF	P-Value		
	-0.19	25	0.853		

Q60 If you were to use your standard method of communicating design suggestions to a client to recommend ***adding grab bars in the shower/bath area,*** how confident do you think they would they be in the attractiveness, the ability of a contractor to successfully install them (constructability), the comfort of showering and the level of safety provided by the ***grab bars***?

Table 4. 255 Confidence of HCP in Adding GB in Shower Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.19	1.18	1.40	16
2	Constructability	2.00	6.00	4.94	1.20	1.43	16
3	Ease of maneuvering through the home	4.00	6.00	5.13	0.86	0.73	16
4	Level of safety provided by the grab bars in the shower/bath area	3.00	6.00	5.13	1.11	1.23	16

Q83 If your client were shown a walk through of his/her home with ***grab bars placed in the shower/bath area***, how confident do your think your client would you be in the attractiveness, the constructibility, the level of comfort, and the level of safety of the ***grab bars***?

Table 4. 256 Confidence of HCP in Adding GB in Shower After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.73	1.29	1.66	15
2	Constructability	3.00	6.00	5.27	1.00	1.00	15
3	Ease of maneuvering through the home	4.00	6.00	5.67	0.60	0.36	15
4	Level of safety provided by the grab bars in the shower/bath area	5.00	6.00	5.80	0.40	0.16	15

Statistical significance of the attractiveness of grab bars in the shower from the perspective of a health care professional was found to be not significant

Table 4. 257 StatSig re: Attractiveness of GB in Shower Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	4.19	1.18	0.29	
After Walkthrough	15	4.73	1.29	0.33	12 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.540	(-1.451, 0.371)			
	T Value	DF	P-Value		
	-1.21	28	0.235		

Statistical significance of the constructability of grab bars in the shower from the perspective of a health care professional was found to be not significant

Table 4. 258. StatSig re: Comfort of GB in Shower Before and After WT by HCP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	4.94	1.20	0.30	
After Walkthrough	15	5.27	1.00	0.26	7 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.330	(-1.141, 0.481)			
	T Value	DF	P-Value		
	-0.83	28	0.411		

Statistical significance of the ease of use of grab bars in the shower from the perspective of a health care professional was found to be significant

Table 4. 259 StatSig re: Ease of Use of GB in Shower Before and After WT by HCP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	5.13	0.86	0.21	
After Walkthrough	15	5.67	0.60	0.15	10 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.540	(-1.085, 0.005)			
	T Value	DF	P-Value		
	-2.04	26	0.052		

Statistical significance of the safety of grab bars in the shower from the perspective of a health care professional was found to be significant

Table 4. 260 StatSig re: Safety of GB in Shower Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	5.13	1.11	0.28	
After Walkthrough	15	5.80	0.40	0.10	13 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.670	(-1.290, -0.050)			
	T Value	DF	P-Value		
	-2.26	19	0.036		

4.3.7 Impact of Walkthrough on Perceptions of a Taller (Comfort Height) Toilet

Q62 If you were told to ***add a taller toilet*** in your home, how confident do you think you would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the level of comfort toileting, and level of safety provided by the ***taller toilet***?

Table 4. 261 Confidence of AI in Taller (Comfort Height) Toilet Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.43	1.64	2.70	35
2	Constructability	1.00	6.00	4.86	1.51	2.29	36
3	Level of comfort of the taller toilet	1.00	6.00	4.86	1.37	1.89	33
4	Level of safety provided by the taller toilet	1.00	6.00	4.92	1.44	2.08	36

Q84 If you were shown a walk through of your home with a ***higher toilet***, how confident do you think they would you be in the attractiveness, the constructability, the level of comfort and the level of safety of the ***higher toilet***?

Table 4. 262 Confidence of AI in Taller (CH) Toilet After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.43	1.71	2.91	30
2	Constructability	1.00	6.00	5.19	1.33	1.77	31
3	Level of comfort provided by the higher toilet	1.00	6.00	5.13	1.33	1.78	30
4	Level of safety provided by the higher toilet	1.00	6.00	4.90	1.47	2.16	30

Statistical significance of the attractiveness of taller (comfort height) toilet from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 263 StatSig re: Attractiveness of Taller (CH) Toilet Before and After WT by AI

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	35	4.43	1.64	0.28	
After Walkthrough	30	4.43	1.71	0.31	0 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.000	(-0.835, 0.835)			
	T Value	DF	P-Value		
	0.00	60	1.00		

Statistical significance of the constructability of a taller (comfort height) toilet from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 264 StatSig re: Constructability of Taller (CH) Toilet Before and After WT by AI

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	36	4.86	1.51	0.25	
After Walkthrough	31	5.19	1.33	0.24	7 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.330	(-1.023, 0.363)			
	T Value	DF	P-Value		
	-0.95	64	0.345		

Statistical significance of the ease of use of a taller (comfort height) toilet from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 265 StatSig re: Ease of Use of Taller (CH) Toilet Before and After WT by AI

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	33	4.86	1.37	0.24	
After Walkthrough	30	5.13	1.33	0.24	6 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.270	(-0.951, 0.411)			
	T Value	DF	P-Value		
	-0.79	60	0.431		

Statistical significance of the safety of a taller (comfort height) toilet from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 266 StatSig re: Safety of Taller (CH) Toilet Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	33	4.92	1.44	0.25	
After Walkthrough	30	4.90	1.47	0.27	- 0 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.020	(-0.715, 0.755)			
	T Value	DF	P-Value		
	0.05	60	0.957		

Q62 If your friend or family member were told to ***add a taller toilet*** in his/her home, how confident do you think you would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the level of comfort toileting, and level of safety provided by the ***taller toilet***?

Table 4. 267 Confidence of FF in Taller (CH) Toilet Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.30	1.66	2.74	30
2	Constructability	2.00	6.00	5.00	1.14	1.31	29
3	Level of comfort of the taller toilet	2.00	6.00	4.92	1.38	1.92	26
4	Level of safety provided by the taller toilet	2.00	6.00	5.14	1.14	1.29	29

Q84 If your friend or family member were shown a walk through of his/her home with a ***higher toilet***, how confident do you think they would you be in the attractiveness, the constructability, the level of comfort and the level of safety of the ***higher toilet***?

Table 4. 268 Confidence of FF in Taller (Comfort Height) Toilet After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	5.07	1.30	1.70	27
2	Constructability	1.00	6.00	5.29	1.31	1.70	28
3	Level of comfort provided by the higher toilet	1.00	6.00	5.25	1.303	1.69	28
4	Level of safety provided by the higher toilet	1.00	6.00	5.11	1.31	1.73	27

Statistical significance of the attractiveness of a taller (comfort height) toilet from the perspective of a friend or family member was found to be significant

Table 4. 269 StatSig re: Attractiveness of Taller (CH) Toilet Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	30	4.30	1.66	0.30	
After Walkthrough	27	5.07	1.30	0.25	18 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.770	(-1.558, 0.018)			
	T Value	DF	P-Value		
	-1.96	54	0.055		

Statistical significance of the constructability of a taller (comfort height) toilet from the perspective of a friend or family member was found to be not significant

Table 4. 270 StatSig re: Constructability of Taller (CH) Toilet Before and After WT by FF

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	5.00	1.21	0.22	
After Walkthrough	28	5.29	1.31	0.25	6 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.290	(-0.960, 0.380)			
	T Value	DF	P-Value		
	-0.87	54	0.326		

Statistical significance of the ease of use of a taller (comfort height) toilet from the perspective of a friend or family member was found to be not significant

Table 4. 271 StatSig re: Ease of Use of Taller (CH) Toilet Before and After WT by FF

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	26	4.92	1.38	0.27	
After Walkthrough	28	5.25	1.30	0.25	7 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.330	(-1.064, 0.404)			
	T Value	DF	P-Value		
	-0.90	51	0.371		

Statistical significance of the safety of a taller (comfort height) toilet from the perspective of a friend or family member was found to be not significant

Table 4. 272 StatSig re: Safety of Taller (CH) Toilet Before and After WT by FF

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	29	5.14	1.14	0.21	
After Walkthrough	27	5.11	1.31	0.25	- 0 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.030	(-0.631, 0.691)			
	T Value	DF	P-Value		
	0.09	51	0.928		

Q63 If you were to use your standard method of communicating design suggestions to a client to recommend ***adding a taller toilet*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the level of comfort toileting, and level of safety provided by the ***taller toilet***?

Table 4. 273 Confidence of DP in Taller (CH) Toilet Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	5.11	1.31	1.73	27
2	Constructability	3.00	6.00	5.41	1.03	1.06	27
3	Level of comfort of the taller toilet	3.00	6.00	5.32	1.00	1.00	28
4	Level of safety provided by the taller toilet	3.00	6.00	5.33	1.05	1.11	27

Q85 If you were able to show your client a walk through of his/her home with a ***higher toilet***, how confident do you think they would you be in the attractiveness, the constructability, the level of comfort and the level of safety of the ***higher toilet***?

Table 4. 274 Confidence of DP in Taller (CH) Toilet After the Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	5.58	0.93	0.86	26
2	Constructability	2.00	6.00	5.41	0.99	0.98	27
3	Level of comfort provided by the higher toilet	2.00	6.00	5.48	1.00	0.99	27
4	Level of safety provided by the higher toilet	2.00	6.00	5.22	1.26	1.58	27

Statistical significance of the attractiveness of a taller (comfort height) toilet from the perspective of a design professional was found to be not significant

Table 4. 275 StatSig re: Attractiveness of Taller (CH) Toilet Before and After WT by DP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	5.11	1.31	0.25	
After Walkthrough	26	5.58	0.93	0.18	9 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.470	(-1.096, 0.156)			
	T Value	DF	P-Value		
	-1.51	46	0.138		

Statistical significance of the constructability of a taller (comfort height) toilet from the perspective of a design professional was found to be not significant

Table 4. 276 StatSig re: Constructability of Taller (CH) Toilet Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	5.41	1.03	0.20	
After Walkthrough	26	5.41	0.99	0.19	0 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.000	(-0.557, 0.557)			
	T Value	DF	P-Value		
	0.00	50	1.000		

Statistical significance of the ease of use of a taller (comfort height) toilet from the perspective of a design professional was found to be not significant

Table 4. 277 StatSig re: Ease of Use of Taller (CH) Toilet Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	5.32	1.00	0.19	
After Walkthrough	26	5.48	1.00	0.20	3 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.160	(-0.712, 0.392)			
	T Value	DF	P-Value		
	-0.58	50	0.563		

Statistical significance of the safety of a taller (comfort height) toilet from the perspective of a design professional was found to be not significant

Table 4. 278 StatSig re: Safety of Taller (CH) Toilet Before and After WT by DP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	5.33	1.05	0.20	
After Walkthrough	26	5.22	1.26	0.25	- 2%
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.110	(-0.532, 0.752)			
	T Value	DF	P-Value		
	0.34	48	0.732		

Q63 If you were to use your standard method of communicating design suggestions to a client to recommend ***adding a taller toilet*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the level of comfort toileting, and level of safety provided by the ***taller toilet***?

Table 4. 279 Confidence of CP in Taller (CH) Toilet Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.54	1.34	1.79	13
2	Constructability	3.00	6.00	5.41	1.03	2.03	143
3	Level of comfort of the taller toilet	3.00	6.00	5.32	1.00	1.84	14
4	Level of safety provided by the taller toilet	3.00	6.00	5.33	1.05	1.46	13

Q85 If you were able to show your client a walk through of his/her home with a ***higher toilet***, how confident do you think they would you be in the attractiveness, the constructability, the level of comfort and the level of safety of the ***higher toilet***?

Table 4. 280 Confidence of CP in Taller (CH) Toilet After the Walkthrough

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	5.23	1.12	1.25	13
2	Constructability	3.00	6.00	5.08	1.21	1.46	13
3	Level of comfort provided by the higher toilet	3.00	6.00	4.92	1.21	1.46	13
4	Level of safety provided by the higher toilet	3.00	6.00	4.92	1.27	1.61	13

Statistical significance of the attractiveness of a taller (comfort height) toilet from the perspective of a construction professional was found to be not significant

Table 4. 281 StatSig re: Attractiveness of Taller (CH) Toilet Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	13	4.54	1.34	0.37	
After Walkthrough	13	5.23	1.12	0.31	15%
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.690	(-1.692, 0.312)			
	T Value	DF	P-Value		
	-1.42	23	0.168		

Statistical significance of the constructability of a taller (comfort height) toilet from the perspective of a construction professional was found to be not significant

Table 4. 282 StatSig re: Constructability of Taller (CH) Toilet Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	5.41	1.03	0.28	
After Walkthrough	13	5.08	1.21	0.34	- 6%
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.330	(-0.568, 1.228)			
	T Value	DF	P-Value		
	0.76	23	0.455		

Statistical significance of the ease of use of a taller (comfort height) toilet from the perspective of a construction professional was found to be not significant

Table 4. 283 StatSig re: Ease of Use of Taller (CH) Toilet Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	5.32	1.00	0.27	
After Walkthrough	13	4.92	1.21	0.34	- 8 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.440	(-0.487, 1.287)			
	T Value	DF	P-Value		
	0.93	23	0.361		

Statistical significance of the safety of a taller (comfort height) toilet from the perspective of a construction professional was found to be not significant

Table 4. 284 StatSig re: Safety of Taller (CH) Toilet Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	13	5.33	1.05	0.29	
After Walkthrough	13	4.92	1.61	0.45	- 8 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.410	(-0.702, 1.522)			
	T Value	DF	P-Value		
	0.77	20	0.451		

Q63 If you were to use your standard method of communicating design suggestions to a client to recommend ***adding a taller toilet*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the level of comfort toileting, and level of safety provided by the ***taller toilet***?

Table 4. 285 Confidence of HCP in Taller (CH) Toilet Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	4.25	1.20	1.44	16
2	Constructability	4.00	6.00	5.25	0.83	0.69	16
3	Level of comfort of the taller toilet	3.00	6.00	5.06	0.90	0.81	16
4	Level of safety provided by the taller toilet	4.00	6.00	5.27	0.85	0.73	16

Q85 If you were able to show your client a walk through of his/her home with a ***higher toilet***, how confident do you think they would you be in the attractiveness, the constructability, the level of comfort and the level of safety of the ***higher toilet***?

Table 4. 286 Confidence of HCP in Taller (CH) Toilet After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	5.07	0.93	0.86	15
2	Constructability	4.00	6.00	5.27	0.85	0.73	15
3	Level of comfort provided by the higher toilet	4.00	6.00	5.40	0.71	0.51	15
4	Level of safety provided by the higher toilet	2.00	6.00	5.40	1.08	1.17	15

Statistical significance of the attractiveness of a taller (comfort height) toilet from the perspective of a health care professional was found to be significant

Table 4. 287 StatSig re: Attractiveness of Taller (CH) Toilet Before and After WT by HCP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	4.25	1.20	0.30	
After Walkthrough	15	5.07	0.93	0.24	19 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.820	(-1.607, 0.033)			
	T Value	DF	P-Value		
	-2.13	28	0.042		

Statistical significance of the constructability of a taller (comfort height) toilet from the perspective of a health care professional was found to be not significant

Table 4. 288 StatSig re: Constructability of Taller (CH) Toilet Before and After WT by HCP

Two sample T- test and CI				
	Descriptive Statistics			
	N	Mean	StDev	Se Mean
Before Walkthrough	16	5.25	0.83	0.21
After Walkthrough	15	5.27	0.85	0.22
	Estimation for Difference			
	Difference	95% CI for Difference		
	-0.020	(-0.639, 0.599)		
	T Value	DF	P-Value	
	-0.07	28	0.948	

Statistical significance of the ease of use of a taller (comfort height) toilet from the perspective of a health care professional was found to be not significant

Table 4. 289 StatSig re: Ease of Use of Taller (CH) Toilet Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	5.25	0.83	0.21	
After Walkthrough	15	5.27	0.85	0.22	0 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	0.020	(-0.639, 0.599)			
	T Value	DF	P-Value		
	-0.07	28	0.948		

Statistical significance of the safety of a taller (comfort height) toilet from the perspective of a health care professional was found to be not significant

Table 4. 290 StatSig re: Safety of Taller (CH) Toilet Before and After WT by HCP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	16	5.27	0.85	0.21	
After Walkthrough	15	5.40	1.08	0.28	2 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.130	(-0.851, 0.591)			
	T Value	DF	P-Value		
	-0.37	26	0.714		

Table 4. 291 StatSig re: Safety of Taller (CH) Toilet Before and After WT by CP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	4.26	1.43	0.28	
After Walkthrough	26	5.00	1.04	0.20	17 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.740	(-1.429, -0.51)			
	T Value	DF	P-Value		
	-2.16	47	0.036		

4.3.8 Impact of Walkthrough on Perceptions of a Smart Toilet

Q64 If you were verbally told to ***add a smart toilet*** in your home, how confident do you think you would be in the attractiveness, the ability of a contractor to successfully install it (constructability /buildability), the support of cleansing, and the level of safety provided by the ***smart toilet***? A smart toilet is one which adds the cleansing functions of a bidet to the flushing functions of a standard toilet.

Table 4. 292 Confidence of AI in Smart Toilet Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.22	1.75	3.06	36
2	Constructability	1.00	6.00	4.65	1.36	1.85	37
3	Support of the cleansing aspect to the toileting activity of daily living	1.00	6.00	4.47	1.82	3.30	36
4	Level of safety provided by smart toilet	1.00	6.00	4.47	1.71	2.92	36

Q86 If you were shown a walkthrough of your home with a smart toilet installed in the primary bathroom, how confident do you would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the support of cleansing, and level of safety provided by the ***smart toilet***?

Table 4. 293 Confidence of AI in Smart Toilet After WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.45	1.65	2.73	29
2	Constructability	2.00	6.00	5.07	1.12	1.26	30
3	Support of the cleansing aspect to the toileting activity of daily living	1.00	6.00	4.86	1.59	2.53	29
4	Level of safety provided by smart toilet	1.00	6.00	4.89	1.37	1.88	28

Statistical significance of the attractiveness of smart toilet from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 294 StatSig re: Attractiveness of Smart Toilet Before and After WT by AI

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	4.26	1.43	0.28	
After Walkthrough	26	5.00	1.04	0.20	17 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.740	(-1.429, -0.51)			
	T Value	DF	P-Value		
	-2.16	47	0.036		

Statistical significance of the constructability of a smart toilet from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. Statistical significance of the constructability of a smart toilet from the perspective of a person interested in aging in place for themselves

. Table 4. 295 StatSig re: Constructability of Smart Toilet Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	4.26	1.43	0.28	
After Walkthrough	26	5.00	1.04	0.20	17 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.740	(-1.429, -0.51)			
	T Value	DF	P-Value		
	-2.16	47	0.036		

Statistical significance of the ease of use of a smart toilet from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 296 StatSig re: Ease of Use of Smart Toilet Before and After WT by AI

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	4.26	1.43	0.28	
After Walkthrough	26	5.00	1.04	0.20	17 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.740	(-1.429, -0.51)			
	T Value	DF	P-Value		
	-2.16	47	0.036		

Statistical significance of the safety of a smart toilet from the perspective of a person interested in aging in place for themselves was found to be not significant

Table 4. 297 StatSig re: Safety of Smart Toilet Before and After WT by AI

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	4.26	1.43	0.28	
After Walkthrough	26	5.00	1.04	0.20	17 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.740	(-1.429, -0.51)			
	T Value	DF	P-Value		
	-2.16	47	0.036		

Q64 If your friend or family member were verbally told to ***add a smart toilet*** in his/her home, how confident do you think you would be in the attractiveness, the ability of a contractor to successfully install it (constructability /buildability), the support of cleansing, and the level of safety provided by the ***smart toilet***? A smart toilet is one which adds the cleansing functions of a bidet to the flushing functions of a standard toilet.

Table 4. 298 Confidence of FF in Smart Toilet Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.61	1.54	2.38	28
2	Constructability	1.00	6.00	4.61	1.42	2.02	28
3	Support of the cleansing aspect to the toileting activity of daily living	1.00	6.00	4.70	1.36	1.84	27
4	Level of safety provided by smart toilet	1.00	6.00	4.26	1.43	2.04	27

Q86 If you were shown a walkthrough of your friend or family members' home with a smart toilet installed in the primary bathroom, how confident do you would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the support of cleansing, and level of safety provided by the ***smart toilet***?

Table 4. 299 Confidence of FF in Smart Toilet After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	5.04	1.29	1.65	26
2	Constructability	1.00	6.00	5.35	1.21	1.46	26
3	Support of the cleansing aspect to the toileting activity of daily living	1.00	6.00	5.00	1.24	1.54	26
4	Level of safety provided by smart toilet	3.00	6.00	5.00	1.04	1.08	26

Statistical significance of the attractiveness of a smart toilet from the perspective of a friend or family member was found to be not significant

Table 4. 300 StatSig re: Attractiveness of Smart Toilet Before and After WT by FF

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	28	4.61	1.54	0.29	
After Walkthrough	26	5.04	1.29	0.25	9 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.740	(-1.429, -0.51)			
	T Value	DF	P-Value		
	-1.12	51	0.270		

Statistical significance of the constructability of smart toilet from the perspective of a friend or family member was found to be significant

Table 4. 301 StatSig re: Constructability of a Smart Toilet Before and After WT by FF

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	28	4.61	1.42	0.27	
After Walkthrough	26	5.35	1.21	0.24	16 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.740	(-1.429, -0.021)			
	T Value	DF	P-Value		
	-2.07	51	0.044		

Statistical significance of the Effectiveness of a smart toilet from the perspective of a friend or family member was found to be not significant

Table 4. 302 StatSig re: Effectiveness of a Smart Toilet Before and After WT by FF

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	4.70	1.36	0.26	
After Walkthrough	26	5.00	1.04	0.20	6 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.300	(-0.967, 0.367)			
	T Value	DF	P-Value		
	-0.90	48	0.370		

Statistical significance of the safety of a smart toilet from the perspective of a friend or family member was found to be significant

Table 4. 303 StatSig re: Safety of Smart Toilet Before and After WT by FF

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	27	4.26	1.43	0.28	
After Walkthrough	26	5.00	1.04	0.20	17 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.740	(-1.429, -0.051)			
	T Value	DF	P-Value		
	-2.16	47	0.036		

Q65 If you were to use your standard method of communicating design suggestions to a client to recommend ***adding a smart toilet*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability /buildability), the support of cleansing, and the level of safety provided by the ***smart toilet***? A smart toilet is one which adds the cleansing functions of a bidet to the flushing functions of a standard toilet.

Table 4. 304 Confidence of DP in Smart Toilet Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	3.00	6.00	4.88	1.15	1.33	26
2	Constructability	3.00	6.00	5.07	1.15	1.33	27
3	Support of the cleansing aspect to the toileting activity of daily living	2.00	6.00	4.77	1.19	1.41	26
4	Level of safety provided by smart toilet	2.00	6.00	4.50	1.28	1.63	26

Q87 If you were able to show your client a walkthrough of his/her home with a smart toilet installed in the primary bathroom, how confident do you think the client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the support of cleansing, and level of safety provided by the ***smart toilet***?

Table 4. 305 Confidence of DP in Smart Toilet After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	2.00	6.00	5.27	1.19	1.43	26
2	Constructability	2.00	6.00	5.37	0.95	0.90	27
3	Support of the cleansing aspect to the toileting activity of daily living	2.00	6.00	4.81	1.33	1.78	27
4	Level of safety provided by smart toilet	2.00	6.00	4.74	1.38	1.90	27

Statistical significance of the attractiveness of a smart toilet from the perspective of a design professional was found to be not significant

Table 4. 306 StatSig re Attractiveness of Smart Toilet Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	26	4.88	1.15	0.23	
After Walkthrough	26	5.27	1.19	0.23	8 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.390	(-1.042, -0.262)			
	T Value	DF	P-Value		
	-1.20	49	0.235		

Statistical significance of the constructability of a smart toilet from the perspective of a design professional was found to be not significant

Table 4. 307 StatSig re: Effectiveness of Smart Toilet Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	26	4.88	1.15	0.23	
After Walkthrough	26	5.27	1.19	0.23	8 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.390	(-1.042, -0.262)			
	T Value	DF	P-Value		
	-1.20	49	0.235		

Statistical significance of the cleansing aspect to the toileting activity of daily living of a smart toilet seat from the perspective of a design professional was found to be not significant

Table 4. 308 StatSig re: Effectiveness of Smart Toilet Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
Sample	N	Mean	StDev	Se Mean	
Before Walkthrough	26	4.88	1.15	0.23	
Sample After Walkthrough	26	5.27	1.19	0.23	8 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.390	(-1.042, -0.262)			
	T Value	DF	P-Value		
	-1.20	49	0.235		

Statistical significance of the safety of a smart toilet from the perspective of a design professional was found to be not significant

Table 4. 309 StatSig re: Safety of Smart Toilet Before and After WT by DP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
Sample	N	Mean	StDev	Se Mean	
Before Walkthrough	26	4.88	1.15	0.23	
Sample After Walkthrough	26	5.27	1.19	0.23	8 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.390	(-1.042, -0.262)			
	T Value	DF	P-Value		
	-1.20	49	0.235		

Q65 If you were to use your standard method of communicating design suggestions to a client to recommend ***adding a smart toilet*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability /buildability), the support of cleansing, and the level of safety provided by the ***smart toilet***? A smart toilet is one which adds the cleansing functions of a bidet to the flushing functions of a standard toilet.

Table 4. 310 Confidence of CP on a Smart Toilet Before the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.36	1.44	2.09	14
2	Constructability	1.00	6.00	4.36	1.54	2.37	14
3	Support of the cleansing aspect to the toileting activity of daily living	1.00	6.00	4.71	1.48	2.20	14
4	Level of safety provided by smart toilet	1.00	6.00	4.50	1.50	2.25	14

Q87 If you were able to show your client a walkthrough of his/her home with a smart toilet installed in the primary bathroom, how confident do you think the client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the support of cleansing, and level of safety provided by the ***smart toilet***?

Table 4. 311 Confidence of CP in Smart Toilet After the WT

#	Field	Min	Max	Mean	Std Deviation	Variance	Count
1	Attractiveness	1.00	6.00	4.77	1.48	2.18	13
2	Constructability	3.00	6.00	5.46	0.93	0.86	13
3	Support of the cleansing aspect to the toileting activity of daily living	1.00	6.00	4.69	1.54	2.37	13
4	Level of safety provided by smart toilet	1.00	6.00	4..62	1.64	2.70	13

Statistical significance of the attractiveness of a smart toilet from the perspective of a construction professional was found to be significant

Table 4. 312 StatSig re: Attractiveness of a Smart Toilet Before and After WT by CP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	4.36	1.54	0.41	
After Walkthrough	13	5.46	0.93	0.26	25 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.100	(-2.110, -0.090)			
	T Value	DF	P-Value		
	-2.26	21	0.034		

Statistical significance of the constructability of a smart toilet from the perspective of a construction professional was found to be significant

Table 4. 313 StatSig re: Constructability of Smart Toilet Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	4.36	1.54	0.41	
After Walkthrough	13	5.46	0.93	0.26	25 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-1.100	(-2.110, 0.090)			
	T Value	DF	P-Value		
	-2.26	21	0.034		

Statistical significance of the ease of use of a smart toilet from the perspective of a construction professional was found to be not significant

Table 4. 314 StatSig re: Effectiveness of Smart Toilet Before and After WT by DP

	Two sample T- test and CI				% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	14	4.71	1.48	0.40	
After Walkthrough	13	4.69	0.54	0.43	0 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.020	(-1.181, 1.221)			
	T Value	DF	P-Value		
	0.03	24	0.973		

Statistical significance of the safety of a smart toilet from the perspective of a construction professional was found to be not significant

Table 4. 315 StatSig re: Safety of Smart Toilet Before and After WT by DP

Two sample T- test and CI					% of Change
	Descriptive Statistics				
	N	Mean	StDev	Se Mean	
Before Walkthrough	26	4.50	1.28	0.25	
After Walkthrough	27	4.74	1.38	0.27	5 %
	Estimation for Difference				
	Difference	95% CI for Difference			
	-0.240	(-0.974, -0.494)			
	T Value	DF	P-Value		
	-0.66	50	0.514		

4.4 Impact Charts

Most influenced by the walk through (number of areas where there is a statistical difference between the mean confidence level before and after viewing the walk through are indicated by "yes" on the charts below)

Friends and Family = 16

Construction Professionals = 5

Health Care Professionals = 5

Aging Individuals = 3

Design Professionals = 2

Table 4. 316 Impact on Aging Individuals

Aging Individuals = 3 YES	Attractive	Constructible	Functional	Safe
Wider Doorways	yes			Yes
Wider Hallways				
Handrails	yes			
Ramp				
Walk in Shower				
Grab Bars Toilet				
Grab Bars Shower				
Comfort Height Toilet				
Smart Toilet				

Table 4. 317 Impact on Friends and Family Members

Friend &Family Members = 16 YES	Attractive	Constructible	Functional	Safe
Wider Doorways	Yes	Yes	Yes	Yes
Wider Hallways	yes	Yes	Yes	
Handrails				
Ramp				
Walk in Shower	yes			
Grab Bars Toilet	yes	Yes	Yes	Yes
Grab Bars Shower	yes			
Comfort Height Toilet	yes			
Smart Toilet		Yes		Yes

Table 4. 318 Impact on Design Professionals

Design Professionals = 2 YES	Attractive	Constructible	Functional	Safe
Wider Doorways				
Wider Hallways	yes	Yes		
Handrails				
Ramp				
Walk in Shower				
Grab Bars Toilet				
Grab Bars Shower				
Comfort Height Toilet				
Smart Toilet				

Table 4. 319 Impact on Construction Professionals

Construction Professionals = 5 Yes	Attractive	Constructible	Functional	Safe
Wider Doorways	Yes			
Wider Hallways	Yes	Yes		
Handrails	Yes			
Ramp				
Walk in Shower				
Grab Bars Toilet				
Grab Bars Shower				
Comfort Height Toilet				
Smart Toilet		Yes		

Table 4. 320 Impact on Health Care Professionals

Heath Care Professionals = 5 YES	Attractive	Constructible	Functional	Safety
Wider Doorways				
Wider Hallways				
Handrails	Yes			
Ramp				
Walk in Shower	yes			
Grab Bars Toilet				
Grab Bars Shower			Yes	Yes
Comfort Height Toilet			Yes	
Smart Toilet				

Table 4. 321 Attractiveness

	AI	F&F	DP	CP	HCP
Wider Doorways	N	Y	N	N	N
Wider Hallways	N	Y	N	N	N
Handrails	N	N	N	N	N
Ramp	N	N	N	N	N
Walk in Shower	N	y	N	N	N
Grab Bars Toilet	N	Y	Y	N	N
Grab Bars Shower	N	N	N	N	Y
Comfort Height Toilet	N	N	N	N	Y
Smart Toilet	N	N	N	N	NA

Table 4. 322 Constructability

	AI	F&F	DP	CP	HCP
Wider Doorways	N	Y	N	N	N
Wider Hallways	N	Y	Y	Y	N
Handrails	N	N	N	N	N
Ramp	N	N	N	N	N
Walk in Shower	N	N	N	N	N
Grab Bars Toilet	N	Y	Y	N	N
Grab Bars Shower	N	N	N	N	N
Comfort Height Toilet	N	N	N	N	N
Smart Toilet	N	Y	N	Y	NA

Table 4. 323 Ease of Use

	AI	F&F	DP	CP	HCP
Wider Doorways	N	Y	N	N	N
Wider Hallways	N	Y	N	N	N
Handrails	N	N	N	N	N
Ramp	N	N	N	N	N
Walk in Shower	N	N	N	N	N
Grab Bars Toilet	N	Y	N	N	N
Grab Bars Shower	N	N	N	N	Y
Comfort Height Toilet	N	N	N	N	Y
Smart Toilet	N	N	N	N	NA

Table 4. 324 Safety

	AI	F&F	DP	CP	HCP
Wider Doorways	Y	Y	N	N	N
Wider Hallways	N	N	N	N	N
Handrails	N	N	N	N	N
Ramp	N	N	N	N	N
Walk in Shower	N	N	N	N	N
Grab Bars Toilet	N	Y	N	N	N
Grab Bars Shower	N	N	N	N	Y
Comfort Height Toilet	N	N	N	N	N
Smart Toilet	N	Y	N	N	NA

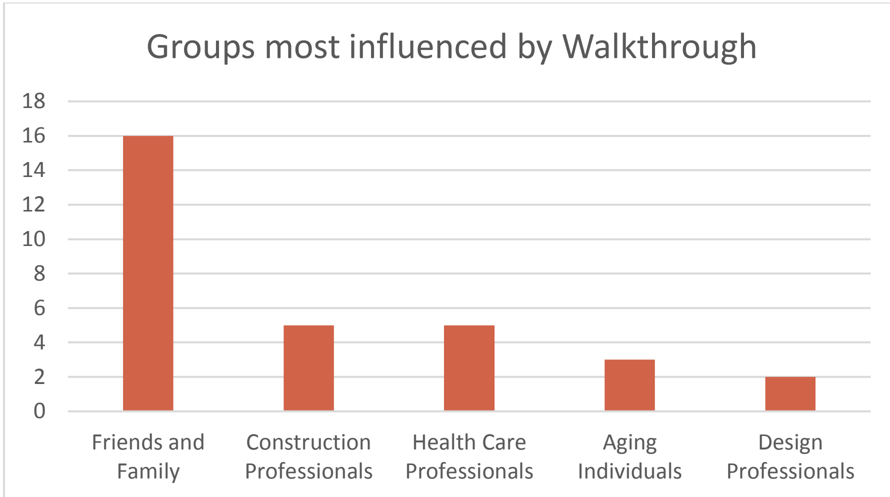


Figure 4.1 Groups Most Influenced by WT

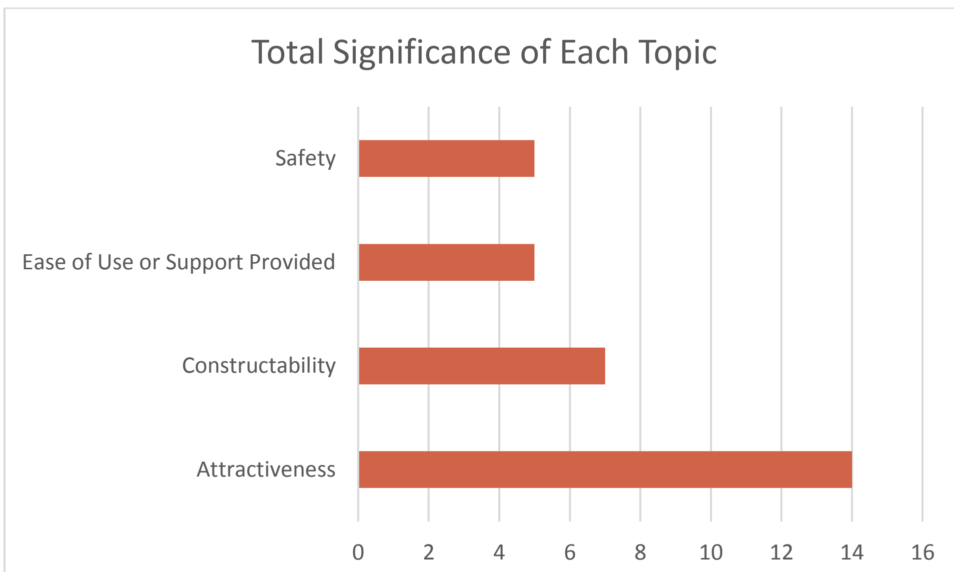


Figure 4. 1 Total Significance of Each Topic

4.5 Qualitative Analysis

Thematic analysis was used to analyze the collected qualitative data. Analysis began with themes reflecting the variables queried in the study, attractiveness, constructability, funtionality and safety. Affordability, ADA, and Denial were added as they came up frequently in the comments. Comments found in each theme were then coded to find sub catergories of the main themes as they emerged.

4.5.1 Attractiveness

Concern for the attractiveness of home modifications did not come up as often as expected. Respondents did comment on the stigma associated with many aging in place modifications. One respondent shared “there is a stigma with aging in place because the modifications are thought to be outdated/old looking”. The comment went on to praise the ability of the walkthrough to demonstrate the modifications in a more modern or updated space which made the viewer barely notice the added modifications. A design professional commented that “major manufacturers and home improvement showrooms need to display and advertise these modifications in attractive surroundings. The design professionals felt that would assist designers by providing actual products to show clients as well as serving to make the modifications more mainstream and thus more acceptable to the general public.

4.5.2 Constructability

Concern regarding constructability was also not as prevalent as anticipated. Primary concerns centered around issues which would potentially be very difficult to remedy, such as no bathroom or bedroom on the main level of the home and a basement laundry room. Several respondents commented that due to an already limited space, it would be very difficult to widen doorways or hallways of even to add grab bars. Other respondents mentioned the opposite problem, that of stairways and hallways that were too wide to allow the user to reach out for support on both sides.

4.5.3 Functionality

Functionality was mentioned regarding many components which cause concern such as cabinets and mailboxes which were difficult to reach. Lighting to support failing vision was mentioned as well as inadequate shower heads and unsafe or difficult to use appliances. Being able to participate in activities of daily living such as preparing meals and performing personal care duties was mentioned. In line with personal care, most often mentioned were hazards regarding bathing or showering, primarily missing or inadequate grab bars of difficult to access fixtures.

4.5.4 Safety

Falling was my far the most mentioned fear when it came to the safety of the home environment. Stairs were thought to be the biggest hazard but tripping and a lack of grab bars on a single level was also frequently mentioned. Respondents also mentioned security concerns and a lack of social support which could enable an aging person to call for help if needed and experience a quick response. Inadequate lighting was also mentioned as a safety hazard, particularly navigating through a dark house at night.

4.5.5 Affordability

Concern regarding affordability was also not as frequently mentioned as anticipated. However, many health care professionals mentioned it as a deal breaker for many of their clients who simple do not have the funds to make needed modifications. We were told by one of our health care respondents, “I work in a lower-income area where many of my patients are on a fixed income. Most of the suggestions I make about home modifications fall on deaf ears because they don’t have the money to make modifications. Grab bars, toilet bars, a temporary ramp, stair rails, and shower chair or bench are the ones we often suggest and are the most likely to get done."

4.5.6 Americans with Disabilities Act (ADA)

Several respondents mentioned issues which support the stance that often modifications required by various codes and standards for commercial spaces are not always indicated for those aging in place. One member of the friends and family group shared "While I think wider hallways would be helpful for a person who uses a wheelchair or walker, my mom is able to walk and I would fear she might not be able to catch herself if she were to trip in a wider hallway." Another family member made a similar comment regarding wider doorways. We heard, "For example, my father used his standard doorway to 'prop' himself up to get dressed (preferred to maintain integrity of independence, refusing help). So wider doorways might have been more 'manageable' to maneuver a walker but in his case, the later was preferred". Several other respondents mentioned, because there was no wheelchair being used, there was no reason for a ramp or wider doorway and wider hallways.

4.5.7 Denial

Several respondents mentioned the issue of denial on the part of the aging individual, who simply refuses to accept the idea that he or she may need additional accommodations due to their age and resulting physical limitations. We were told by a family member, "I feel the 'denial' aspect is such a strong obstacle. It has been virtually impossible for me to convince my mother-in-law to plan more space in her bathroom and kitchen and she is specifically designing/building a new house for aging in place. She insists she is different and won't need more space around a toilet or ever must wheel into a shower. I couldn't even convince her to make her doors wider.

She says she is fine just removing all her doors and stops to make the openings wide enough for a wheelchair if she were ever to need one."

4.6 Comments by Group Type

4.6.1 Comments by Persons Interested in Aging in Place Themselves

Figure 4.1 Comments from Those Interested in Aging in Place for Themselves

Those persons who indicated they were interested in aging in place themselves shared comments across the analyzed themes, with none found dominant over any of the others. Seventy six percent of this group are female, with twenty four percent being male. Every age group was represented but 52 percent came from the age group of 51 to 65 years old with an additional 32 percent representing those 66 to 80 years old.

“Expense would be crippling”

“I feel the shower head was really far away from the seat which may make it difficult for an aging individual to shower.”

“I live in a one story home on a slab with hallways and doorways that would be qite expensive to modify without compromising the integrety of the structure.”

4.6.2 Comments by Friends and Family Members

Figure 4.2 Friends and Family Members’ Comments

“Social constructs of some family members, recogintion of what may be needed.”

“Already has walk in shower with handrails.”

“She is short so a taller toilet might be dangerous.”

“Making wider doors would not fit in the home.”

“Taller/smart toilets may work.”

“Grapbars in the shower would limit the space which seems small already.”

“I think that the concerns will be minimized if properly addressed.”

“While I think wider hallways would be helpful for a person who uses a wheelchair or walker, my mom is able to walk and I would fear she might not be able to catch herself if she were to trip in a wider hallway.”

“Some people aging in place would/do feel that they are not aging and would refuse to get these modifications to their home.”

“It would be great if today’s home construction automatically included the aging in place features. Unfortunately, some homes, especially the traditional hallways, would be too hard (or expensive, to modify after original construction.”

“I think it is a great tool.”

“She lives in a manufactured home, so construction is limited. Already has a walk-in shower with handrails. She is short so a taller toilet might be dangerous.”

“One additional note…. I’ve learned through my elderly family’s conditions (Alzheimer’s/Parkinson’s) social constructs (family), cost and the disease all play a big role in decisions and/or built environment.”

“Several questions don’t necessarily apply to the clients’ home and clients’ condition. Alzheimer patients are confused. – Consistency is key (space included). -she wouldn’t have opinions on aesthetics, construct ability, etc. no wheelchair bound – not able to understand her disease due to the nature of the home (single story and)”

“These modifications would help my family to age in place along with help from an aide.”

“I feel as though it is important for my family member and myself as I age to have the opportunity to stay in my own home as I age, and I fear the possibility of inaccessibility interfering with that opportunity.”

“My parents could not afford to make the needed modifications, they can add handrails, grab bars, and higher toilets. They should have the uneven steps to their bedroom replaced but won’t due to cost. They are not in wheelchairs so do not need ramps and wider doors.”

“There is a stigma with aging in place because the modifications are thought to be outdated/old looking. If you show people there is a modern/updated look and style to an ‘aging in place home’, then people would be more accepting of the idea. As the walkthrough video shows a more modern feel, you barely notice the modifications added to the home.” ☺

“Aside from the question pertaining to the actual survey, I question why all surveys are dismissive of Associate Degree holders, i.e. some college as though completing a two-year degree is only “some college” as though the person only attended a few classes?”

“For example, my father used his standard doorway to ‘prop’ himself up to get dressed (preferred to maintain integrity of independence, refusing help). So wider doorways might have been more ‘manageable’ to maneuver a walker but in his case, the later was preferred. I’m quite passionate about this topic due to personal experiences!”

4.6.3 Comments by Design Professionals

Figure 4. 1 Design Professionals’ Comments

“Having a larger home is not as big of a problem but a small home would restrict many of these suggestions.”

“Major manufacturers and home improvement showrooms need to display and advertise these modifications in attractive surroundings. This helps the design professionals by giving them actual products to show their clients and it makes these modifications more mainstream and therefore acceptable to clients.”

“It’s clear to me the effectiveness and the safety are harder to quantify for clients since it would have to be based on historical numerical proof – statistics which, to my knowledge to not have a long history of proof.”

“Before any of these questions can be addressed, it must be known if the existing structure has enough space to allow modifications. Ex. A 36” wide corridor will not allow more than a 2’*” door at the end of it.”

“Many homes are already so tightly planned, that it would be very difficult to make an existing bathroom accessible or wide hallway without severely impacting the function of adjacent areas in the home. I answered the above questions as if we were talking about renovating an existing home.”

“It has been my experience that denial is the biggest factor. Most people don’t want to act until the need is there then it is too late to do everything properly.”

“Clients have shared their anticipated embarrassment over having a home that looks like they are old or looks like a nursing home.”

“If the home was in an older community it might have a greater resale value.”

“Widening hallways make other room smaller” ….

“Grab bars are not aesthetically pleasing in a home.”

“Just how wide is a wider doorway?”

“These items can be beneficial and even appealing to some, but the cost is high.”

“The hidden costs of reinforcing walls and other areas are high.”

“A ramp at the front door is not always possible and a good ramp takes up a lot of real estate.”

“While I think a 3D, walkthrough is helpful for clients to better visualize how their new space can look most are not willing to pay for the professionals time needed to produce it. Seeing actual products that can be touched, sat on, walked through, etc. is better in my opinion. “

“I think it is a great tool.”

“I feel the ‘denial’ aspect is such a strong obstacle. It has been virtually impossible for me to convince my mother-in-law to plan more space in her bathroom and kitchen and she is specifically designing/building a new house for aging in place. She insists she is different and won’t need more space around a toilet or ever must wheel into a shower. I couldn’t even convince her to make her doors wider. She says she is fine just removing all her doors and stops to make the openings wide enough for a wheelchair if she were ever to need one.”

“But in for some will be tough but for those that live without and need it may be easier …. Some kickback from the government to help pay for it may make it more appealing. “

“Several questions don’t necessarily apply to the client’s home & client’s condition. Alzheimer patients are confused. Consistency is key (space included). – she wouldn’t have options on aesthetics, construct ability etc. – not wheelchair bound – not able to understand her disease due to the nature of the home (single story and" …CUTS OFF

"Video would not play on my mobile device; sorry I couldn't comment on anything after that."

"Until those modifications are embraced by architects, designers, manufacturers, showrooms as attractive and necessary for the safety of all people, I am afraid they will be difficult to introduce to the aging population."

"Cost for modifications is a factor for most people who are over the age of 65, on a limited budget and the disruption of life during a remodel seems to always be a factor."

4.6.4 Comments by Construction Professionals

Figure 4. 2 Construction Professionals' Comments

"Making wider doors would not fit in the home. Taller/smart toilets may work. Grab bars in the shower would limit the space, which may seem small already."

"My customers don't always seem to understand how things I recommend would look, or how I could make It happen."

"Some people aging in place would/do feel that they are not aging and would refuse to get these modifications to their home."

“My clients would like to see this”

“Making wider doors would not fit in the home.”

“Taller/smart toilets may work.”

“Grapbars in the shower would limit the space which seems small already.”

“My customers don’t always seem to understand how things I recommend would look, or how I could make it happen.”

4.6.5 Comments by Health Care Professionals

Figure 4. 3 Health Care Professionals’ Comments

“The home could be a rental and permanent modifications may not be allowed.”

“Answers are based on the walk through including a person navigating the home with the required mobility device.”

"In our area, ability to pay for needed modifications would be the biggest concern. As a carpenter's wife, I know how hard it is to move doorways and walls while properly supporting the ceiling."

"I work in a lower-income area where many of my patients are on a fixed income. Most of the suggestions I make about home modifications fall on deaf ears because they don't have the money to make modifications. Grab bars, toilet bars, a temporary ramp, stair rails, and shower chair or bench are the ones we often suggest and are the most likely to get done."

"Since I am not a construction consultant, I can't comment on how I think a client would respond to changes made to a house."

"I enjoyed being able to view the walk through as it allowed me to visualize the home. I had a picture in my mind of what I thought it would look like but being able to watch the walk through gave me a clearer picture. "

"I am essentially semi-retired but personally have dealt with the issues brought up in the survey secondary to debilitation back issues that were later surgically resolved. As an OT and CLIPP I was able to select, supervise and guide contractors in the installation of the devices I needed, and the renovation required. I learned a great deal."

"No concerns. Well done"

"My clients often don't understand what I'm telling them to do or have already made up their minds it can't be done."

"I think it would really help convince my clients if they could see their home modifications like this."

"I think all of these ideas and designs are wonderful. I strongly support the concept of allowing the person to stay at home if they are able. My biggest concern is how do you proposed to deliver these services to people on fixed incomes or to those with limited resources? The financial aspect is my biggest concern."

CHAPTER 5. CONCLUSION AND RECOMMENDATION FOR FUTURE STUDIES

5.1 Within the Aging in Place Professional Services Environment

Literature shows Americans want to maintain independence when aging. Those who indicate they are taking the study because they are interested in aging in place for themselves show confidence in their ability it does just that. In contrast, those who identify as having an interest in aging in place for a friend or family member have much less confidence in the ability of their loved one to maintain their independence as they age. Professionals who are committed to supporting the populations' desire to age in place

Professionals committed to supporting the design to age in place include design professionals, such as interior designers and kitchen and bath planners, construction professionals who are building and remodeling homes for aging in place, and health care professionals who are charged with doing home assessments and making recommendations to ensure their patients are safe in their home environment.

5.2 Reflections on findings of this study

This study shows a significant difference in the confidence and the fear that aging individuals and the friends and family members who love them have regarding aging in place. Interior designers and construction professionals working in the aging in place sphere recognize the ideal scenario for the aging population is to age in place independently, with dignity. Much of the work being done on home modifications to support the aging population is being done without the participation of interior designers. Those who are called to work with aging consumers are often challenged to change consumer expectations regarding the creation of safe, healthy homes that don't look like institutional facilities. Current research indicates beautiful new products, including appropriate building systems and safe home technology can empower us, as designers to create spaces which support people staying in the homes they love.

Participants of this study may agree to take the survey while having already decided against remodeling an existing home. Due to the recruitment strategy targeting those with internet access they may be from a higher socio-economic class and potentially not be tuned in to the challenges of less privileged persons. The subject, or model, in the study was a 1970's single family, ranch home located in a Midwestern suburb. Different housing stock would require differently constructed modifications. Comparisons are made in the findings between persons interested in aging in place for themselves and interested friends and family members. Those two groups, in this study are not matched sets. Personal opinions about styles and colors, while not being studied, may influence participants for or against the visualization.

Additional restrictions include that this research is not expected to uncover all the biases of recommended modifications. Any prejudices participants might have about the feasibility of the modifications is not identified. Because participants in both groups had a higher education level than the national average, they may not be applied to the population in general. Participants may have chosen to participate in the study because they have previous experience with the topic or higher than average level of interest.

Codes and standards used to make recommendations for aging in place are often based on the needs of a person using a wheelchair in public spaces, not on the needs of a person with physical limitations typical with aging. Questioning those standards and developing a tool which can filter needs during the information gathering process would position those constructors and other professionals to make recommendations based on the true needs of the aging person, not on inappropriate, and often counter indicated codes and standards.

5.4 Future Studies

- Communicating home modifications with the use of virtual and augmented reality.
- Multi-generational housing and aging in place (section 2.6.4).
- Home assessments – the haves and the have nots.

i.e. low number of participants who have had assessments done. Need to look at the population who has as well to serve those who do not have access to such services.

- Investigate the participation of construction professionals in the home modification process specifically for aging in place. Specifically, to what degree are these professionals creating design solutions and to what degree are they simply following the solutions recommended by others?
- Theory of reasoned action to further explore the findings from this study regarding the fears and confidences of the aging individuals and their friends and family members represented in this study.
- Investigate existing housing stock in various parts of the country. This study looks at appropriate modifications for a midcentury ranch in the midwestern United States, identify common construction types and their layouts to prepare to make appropriate remodeling recommendations.
- Explore the utilization of existing standards being followed by construction professionals when implementing home modifications for aging in place. Investigate the possibility of

developing standards specific to the needs of those with strength and mobility issues rather than only those who are wheelchair users.

- Develop a tool which could enhance the construction, design, and health care professionals' ability to analyze and design appropriate home modifications for aging in place.

APPENDIX A. SURVEY

Utilizing Architectural Visualization Technology To Enhance Confidence in Safe Aging in Place Modifications

Start of Block: Default Question Block

Q1 This study is designed to provide understanding regarding how much confidence people have in recommended home modifications for aging in place when those recommendations are delivered using architectural visualization technology. Aging in place is defined for the purpose of this study as a person living in the residence of their choice for as long as they are able as they age. This includes being able to have any services (or other support) they might need over time as their needs change (ageinplace.com). Members of AARP (American Association of Retired Persons), NAHB (National Association of Home Builders), ASID (American Society of Interior Designers), and AOTA (American Occupational Therapy Association), have been sent the survey from their parent organizations. The survey has also been shared through the investigator's Facebook and LinkedIn accounts. There are minimal risks to you, the participant. No direct benefits are anticipated but your participation will help the researcher find out which communication method inspires the most confidence in persons interested in aging in place, either for themselves or another person. Participation in this survey is entirely voluntary. You may refuse to participate or withdraw from the survey at any time. The survey is expected to take approximately ten to fifteen minutes. You will have the opportunity to write in responses to certain questions to further elaborate on your opinion. No personal information will be collected, and responses will be collated anonymously. If you have any questions, please contact investigator Denise McAllister Wilder by phone at 765.210.8311 or by email at wilder2@purdue.edu OR primary investigator Dr. Emad Elwakil by phone at 765.496.7952 or by email at eelwakil@purdue.edu. This survey is approved through IRB #. By continuing with the study you agree that you have been informed of any associated benefits or risks.

Q2 Are you age 18 or over?

- Yes (5)
- No (6)

Skip To: End of Survey If Are you age 18 or over? = No

Q3 What is your gender?

- Female (1)
- Male (2)
- Prefer not to say (3)

Q4 What is your age group?

- 18 - 25 (1)
- 26 - 34 (2)
- 35 - 50 (3)
- 51 - 65 (4)
- 66 - 80 (5)
- Over 80 (6)

Q5 How would you describe your education level?

- Less than a High School Diploma (1)
- High School Graduate (or GED) (2)
- Some College (3)
- Bachelor's Degree (4)
- Graduate Degree (5)

Q6 What is your role regarding aging in place?

- I am interested in aging in place myself (1)
- I am interested in aging in place for a friend or family member (2)
- I am a design professional (interior designer, architect, engineer (3)
- I am a medical professional (nurse, occupational/physical therapist, medical doctor) (4)
- I am a construction professional (5)

Q7 In which state do you currently reside?

▼ Alabama (1) ... I do not reside in the United States (53)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Q8 How would you describe the area where you currently live?

- Urban (1)
- Rural (2)
- Suburban (3)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Q9 How would you describe your current living situation?

- I live alone (1)
- I live with a spouse or significant other (2)
- I live with a roommate or other family member (3)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Q10 If you live with someone else, how would you describe the personal daily care aspect of the relationship? Personal care is defined as help with activities of daily (personal hygiene, oral care), grooming, (skin and hair care), showering or bathing and toileting, (getting on/off the toilet and cleaning oneself).

- I primarily provide personal care for the other person (1)
- The other person provides personal care for me (2)
- We share equally in the personal care giving responsibilities, helping each other out with personal care as required (3)
- We live independently with neither one providing personal care for the other (4)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Q11 How concerned are you about your safety when moving yourself from seated to standing, getting in and out of bed and walking independently from one location to another?

Not at all	Somewhat	Very concerned

	0	1	2	3	4	5	6
Level of concern ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Q12 How concerned are you about your safety when providing personal hygiene, oral care, and grooming, (skin and hair care) for yourself in your home?

	Not at all			Somewhat			Very concerned
	0	1	2	3	4	5	6
Level of concern ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Q13 How concerned are you about your safety when showering or bathing in your home?

	Not at all			Somewhat			Very concerned
	0	1	2	3	4	5	6
Level of concern ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Q14 How concerned are you about your safety when toileting, which includes getting on/off the toilet and cleaning yourself in your home?

	Not at all			Somewhat		Very concerned	
	0	1	2	3	4	5	6
Level of concern ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Q15 Have you ever had a home assessment done to evaluate your home regarding safe aging in place?

- Yes (1)
- No (2)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Q16 If yes, who did the evaluation?

- ◯ A medical professional, such as a nurse of occupational therapist (1)
- ◯ A design professional, such as an interior designer or architect (2)
- ◯ A construction professional, such as a contractor or a handyman (3)
- ◯ A social worker (4)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Q17 Which of the following best describes the bathroom you primarily use?

- ◯ Small bathroom with a shower stall only (1)
- ◯ Small bathroom with a shower in the bathtub (2)
- ◯ Small bathroom with both a shower stall and a bathtub (3)
- ◯ Med/Large bathroom with shower stall only (4)
- ◯ Medium or large bathroom with shower in the bathtub (5)
- ◯ Medium or large bathroom with both a shower stall and a bathtub (6)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Q18 What is the highest amount of money (% of the value of your home) that you would consider investing in modifications to enable you to age in place?

- ◯ Less than or equal to 9.9% (1)
- ◯ Between 10% and 20% (2)
- ◯ 20.1% or more (3)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Q19 Tell us a few concerns you have regarding your safety when aging in place. You may write a list rather than sentences if you prefer.

____

____

____

____

____

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q20 How would you describe the area where your friend or family member currently lives?

- ◯ Urban (1)
- ◯ Rural (2)
- ◯ Suburban (3)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q21 How would you describe your friend or family members current living situation?

- ◯ He/she lives alone (1)
- ◯ He/she lives with a spouse of significant other (2)
- ◯ He/she lives with a roommate or other family member (3)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

And How would you describe your friend or family members current living situation? = He/she lives with a spouse of significant other

Or How would you describe your friend or family members current living situation? = He/she lives with a roommate or other family member

Q22 If your friend or loved one lives with someone else, how would you describe the personal caregiving aspect of the relationship? Personal caregiving is defined as help with activities of daily living which involve personal hygiene, oral care, grooming (which includes skin and hair care, showering or bathing) and toileting, (which includes getting on/off the toilet and cleaning oneself).

○ He/she primarily provides care for the other person (1)

○ The other person primarily provides care for him/her (2)

○ They share equally in personal care giving responsibilities, helping each other out with personal care as required. (3)

○ They live independently with neither providing personal care for the other. (4)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q23 How concerned are you about your friend or family member's safety when moving from seated to standing, getting in and out of bed and walking independently from one location to another?

	Not at all		Somewhat		Very concerned		
	0	1	2	3	4	5	6
Level of concern ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q24 How concerned are you about your friend or family member's safety when providing personal hygiene, oral care, and grooming, (which includes skin and hair care)?

	Not at all	Somewhat	Very concerned
	0 1 2	3	4 5 6
Level of concern ()			

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q25 How concerned are you about your friend or family member's safety when showering or bathing in his/her home?

	Not at all	Somewhat	Very concerned
	0 1 2	3	4 5 6
Level of concern ()			

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q26 How concerned are you about your friend or family member's safety when toileting, which includes getting on/off the toilet and cleaning him/herself at home?

	Not at all	Somewhat	Very concerned
	0 1 2	3	4 5 6

Level of concern ()	

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q27 Has your friend or loved one ever had a home assessment done to evaluate their home regarding safe aging in place?

- ○ Yes (1)
- ○ I'm not sure (2)
- ○ No (3)

Display This Question:

If Has your friend or loved one ever had a home assessment done to evaluate their home regarding saf... = Yes

Q28 Who did the evaluation?

- ○ A medical professional, such as a nurse of occupational therapist (1)
- ○ A design professional, such as an interior designers or architect (2)
- ○ A construction professional, such as a contractor or a handyman (3)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q29 Which of the following best describes the bathroom your friend or loved one primarily uses?

- ◯ Small bathroom with a shower stall only: (1)
- ◯ Small bathroom with a shower in the bathtub: (2)
- ◯ Small bathroom with both a shower stall and a bathtub: (3)
- ◯ Med/Large bathroom with shower stall only: (4)
- ◯ Medium or large bathroom with shower in the bathtub: (5)
- ◯ Medium or large bathroom with both a shower stall and a bathtub: (6)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q30 What is the highest amount of money (% of the value of your home) that you would advise your friend or family member to invest in their home to enable them to age in place?

- ◯ Less than 9.9% (1)
- ◯ Between 10% and 20% (2)
- ◯ 20.1% or more (3)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q31 Tell us a few concerns you have regarding your friend or family member's safety when aging in place. You may write a list rather than sentences if you prefer.

____

____

____

____

____

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Q32 Do you ever provide home assessments for clients intending to age in place?

○ Yes (1)

○ No (2)

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Q33 Do you work primarily in

- Urban Areas (1)
- Suburban Areas (2)
- Rural Areas (3)
- Combination of the three (4)

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Q34 Do you hold any of the following certifications? (Check all that apply)

- NCIDQ (1)
- NCARB (2)
- CAPS (Certified Aging in Place Specialist) (3)
- Certified Kitchen and Bath Specialist (4)
- LEED Certified (5)
- WELL Building Certified (6)

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Q35 Do you have any professional affiliations? (Check all that apply)

- ☐ ASID (1)
- ☐ AIA (2)
- ☐ IIDA (3)
- ☐ NAHB (4)

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Q36 How do you convey your design solutions to your clients? (Check all that apply)

- ▢ Hand drawn sketches, floor plans, elevations and /or perspectives (1)
- ▢ Computer generated floor plans, elevations and/or perspectives (2)
- ▢ Manufacture's specifications and cut sheets (3)
- ▢ Estimate or quote of anticipated cost (4)
- ▢ Verbal description of recommendations (5)

Display This Question:

If What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Q37 Do you ever provide home assessments for clients intending to age in place?

- ◯ Yes (1)
- ◯ No (2)

Display This Question:

If What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Q38 Do you work primarily in

○ Urban Areas (1)

○ Suburban Areas (2)

○ Rural Areas (3)

○ Combination of the three (4)

Display This Question:

If What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Q39 Do you hold any of the following certifications? (Check all that apply)

☐ OTA (Occupational Therapist) (1)

☐ PT (Physical Therapist) (2)

☐ CAPS (Certified Aging in Place Specialist) (3)

☐ ATP (Assistive Technology Professional) (4)

☐ Other (5)

Display This Question:

If What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Q40 Do you have any professional affiliations? (Check all that apply)

- ☐ AOTA (American Occupational Therapy Association) (1)
- ☐ NBCOT (National Board for Certification in Occupational Therapy) (2)
- ☐ WFOT (World Federation of Occupational Therapists) (3)
- ☐ NAHB (National Association of Home Builders) (4)
- ☐ Other (5)

Display This Question:

If What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Q41 How do you convey your design solutions to your clients? (Check all that apply)

- ☐ Hand drawn sketches, floor plans, elevations and /or perspectives (1)
- ☐ Computer generated floor plans, elevations and/or perspectives (2)
- ☐ Manufacturer's specifications and cut sheets (3)
- ☐ Estimate or quote of anticipated cost (4)
- ☐ Verbal description of recommended changes/additions (5)

Display This Question:

If What is your role regarding aging in place? = I am a construction professional

Q42 Do you ever provide home assessments for clients intending to age in place?

- ◯ Yes (1)
- ◯ No (2)

Display This Question:

If What is your role regarding aging in place? = I am a construction professional

Q43 Do you work primarily in

- ◯ Urban Areas (1)
- ◯ Suburban Areas (2)
- ◯ Rural Areas (3)
- ◯ Combination of the three (4)

Display This Question:

If What is your role regarding aging in place? = I am a construction professional

Q44 Do you hold any of the following certifications? (Check all that apply)

- ▢ CMCI (Construction Manager Certification Institute) (1)
- ▢ AIC (American Institute of Constructors) (2)
- ▢ CAPS (Certified Aging in Place Specialist) (3)
- ▢ Green Business Certification Inc (4)
- ▢ LEED Certified (5)
- ▢ WELL Building Certified (6)

Display This Question:

If What is your role regarding aging in place? = I am a construction professional

Q45 Do you have any professional affiliations? (Check all that apply)

- ☐ ABC (Associated Builders and Contractors) (1)
- ☐ AGC (Associated General Contractors of America) (2)
- ☐ AIC: (American Institute of Constructors) (3)
- ☐ NAHB (National Association of Home Builders) (4)
- ☐ ASA (American Subcontractors Association, Inc) (5)
- ☐ NARI (National Association of the Remodeling Industry) (6)
- ☐ NAWIC (National Association of Women in Construction) (7)
- ☐ USBC (U.S. Green Building Council) (8)

Display This Question:

If What is your role regarding aging in place? = I am a construction professional

Q46 How do you convey your design solutions to your clients? (Check all that apply)

- ☐ Hand drawn sketches, floor plans, elevations and /or perspectives (1)
- ☐ Computer generated floor plans, elevations and/or perspectives (2)
- ☐ Manufacture's specifications and cut sheets (3)
- ☐ Estimate or quote of anticipated cost (4)

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q47 If you or your friend or family member were told verbally to ***widen the doorways*** in the home, how confident would you be in the attractiveness, the ability of a contractor to successfully widen them (constructability), the ease in maneuvering through the house and the level of safety of the widened doorways?

	Not at all	Somewhat	Very
	0 1 2	3 4	5 6
Attractiveness ()			
Constructibility ()			
Ease of maneuvering through your home ()			
Level of safety provided ()			

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q48 If you were to use your standard method of communicating design suggestions to a client to recommend ***widening the doorways*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully widen them (constructability), the ease in maneuvering through the house, and the level of safety of the widened doorways?

	Not at all			Somewhat			Very
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Ease of maneuvering through the home ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q49 If you were to use your standard method of communicating design suggestions to a client to recommend ***widening the hallways*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully widen them (constructability), the ease in maneuvering through the house, and the level of safety of the widened hallways?

	Not at all		Somewhat		Very		
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Ease of maneuvering through the home ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q50 If you or your friend or family member were verbally told to ***widen the hallways*** inside your home, how confident would you be in the attractiveness, the ability of a contractor to successfully widen them (constructability), the comfort in maneuvering through the house, and the level of safety with the ***wider hallways?***

Not at all		Somewhat		Very		
0	1	2	3	4	5	6

Attractiveness ()	
Constructibility ()	
Ease of maneuvering through your home ()	
Level of safety provided ()	

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q51 If you or your friend or family member were verbally told to ***add handrails to stairways and other areas with change in level*** inside your home, how confident would you be in the attractiveness, the ability of a contractor to successfully install them (constructability), the ease in climbing the stairs, and the level of safety of the stairs with the new handrails?

	Not at all			Somewhat			Very
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Ease of climbing the stairs ()							
Level of safety provided by the handrails ()							

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q52 If you were to use your standard method of communicating design suggestions to a client to recommend ***adding handrails to stairways and other areas with change in level*** inside your home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install them (constructability), the support in climbing the stairs, and the level of safety of the stairs with the new handrails?

	Not at all			Somewhat			Very
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Ease of climbing the stairs ()							
Level of safety provided by the handrails ()							

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q53 If you were to use your standard method of communicating design suggestions to a client to recommend ***adding a ramp*** to the entrance in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the ease in entering the house, and the level of safety provided by the ramp?

	Not at all			Somewhat		Very	
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Ease of entering the home ()							
Level of safety provided by the ramp ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q54 If you or your friend or family member were verbally told to ***add a ramp*** to the entrance to your/their home, how confident would you be in the attractiveness, the ability of a contractor to successfully install it (constructability), the ease in entering the house, and the level of safety the entrance ramp provides?

	Not at all			Somewhat		Very	
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Ease of entering the home ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q55 If you or your friend were verbally told to ***add a walk in shower*** to your/their primary bathroom, how confident would you be in the attractiveness, the ability of a contractor to successfully install it (constructability), the comfort performing the activities related to showering, and the level of safety of the ***step in shower?***

	Not at all		Somewhat		Very		
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Comfort in showering ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q56 If you were to use your standard method of communicating design suggestions to a client to recommend adding a ***walk in shower*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the comfort of showering, and the level of safety provided by ***the walk in shower***?

	Not at all		Somewhat		Very		
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Comfort of showering ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q57 If you were told verbally to ***add grab bars next to the toilet***, how confident would you be in the attractiveness, the ability of a contractor to successfully install it (constructability), the comfort of using the toilet, and the level of safety of the grab bars?

	Not at all		Somewhat		Very		
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Level of comfort provided ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q58 If you were to use your standard method of communicating design suggestions to a client to recommend ***adding grab bars in shower*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the comfort in showering, and the level of safety provided by the added grab bars?

	Not at all	Somewhat	Very
	0 1 2	3 4	5 6
Attractiveness ()			
Constructibility ()			
Level of comfort showering provided ()			
Level of safety provided ()			

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q59 If you or your friend or family member were verbally told to ***add grab bars in the shower/bath area,*** how confident would you be in the attractiveness, the ability of a contractor to successfully install them (constructability), the comfort of showering and the level of safety provided by the grab bars?

	Not at all		Somewhat		Very		
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Level of comfort provided ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q60 If you or your family member were verbally told to ***install a taller toilet***, how confident would you be in the attractiveness, the ability of a contractor to successfully install it (constructability), the level of comfort, and the level of safety of the taller toilet.

	Not at all		Somewhat		Very		
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Level of comfort provided ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q61 If you were to use your standard method of communicating design suggestions to a client to recommend ***adding a taller toilet*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability), the level of comfort toileting, and level of safety provided by the taller toilet?

	Not at all		Somewhat		Very		
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Level of comfort in toileting ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q62 If you or your friend or family member were verbally told to ***install a smart toilet*** in your/their home, how confident would you be in the attractiveness, the ability of a contractor to successfully install it (constructability), the support of cleansing, and the level of safety of the smart toilet? A smart toilet is one which adds the cleansing functions of a bidet to the flushing functions of a standard toilet.

	Not at all			Somewhat			Very
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Support of cleansing aspect of the toileting activity of daily living ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a construction professional

Q63 If you were to use your standard method of communicating design suggestions to a client to recommend ***adding a smart toilet*** in his/her home, how confident do you think your client would be in the attractiveness, the ability of a contractor to successfully install it (constructability /buildability), the support of cleansing, and the level of safety provided by the smart toilet? A smart toilet is one which adds the cleansing functions of a bidet to the flushing functions of a standard toilet.

	Not at all			Somewhat			Very
	0	1	2	3	4	5	6

Attractiveness ()	
Constructibility ()	
Support of cleansing aspect to the toileting activity of daily living ()	
Level of safety provided ()	

Q64 Select all the potential concerns you have about the success of home modifications to insure safe aging in place.

- ▢ It would be too difficult to make needed modifications (1)
- ▢ The financial cost of needed modifications would be too high (2)
- ▢ The recommended modifications wouldn't ensure safety (3)
- ▢ The recommended modifications would distract from the physical appeal of the space (4)
- ▢ Other (5)

Q65 If you selected other in the question above, please list your concerns.

____

Q66 Please watch the attached walk through and then answer the questions following the walk through

---

Q67

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Q68 After watching a walk through similar to the one you just watched but showing your own home with the recommendations in place, how confident would you be that the following modifications would work for you in your home and provide an increased level of safety?

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q69 After watching a walk through similar to the one you just watched but showing your friend or family members home with the recommendations in place, how confident would you be that the following modifications would work for your friend or family member, in their home and provide an increased level of safety?

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Q70 After watching a walk through similar to the one you just watched but showing your own, your clients' home with the recommendations in place, how confident would you be that the following modifications would work for your client in their home and provide an increased level of safety?

Display This Question:

If What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Q71 After watching a walk through similar to the one you just watched but showing your patients' home with the recommendations in place, how confident would you be that the following modifications would work for your patient in their home and provide an increased level of safety?

Display This Question:

If What is your role regarding aging in place? = I am a construction professional

Q72 After watching a walk through similar to the one you just watched but showing your customers' home with the recommendations in place, how confident would you be that the following modifications would work for your customer in their home and provide an increased level of safety?

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q73 After watching a walkthrough of your own home with ***wider doorways***, how confident would you be in the attractiveness, the constructability, the ease in maneuvering through the house and level of safety of the ***widened doorways***?

Not at all		Somewhat			Very	
0	1	2	3	4	5	6

Attractiveness ()	
Constructibility ()	
Ease of maneuvering through your home ()	
Level of safety provided ()	

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q74 If your client was shown a walkthrough of his/her own home with ***wider doorways***, how confident do you think your client would you be in the attractiveness, the constructability, the ease in maneuvering through the house and the level of safety of the ***widened doorways***?

Not at all Somewhat Very

0 1 2 3 4 5 6

Attractiveness ()	
Constructibility ()	
Ease of maneuvering through your home ()	
Level of safety provided ()	

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q75 After watching a walkthrough of your own home (or your friend or family members' home) with ***wider hallways,*** how confident would you be in the attractiveness, the constructability, the ease in maneuvering through the house, and the level of safety with the ***wider hallways***?

	Not at all		Somewhat		Very		
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Ease of maneuvering through your home ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q76 If you were able to show your client a walkthrough of his/her own home with ***wider hallways***, how confident do you think your client would you be in the attractiveness, the constructability, the ease in maneuvering through the house, and the level of safety with the ***wider hallways***?

	Not at all		Somewhat		Very		
	0	1	2	3	4	5	6

Attractiveness ()	
Constructibility ()	
Ease of maneuvering through your home ()	
Level of safety provided ()	

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q77 If you were shown a walkthrough of your home (or the home of a friend of family member) with ***handrails added to stairways and other areas with change in level*** inside your home, how confident would you be in the attractiveness, the constructability, the ease of climbing the stairs, and the level of safety of the stairs with the ***new handrails***?

	Not at all		Somewhat		Very		
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Ease of climbing the stairs ()							
Level of safety provided by the handrails ()							

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q78 If you were able to show your client a walkthrough of his/her home with ***handrails added to stairways and other areas with change in level*** inside your home, how confident do you think your client would be in the attractiveness, the constructability, the ease of climbing the stairs, and the level of safety of the stairs with the ***new handrails?***

	Not at all		Somewhat		Very		
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Ease of climbing the stairs ()							
Level of safety provided by the handrails ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q79 If you were shown a walkthrough of your home (or the home of a friend or family member) with a ***ramp to the entrance*** to your home, how confident would you be in the attractiveness, the constructability, the ease of maneuvering into the house, and the level of safety of the ***entrance ramp***?

Not at all | Somewhat | Very

	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Ease of entering the home ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q80 If you were able to show your client a walkthrough of his/her home with a ***ramp to the entrance,*** how confident do you think your client would you be in the attractiveness, the constructability, the ease of entering the home, and the level of safety of the ***entrance ramp?***

	Not at all		Somewhat		Very		
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Ease of entering the home ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q81 If you were shown a walkthrough of your home (or the home of your friend or family member) with a ***walk in shower*** in the primary bathroom, how confident would you be in the attractiveness, the constructability, the comfort performing the activities related to showering, and the level of safety of the ***walk in shower***?

	Not at all			Somewhat		Very	
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Comfort showering ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q82 If you were able to show your client a walkthrough of his/her home with a ***walk in shower*** in their primary bathroom, how confident do you think they would be in the attractiveness, the constructability, the comfort when performing the activities related to showering, and level of safety of the ***walk in shower***?

Not at all Somewhat Very

	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Comfort when showering ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q83 If you were shown a walkthrough of your home (or the home of a friend or family member) with ***grab bars placed next to the toilet,*** how confident would you be in the attractiveness, the constructability, the level of comfort and the level of safety of the ***grab bars***?

	Not at all			Somewhat			Very
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Level of comfort provided ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q84 If your client were shown a walkthrough of his/her home with ***grab bars placed next to their toilet***, how confident do you think your client would you be in the attractiveness, the constructability, the level of comfort, and the level of safety of the ***grab bars***?

	Not at all / Somewhat / Very 0 1 2 3 4 5 6
Attractiveness ()	
Constructibility ()	
Level of comfort provided ()	
Level of safety provided ()	

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q85 If you were shown a walkthrough of your home (or the home of your friend or family member) with ***grab bars placed in the bath/shower area***, how confident would you be in the attractiveness, the constructability, the level of comfort, and the level of safety of the ***grab bars***?

Not at all Somewhat Very

0 1 2 3 4 5 6

Attractiveness ()	
Constructibility ()	
Level of comfort provided ()	
Level of safety provided ()	

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q86 If you were able to show your client a walkthrough of his/her home with ***grab bars placed in the bath/shower area***, how confident do you think they would be in the attractiveness, the constructability, the level of comfort and the level of safety of the ***grab bars***?

	Not at all			Somewhat			Very
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Level of comfort provided ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q87 If you were shown a walkthrough of your home (or your friend or family members) with a ***higher toilet***, how confident would you be in the attractiveness, the constructability, the level of comfort and the level of safety of the toilet?

	Not at all		Somewhat		Very		
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
The level of comfort provided ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q88 If you were able to show your client a walkthrough of his/her home with a ***higher toilet***, how confident do you think they would you be in the attractiveness, the constructability, the level of comfort and the level of safety of the toilet?

	Not at all		Somewhat		Very		
	0	1	2	3	4	5	6

Attractiveness ()	
Constructibility ()	
Level of comfort provided ()	
Level of safety provided ()	

Display This Question:

If What is your role regarding aging in place? = I am interested in aging in place myself

Or What is your role regarding aging in place? = I am interested in aging in place for a friend or family member

Q89 If you were shown a walkthrough of your home (or the home of a friend or a family member) with a ***smart toilet*** installed in the primary bathroom, how confident would you be in the attractiveness, the constructability, the cleansing support and the level of safety of the smart toilet? A smart toilet is one which adds the cleansing functions of a bidet to the flushing functions of a standard toilet.

	Not at all			Somewhat			Very
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Support of cleansing aspect to the toileting activity of daily living ()							
Level of safety provided ()							

Display This Question:

If What is your role regarding aging in place? = I am a design professional (interior designer, architect, engineer

Or What is your role regarding aging in place? = I am a medical professional (nurse, occupational/physical therapist, medical doctor)

Or What is your role regarding aging in place? = I am a construction professional

Q90 If you were able to show your client a walkthrough of his/her home with a ***smart toilet*** installed in the primary bathroom, how confident do you think they would you be in the attractiveness, the constructability, cleansing support and the level of safety of the ***smart toilet***? A smart toilet is one which adds the cleansing functions of a bidet to the flushing functions of a standard toilet.

	Not at all			Somewhat		Very	
	0	1	2	3	4	5	6
Attractiveness ()							
Constructibility ()							
Support of cleansing aspect to the toileting activity of daily living ()							
Level of safety provided ()							

Q91 Now that you've viewed the walk through, select all the potential concerns you have about the success of home modifications to ensure safe aging in place.

- [ ] It would be too difficult to make needed modifications (1)
- [ ] The financial cost of needed modifications would be too high (2)
- [ ] The recommended modifications wouldn't ensure safety (3)
- [ ] The recommended modifications would distract from the physical appeal of the space (4)
- [ ] Other (5)

Q92 If you selected other in the question above, please list your concerns.

____

Q93 Please tell us any additional thoughts you have as you complete this survey.

____

____

____

____

____

Q94 Thank you for taking the survey. Your responses have been recorded.

End of Block: Default Question Block

REFERENCES

(2017, December 9). Retrieved from ExaScience life lab: https://www.exascience.com/researchold/architectural-simulation/

(2017, October 24). Retrieved from Amercian Association of Retired Persons: www.aarp.org

6 North Apartments. (2013). *Universal Design Summit 5* (p. 12). St. Louis: Starkoff Institute.

About Us. (2018, June 2). Retrieved from ANSI: www.ansi.org

Aging in Place and Home Accessibility. (2015). Retrieved from Demand Institute: http://demandinstitute.org/

Aging in Place and Remodeling. (2017, May 01). Retrieved from National Association of Home Builders: http://www.nahb.org/remodel

Aging Statistics. (2008, Mar 12). Retrieved from Census Bureau: www.aoa.acl.gov

Ahmad Jrade, F. (2014). Using Building Information Modeling to Evaluate the Costs and Benefits of Adopting Sustainable Universal Houses in Canada. *International Journal of 3-D Modeling*, 56-76.

Ahn, M. H. (2011). Perceived aspects of home environment and home modifications by older people living in rural areas. *Journal for the Elderly*, 18 - 30.

Ajzen, F. (1980). *Understanding attitudes and predicting social behavior* .

Atwal, A. M. (2014). Occupational Therapists Views on Using a Virtual Reality Interior Design Application within the Pre-Discharge Home Visit Process. *Journal of Medical Internet Research*.

Bady, S. (2011, January). Design Trends in Multi-Generation Housing. *Pro Builder*.

Ball, M. S. (2017). *Aging in Place A Toolkit for Local Governments.* Washington, D.C.: AARP.

Bare Feet and Sandy Floors. (2011). Retrieved from My Seaside Story: http://www.myseasidestory.com/uncategorized/bare-feet-and-sandy-floors/

Barras, S. (2005). A systematic and critical review of the literature: The effectiveness of Occupational Therapy Home Assessment on a range of outcome measures. *Occupational Therapy*.

Bertoa, R. (2007). Assessing the restorative value of the environment: A study on the elderly in comparison with young adults and adolescents. 331-341.

Blackburn, J. L. (2013). Comparison of long-term care in nursing homes versus home health: Costs and outcomes in Alabama. *The Gerontologist*, 215-221.

Board, B. C. (2018). *Elder Home Safety and Environmental Assessment.* Brevard: County of Brevard Florida.

Brandt, D. H. (2014). Conceptualizing disability in US national surveys: application of the World Health Organization's (WHO) International classification of funtioning, disability, and health (ICF) framework. *Quality of Life Research*, 2663-2671.

Builders, N. A. (2009). *Design/Build Solutions for Aging and Accessibility (CAPS II)* . Washington DC: NAHB.

Burton, J. (2017, April 25). *States with the largest elderly population*. Retrieved from Worldatlas: http://www.worldatlas.com/articles/the-us-states-with-the-oldest-population.html

Cameron, N. (2017, January 05). The technology to master in Architecture in 2017. (W. Lau, Interviewer)

CAPABLE Community Aging in Place--Advancing Better Living for Elders. (2016). Retrieved from John Hopkins School of Nursing: https:/learn.nursing.jhu.edu/instruments-interventions/CAPABLE

Chappel, N. H. (2004). Comparative Costs of Home Care and Residential Care. *The Gerontologist*, 389-400.

Clark, K. W. (2017). *Mom, Dad: Your Home isn't Safe*. Retrieved from Money.com: www.money.com

Cumming, R. T. (1999). Home visits by an occupational therapist for assement and modifications of environmental hazards: A randomized trial of falls prevention. *Social Gerontology*.

Cushman, L. A. (2008). Detecting navigational deficits in cognitive aging and Alzheimer disease using virtual reality. *Neurology*, 888-895.

Day, K. C. (2000). The Therapeutic Design of Environments for People with Dementia: A Review of the Empirical Research. *The Gerontologist*.

DDS-CAD Viewer. (2017, December 10). Retrieved from Data Design System: http://www.dds-cad.net/downloads/dds-cad-viewer/

Definition of an older or elderly person. (2010). Retrieved from World Health Organization: http://www.who.int/healthinfo/survey/ageingdefnolder/en/index.html

Delaware, L., & Listou, E. (2017). Living in place - is housing for all ages and abilities. *Universal Design Summit* (pp. 1-43). St Louis: Starkoff Institute.

Demiris, G. H. (2008). Senior resident' perceived need of and preferences for "smart home" sensor technologies. *International Journal of Technology Assessment in Health Care, 24*(1), 120-124.

Dimentia Design and Empathy. (2019). Retrieved from Scottish Housing News: www.scottishhousingnews.com

Ehrenhard, M. K. (2014). Market adoption barriers of multi-stakeholder technology: Smart homes for the aging population. *Technological Forecasting and Social Change*, 306-315.

Engineering at Purdue. (2017, December 10). Retrieved from Purdue.edu: https://engineering.purdue.edu/~hongtan/

Erickson, W., & C. Lee, S. v. (2014). *2012 American Community Survey*. Retrieved from Disability Statistics: www.disabilitystatistics.org

Fausset, C. K. (2011). Challenges to Aging in Place: Understanding Home Maintenance Difficulties. *Journal of Housing for the Elderly*.

Favignano, M. (2015, August 22). MU researchers taking sensors from lab to marketplace. *Columbia Daily Tribune*.

Fisk, A. R. (2009). *Designing for Older Adults.* Boca Raton: CRC Press.

Frieden, T. (2013). *The State of Aging and Health in America*. Retrieved from Centers for Disease Control and Prevention: http://www.cdc.gov/aging/data/index/html

Frieden, T. R. (2013). *The State of Aging and Health in America 2013.* Washington D.C.: National Center for Chronic Disease Prevention and Health Promotion. Retrieved from Centers for Disease Control and Prevention: http://www.cdc.gov/aging/data/index/htm

Fusion. (2017, December 9). *Virtual Walk Through Software*. Retrieved from RTV Interactive Virual Media: https://www.realtourvision.com/virtual-walkthrough-software.html

Gaines, J. P. (2011). Health and medical service use: A matched case comparison between CCRC residents and natoinal health and retirement study samples. *Journal of Gerontological Social Work*, 788-802.

Gensler, V. +. (2016, December 8). 3D Game Programmers Meet Real-World Architects for VR/AR. *Unite 2016*, VIMtrek + Gensler. Los Angeles, California, USA: Unity.

Gerontology/Geriatrics Definitions. (2017, November 13). Retrieved from Association for Gerontology in Higher Education: https://www.aghe.org/resources/gerontology-geriatrics-descriptions

Guidelines. (2018, May 13). Retrieved from United States Access Board: www.access-board.gov

Hamm, J. M. (2017). Fall prevention self-assessments via mobile 3D visualization techonogies: Community dwelling older adults perceptions of opportunities and challenges. *JMIR Human Factors*.

Hamm, J. M. (2017). Mobile three-dimensional visualisation technologies for clinician-led fall prevention assessments. *Health Informatics Journal*.

Hao, K. (2017, August 31). *First-time wheelchair users could learn to navigate the world through virtual reality.* Retrieved from Nextgov: http://cdn.nextgov.com

Heimgartner. (2017, March 07). *Updates for Autodesk Revit Live*. Retrieved from Engineering.com; Inform, Inspire: https://www.engineering.com/BIM/ArticleID/14456/Updates-for-Autodesk-Revit-Live.aspx

Hensel, B. K. (2008). Senior residents' perceived need of and preferences for "smart home" sensor technologies. *International Journal of Technology Assessment in Health Care,* 120-124.

Home Mods. (2017, November 13). Retrieved from USC Leonard Davis School of Gerontology: https://www.homemods.org/

Hooyman, N. (2010). *Social Gerontology: A Multidisciplinary Perspective.* New York: Pearson.

Hooyman, N. A. (2010). *Social Gerontology A Multidisciplinary Perspective.* Prentice Hall .

Huang, C.-U. Y.-W.-P.-C.-C. (2017). Developing BIM-based Visualization and Interactive System for Healthcare Design. *34th International Symposium on Automation and Robotics in Construction.* Taiwan: WeBIM Services Co., Ltd.

Impact of Delaware's new health insurance on seniors. (2015). Retrieved from Cape Gazette: cpg.stparchive.com

Individuals with Disabilities Education Act (IDEA. (2011, January 26). Retrieved from Disability Law Handbook: http://www.bcm.edu/ilru/dlrp/ht

Jessica Lloyd, K. R. (2010). The psychological and social aspects of single family home buying. *Housing and Society*.

Johansson, M. R.-S. (2015). Real-time visualization of building information models (BIM). *Automation in Construction*, 69-82.

Johnson, J. J. (2018). Vulnerable African American Seniors: The Challenges of Aging in Place. *Journal of Housing for the Elderly*.

Justis, R. K. (2012, May June). *Senior Citizens in Indiana Metros*. Retrieved from incontext: http://www.incontext.indiana.edu/2012/may-jun/article1.asp

Katsiyannis, A. Y. (2011). Reflections on the 25th Anniversary of . *Remedial and Special Education*, 324-334.

Keates, S. (2006). Pragmatic research issues confronting HCI practitioners when designing. *Universal Access Information in the Information Society*, 269 - 278.

Knecht, B. (2004, January). Aging baby boomers want smart houses for the golden years. *Architectural Record*.

Knight, W. (2012, October 11). *What comes after the touch screen?* Retrieved from MIT Technology Review: https://www.technologyreview.com/s/429546/what-comes-after-the-touch-screen/

Kopec, D. (2017). *Environmental Psychology for Design.* New York: Fairchild Publications.

Kwon, H. A. (2015). U.S. baby boomers' desire to age in place and residential satisfaction. *Journal of Housing for the Elderly*, 348-372.

Kwon, H. B. (2010). Boomers housing for later life: Comparison of multifamily housing communities and senior housing communities. *Proceedings of the 2010 Annual Conference of the Housing Education and Research Association*, (pp. 168-174).

Kwon, H. B. (2013). Older adults in multifamily housing: Residential satisfaction and intent to move. *Family and Consumer Sciences Research Journal*.

Kwon, H. B. (2013). Older adults in multifamily housing: Residential satisfaction and intent to move. *Family and Consumer Sciences Research Journal*, 40 - 54.

Kwon, S. (2016). *Gerontechnology.* Springer Publishing.

Lau, W. (2017). The technology to master in architecture in 2017. *The Journal of the American Institute of Architects*.

Lee, M. D. (2015). Sensor- based observations of daily living for aging in place. *Pers Ubiquit Comput*, *19*, 27-43.

Lee, M. D. (2015). Sensor- based observations of daily living for aging in place. *Pers Ubiquit Comput*, 27-43.

Lee, M. L. (2015). Sensor-based observations of daily living for aging in place. *Pers Ubiquit Comput*, 27-43.

Lee, Y. H. (2013). Identifying characteristics of design guidelines for elderly care environments from the holistic health perspective. *Indoor and Built Environment*, 242-259.

Lee, Y. H. (2015). Identifying characteristics of design guidelines for elderly care environments from the holistic health perspective. *Indoor and Built Environment*, 242-259.

Leibrock, C. (2011). *Design details for health; Making the most of design's healing potential.* Hoboken: Wiley.

Lidwell, W. H. (2003). *Univeral Principles of Design.* Glouchester: Rockport Publishers.

Little, W. M. (2016). *Introduction to Sociology 1st Canadian Edition.* Vancouver: BC Campus.

Lockwood, K. T. (2017). Pre-discharge home assessment visits in assissting patients' return to community living: a systematic review and meta-analysis. *Journal of Rehab Med*.

Marilyn Rantz, K. L. (2015). Enhanced registered nurse care coordination with sensortechnology: Impact on length of stay and cost in aging in place housing. *Nursing Outlook*, 600-615.

Marquardt, J. D. (2011). A Descriptive Study of Home Modifications for People with Demential and Barriers to Implementation. *Journal of Housing for the Elderly*.

Matchar, E. (2016, June 8). *Using virtual reality to walk in the shoes of someone with Alzheimer's.* Retrieved from Smithsonan.com: http://www.smithsonian.com

Mather, M. (2016, January). *Fact Sheet: Aging in the United States*. Retrieved from Population Reference Bureau: http://www.prb.org/Publications/Media-Guides/2016/aging-unitedstates-fact-sheet.aspx

McAllister Wilder, D. (2011). *The effects of common diseases on mobility.* Muncie: Ball State University.

McAllister Wilder, D. (2012). *Designing for Changes in Spatial Memory.* Muncie: Ball State University.

McAllister Wilder, D. (2014). *Universal Design Project Check list.* Muncie: Ball State University.

McAllister Wilder, D. K. (2017). Aging in Place: How much will they pay. *Associated Schools of Construction.* Associated Schools of Construction.

McAllister-Wilder, D. (2017). Aging in Place in America: User Needs and Related Perceptions. *EDRA 48.* Madison: Environmental Design Research Association.

Memken, J. E. (2007). Accessible housing availability for the growing U.S. elderly population. *Housing and Society*, 101-115.

Mitchell Rice, M. M. (1998). Did Adarand kill minority set-asides? *Public Administration Review*, 82.

Mitchell, N. (2017, December 6). Rift Core 2.0 Dev Diary #1: The next chapter for Rift. *Oculus Blog*.

Mixed reality: Your world is the canvas. (2017, December 8). Retrieved from Microsoft: https://www.microsoft.com/en-us/hololens

Moddesette, A. (2016). *Occupant Indoor Environmental Quality (IEQ) Survey*. Retrieved from Center for the Built Environment: http://www.cbe.berkeley.edu/research/survey.htm

Munzer, T. (2015). *Visualization Analysis and Design.* Boca Raton: Taylor and Francis Group CRC Press.

Null, R. (2014). *Universal Design Principals and Models.* Boca Raton: CRC Press.

Null, R. (2014). *Universal Design Principles and Models.* Boca Raton: CRC Press.

Peek, S. T. (2014). Factors influencing acceptance of technology for aging in place: A systematic review. *International Journal of Medical Informatics*, 235-248.

Prevention, C. f. (2006). Fatalities and Injuries from Falls Among Older Adults. *MMWR Morb.Mortal.Wkly.Reb*.

quickfacts.census.gov. (2015, May 3). Retrieved from United States Census Bureau: www.quickfacts.census.gov

Rantz, M. A. (n.d.). TigerPlace: An Innovative Educational and Research Environment .

Rantz, M. L. (2015). Enhanced registered nurse care coordination with sensor technology: Impact on length of stay and cost in aging in place housing. *Nursing Outlook*, 650-655.

Rappe, E. L. (2006). Visiting outdoor green environments and positively impacts self-rated health among older people in long term care. *Health Technology*, 55-59.

Revit Live. (2017, December 1). Retrieved from Autodesk: https://www.autodesk.com/products/revit-live/overview

Rockoff, J. D. (2015, February 17). Stay Home. The Doctor is Watching You. *The Wall Street Journal*, p. R5.

Ruiz, S. S.-B. (2017). Innovative Home Visity Models Associated With Reductions In Costs, Hospitalizations, and Emergency Department Use. *Health Affairs*, 425-432.

Sarah L Szanton, J. W. (2011). Examining mindfulness-based stress reduction:. *BMC Complementary and Alternative Medicine*.

Schnabel, M. A. (2017, December 9). *Architectural animation becomes alive - Creating spatial narrative with spatial characters for animations*. Retrieved from Academia.edu: https://www.academia.edu/560975/Architectural_Animation_becomes_Alive

Scott, V. V. (2007). Multifactorial and functional mobility assessment tools for fall risk amoung older adults in community, home-support, long-term and acute care settings. *Age and Aging*.

Sheppard, B. H. (1988). The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research. *The Journal of Consumer Research*, 325-341.

Skubic, M. A. (2009). A smart home application to eldercare: Current status and lessons learned. *Technology and Health Care*, 183-201.

Slip, Trip and Fall Prevention. (2016, May). Retrieved from National Safety Council: www.nsc.org

Smith, C. R. (1987). *Interior Design in the 20th-Century America: A History*. New York, NY: Harper and Row.

Sugihara, S. E. (2000, May). Place Attachment and Social Support at Continuing Care Retirement Communities. *Environment and Behavior, 32*(3), 400-409.

Takahashi, G. (2017, November 10). A Tour of Envision Center. (D. M. Wilder, Interviewer)

Takahashi, G. (2017, November 10). Technical Lead, Envision Center Research Computer, Purdue University Information Technology. (D. McAllister Wilder, Interviewer)

Talley, J. (2005). NAHB Briefs: Aging in Place. *Builder*.

Tango Concepts. (2017, December 1). Retrieved from Tango: https://developers.google.com/tango/overview/concepts

Tanner, B. T. (2008). Restoring and Sustaining Home: The Impact of Home Modifications on the Meaning of Home for Older People. *Journal of Housing for the Elderly*, 195-215.

Tekla BIMsight 1.9. (2017, December 4). Retrieved from Trimble: https://www.teklabimsight.com/tekla-bimsight-1-9-whats-new

The Internet of Things. (2015, March 1). Retrieved from Wikipedia: www.wikipedia.org

The population 65 years and older: 2016. (2016). Retrieved from Census.gov: www.census.gov

Theodoridou, I. K. (2012). Assessment of retrofitting measures and solar systems' potential in urban areas using Geographical Information Systems: Application to a Mediterranean City. *Renewable and Sustainable Energy Reviews*, 6240-6259.

Theodoridou, I. K. (2012). Assessment of retrofitting measures and solar systems' potential in urban areas using Geographical Information Systems: Application to a Mediterranean City . *Renewable and Sustainable Energy Reviews*, 6240-6259.

Thordardottir, B. F. (2018). Participation in Everyday life before and after a housing adaptation. *Journal of Housing for the Elderly*.

Thordardottir, B. M. (2018). Participation in everyday life before and after a housing adaptation. *Journal of Housing for the Elderly*.

Thorsten Nikolaus, M. B. (2003). Preventing Falls in Community-Dwelling Frail Older People Using a Home Intervention Team (HIT): Results from the randomized Falls-HIT trial. *Journal of the American Geriatrics Society*, 300 - 305.

Tofle, R. S. (2015). Reflection on 25 Years of the ADA: Seeing Commitment Caveats and Legal Loopholes. *Journal of Interior Design*, v-xii.

Traditionalist Generation: Definition and Characteristics. (2018). Retrieved from Study.com: https://study.com/academy

Turnball, A. (2017). *New virtual reality device will help improve quality of life for people living with dimentia*. Retrieved from VR-EP: http://vr-ep.com

United States Census Bureau. (2016). Retrieved from United States Census Bureau: USCensus.org

Virtual Reality Empathy Platform. (2018). Retrieved from vr-ep: www.vr-ep.com

Weakley, A. T.-E. (2017). Effectiveness of a video-based aging services technology education program for health care professionals. *Gerontology and Geriatrics Education*.

Webster's Dictionary. (2018). Retrieved from Webster's On Line Dictionary: www.websters.com

What is BIM. (2017, November 13). Retrieved from AutoDesk: https://www.autodesk.com/solutions/bim

What is Gerontology. (2017, November 13). Retrieved from USC Leonard Davis School of Gerontology: http://gerontology.usc.edu/resources/articles/what-is-gerontology/

Wilder, D. (2018, January). Aging in Place in America: User Needs and Related Perceptions Concerning Showering Spaces. Indiana, United States: Purdue University.

Will, A. (2015). *Aging in place: implications for remodeling.* Cambridge: Joint Center for Housing Studies Harvard University.

Yan, W. C. (2011). Integrating BIM and gaming for real-time interactive architectural visualization. *Automation in Construction*, 446-458.

Zalewski, K. S. (2009, June). Measures of Physical Ability are Unrelated to Objectively Measured Physical Activity Behavior in Older Adults Residing in Continuing Care Retirement Communities. *Archives of Physical Medicine and Rehabilitation, 90*.

VITA

Denise McAllister, NCIDQ
denisemcallister.phd@gmail.com
Place of birth: Vincennes Indiana
Nationality: US Citizen

Introduction

NCIDQ certified interior designer and interior contractor Denise McAllister Wilder is currently working on a PhD in technology at Purdue University. She has practiced and taught interior design, is a registered interior designer in the State of Indiana and has owned an interior contracting firm for twenty years. She is currently working for Purdue Polytechnic as a Graduate Research Assistant and Graduate Teaching Assistant, which includes serving on the research and evaluation team for the transdisciplinary studies program (TST). TST, a new major at Purdue Polytechnic, has made national headlines as it features hands-on team-based projects in a studio setting. Denise's research focus includes aging in place, sustainable interiors, design/construction integration, BIM, architectural visualization including virtual and augmented reality and transdisciplinary studies in a studio environment.

RESEARCH EFFORTS: CONFERENCE PROCEEDINGS AND PUBLICATIONS

May 2019 Environmental Design Research Association

Increasing Confidence in Home Modifications for Aging in Place Using Architectural Visualization Technology

> Abstract: Home modifications resulting from home assessments performed by occupational therapists are often not implemented. However, research shows pre-discharge home assessments reduce the risk of falls and subsequent readmission to the hospital. These modifications are meant to support safety and independence of an aging individual returning home after hospitalization or rehabilitation. Research also shows, even when implemented, less than 50% of those modifications are being used after one year. This study supposes that the method of communication by which recommendations are shared, contributes to a lack of confidence in their potential effectiveness by the aging client and related stakeholders. That lack of confidence may exist because textual descriptions accompanied with product specifications are difficult for lay people to visualize.

This project studies how architectural visualization technology can increase confidence in proposed modifications resulting in increased implementation and long-term adaptation. A design and presentation tool utilizing Building Information Modeling and gaming software can inspire confidence in proposed modifications. The information gathering process used by interior designers and architects, known as programing, is thought to more realistically reflect client needs. The occupational therapists' model investigates the user's ability to perform specific tasks. Research indicates patients fear not being allowed to return home if they perform inadequately on self-assessment questionnaires so may not be totally honest about their needs. The creation of an architectural visualization model based on architectural programing is believed to result in a more accurate reflection of the aging persons' needs and a better visual depiction of the proposed home modifications.

September 2018 CALC SYMPOSIUM **(**Purdue Center on Aging and the Life Course)
Utilizing Architectural Visualization Technology to Enhance Confidence in Safe Aging in Place Modifications

ABSTRACT: Architectural visualization technology can enhance confidence in home modifications designed to support safe aging in place. Due to a lack of confidence in recommended modifications, many people unwillingly leave their homes when appropriate modifications could allow them to age in place safely. A design and presentation tool combining readily available gaming software with Building Information Modeling (BIM) will result in architectural visualization to support the efforts of those doing home assessments and making related recommendations.

Rather than design professionals, home assessments are often performed by medical professionals, usually occupation therapist, often before a patient is released from a hospital or rehabilitation center. Several theories are being analyzed to explore why clients are reluctant to embrace recommendations and why recommendations do not always adequately meet the needs of a client. When modifications are implemented, less than 50% of those modifications are still being utilized twelve months after the original assessment and implementation. Theories regarding these issues include a lack of user input into the process as well as client fear of fully disclosing their physical needs resulting in not being released to return home. The discussed design and presentation instrument can assist the user in visualizing the proposed solution, thus inspiring confidence in and adherence to, suggested home modifications.

June 2018 NEOCON SPEAKER

Home Modifications and Independent Aging: How Interior Designers Are Contributing and Where They Are Being Excluded

ABSTRACT: Interior designers recognize the ideal scenario for the aging population is to age in place independently, with dignity. Much work being done on home modifications to support the aging population is being done without the participation of interior designers. Those who are called to work with aging consumers are often challenged to change consumer expectations regarding the creation of safe, healthy homes that do not look like institutional facilities. Current research indicates beautiful new products, including appropriate building systems and safe home technology can empower us, as designers to create spaces which support people staying in the home they love.

June 2018 American Society for Engineering Educators (ASEE)

Paper presentation #1

“Peer Critique and Socialization in a Transdisciplinary Design Studio”

Abstract: Engineering educators have shown increasing interest in adopting studio education approaches from art and design education. Elements of studio pedagogy—particularly related to the notion of studio critique—have been viewed as particularly desirable in building students’ metacognitive and reflective capacity in an interdisciplinary, project-based learning environment. While there has been substantial scholarship on students’ development of reflective ability, relatively little is known about how students learn to engage in formative critique with their peers, and how these critique interactions encourage the development of technical and design ability.

June 2018 American Society for Engineering Educators (ASEE)

Paper presentation #2 “Alternative Project Delivery Methods and the Construction Specialists’ Role in Creating Environments for the Aging Population”

ABSTRACT: Construction educators are challenged to prepare their students to work with integrated project delivery (IPD) and other alternate project delivery methods.

Elements of IPD are rapidly being integrated into home modification, where design build and other LEAN building methods have long been the standard.

Significant scholarship indicates construction management and construction engineering students are being exposed as undergraduates to alternative methods to the traditional design/bid/build project delivery method. It is also known in the residential construction realm that the ideal scenario for the vast numbers who find themselves entering or immersed into their retirement years is to be able to age in place with dignity and independence. While there has been extensive scholarship devoted to the current housing environment available to the aging population, as well as to the needs of the identified population, comparatively little is known about where the population lives and how feasible appropriate construction modifications are for those dwellings. There is also a gap in the knowledge about how well prepared those entering the construction management field are to design and build for this population.

May 2018 Environmental Design Research Association (EDRA)

"User Perceptions of Essential Home Modifications Which Make Aging in Place a Reality"

ABSTRACT: Environmental designers, builders and researchers recognize that often the ideal scenario for many people in the United States is to be able to age in place with dignity and independence. While there has been extensive scholarship devoted to studying the current housing environments available to the aging population as well as research regarding the needs of the identified population, comparatively little is known about how the population and their family members view those environments.

June 2017 American Society for Engineering Educators (ASEE)

Paper presentation #1

"Systematically Integrating Liberal Education in a Transdisciplinary Design Studio Environment"

ABSTRACT: Many scholars have cited the importance of integrating humanities and social science content into engineering and technology education, noting the value in building students' deep competence in communication and interpersonal skills, including an understanding of how technology is intertwined with societal and human needs. However, there is relatively little guidance as to how viewpoints and content from liberal education perspectives might be integrated systematically into a single, transdisciplinary learning experience that allows students to view the world through different lenses from a variety of disciplinary perspectives, locating and synthesizing information crucial to solving interesting and worthwhile problems that may not be obvious from a solely technical or solely humanities perspective. In this paper, we present one approach to integrating liberal education and technology content through a series of learning experiences that comprise the core of an undergraduate transdisciplinary degree program. This new course experience is contextualized within several years of iterative development.

Paper presentation #2

"Moving Towards Individual Competence from Group Work in Transdisciplinary Education"

(presented at conference – not listed as author)

Abstract: Collaboration has been identified as a key 21st century skill, vital for success in multidisciplinary environments that are increasingly common in engineering and technology contexts. While researchers have frequently discussed how students develop competencies that facilitate success in groups, little is known about how individual students build their own sense of competence and autonomy after working primarily in groups. In this paper, we present results from an undergraduate transdisciplinary degree program in which students spent the first two years of their core degree experience working almost exclusively in groups, while also developing an individual set of disciplinary interests and competencies. Researchers built an understanding of students' individual and group development through extended ethnographic engagement, focus groups, and interviews as students worked concurrently on group and individual projects for the first time during the first semester of their junior year. Based on analysis of this transitional semester, we identified strategies that students used to build an individual sense of competence, in both technical and "soft" skills. These strategies allow for a fuller conversation regarding how students adapt competence gained in their group experiences and identify new areas of competence that must be confronted and mastered. These findings indicate the need to further understand the differences in the ways that the sequencing of group and individual work might impact the development of competencies in individual students, and the ways in which a project-based environment can encourage this development in a systematic and sustainable way.

May 2017   Environmental Design Research Association (EDRA)

"Aging in Place in America - User's needs and related perceptions"

Abstract: As the already large and quickly growing elderly population in the United States continues to increase, it is believed that the nation's housing needs are going to be significantly impacted. Additionally, disability rates increase as a population ages which indicates a growing need for inclusive designed homes that offer accessible design features. Unfortunately, a perception exists amongst those designing and promoting homes for what they call "empty nesters" that those, primarily baby boomer aged consumers, do not like to envision themselves as aging and therefore do not anticipate their future needs as they age. Additionally, it is perceived that they reject the presence of such features in the homes they decide to build or remodel. The scope of this research is to investigate the feelings of the population regarding amenities typical to inclusive design and therefore believed to be appropriate for inclusion in new or remodeled single-family homes. A quantitative approach is being used to survey a random sample of those living in the United States and anticipating building or remodeling a home. Participants are provided photographs of a variety of spaces with differing levels of accessibility. The respondents are then queried using a Likert-type scale regarding their feelings about the comfort, safety, and attractiveness of the photographed spaces.

April 2017   Associated Schools of Construction Seattle, Washington

"Aging in Place in the United States of America; Consumer Desires Versus Builder and Developer Perceptions"

Abstract: A perception exists amongst some home builders and developers that baby boomer consumers who are planning to purchase or remodel a home will not embrace features that would make it look like they are getting older or becoming infirm. Because family members often influence these decisions, it is necessary that the study include age groups outside of aging adults. Amenities such as non-slip flooring, comfort height toilets, curb less showers and grab bars are desirable components of inclusive design but are not often included in model homes because of existing perceptions.

November 2016 American Association of Colleges and Universities (AAC&U)
Boston, Massachusetts

"Enculturating Peer and Instructor Critique in a Transdisciplinary Technology Studio Environment"

Abstract: This presentation explores undergraduate STEM students' perceptions and acceptance of peer critiques experienced during their first three semesters in college. Included students participated in a pilot undergraduate program focused on competence-based learning. Frequent opportunities for exposure to peer feedback in the form of formal and informal critiques provided students opportunity to shape their designs in response to input from other students in the technology/design studio. Enrolled students engage in cross-disciplinary training where they are exposed to both technology and humanities competencies while also being exposed to cross-course and cross-subject learning. Sharing design solutions with their peers as well as with mentors and instructors in the form of studio critiques has resulted in knowledge which can inform other educators working in STEM fields.

May 2016 Associated Schools of Construction (ASC)
Provo, Utah
"A Home for Anthony – A Post Occupancy Evaluation"

Abstract: In early 2011, a Midwestern family moved into a new home, one that was designed and built for them following universal design standards. A post occupancy evaluation (POE) was recently undertaken to assess how well the home has met their needs and to identify potential improvements for future builds. Because the home was built to allow their disabled son to remain at home, details specific to supporting his physical and psychological needs were of concern. Research questions queried how construction challenges impacted the success of the project and how the home is influencing the lives of individual family members.

April 2016 Environmental Design Research Association (EDRA)
EDRA Shorts
"A Home for Anthony"

Abstract: Since 2005, the Central Indiana nonprofit has been building homes for families who would otherwise be unable to care for their disabled child. Dedicated to keeping a growing child at home rather than in an institution, Samantha's House provides a quality environment for disabled children who are trapped both physically and financially due to serious injuries or disabilities. Five years after the Long family moved into their new custom home designed and built by Samantha's House, the design team conducted a post-occupancy evaluation (POE). The POE strives to determine how well the original design objectives were met as well as which needs identified in the original analysis were successfully conquered, while also uncovering needs that were unanticipated prior to design and construction. Lastly, the POE strives to answer the question of which features played the most significant role in supporting the quality of life and therefore answers which need to be a priority for inclusion in subsequent builds.

March 2016 Interior Design Educators Conference (IDEC)
Category: Scholarship of Design Research
Content Areas: Construction & Fabrication, Human Centered Design, Service Learning/Social Responsibility

"Students Help Create a Home for Anthony"

Abstract: Since 2005, the Central Indiana nonprofit has been building homes for families who would otherwise be unable to care for their disabled child. Dedicated to keeping a growing child at home rather than in an institution, Samantha's House provides a quality environment for disabled children who are trapped both physically and financially due to serious injuries or disabilities. Recruited by the IIDA Indiana director of student affairs, students from Ball State University were assigned to design teams.

When a design group was unable to do a room, the students agreed to take on a room of their own. In addition to working under the professional designer in charge of the quad where their room was located, the student team was also assigned a mentor. The mentor was also a professional member of IIDA Indiana. Students were all in their 3rd of 4th year of study. The job site was located 75 miles from the Ball State campus.

Spring 2015 Environmental Design Research Association (EDRA)
Interior Design Educators Council (IDEC)

"Living and Learning in a Net Zero 1920's Bungalow"

Abstract: The interior design program at Purdue University is working with a multi-disciplinary team to renovate a 1920's Arts and Crafts bungalow into a net-zero energy building with energy and water savings features as well as solar panels that produce both electricity and hot water. Systems in the home will harvest waste heat from appliances and gray water from showers and sinks. As graduate students, we are designing fully accessible spaces while respecting the historical integrity of the home. Our design solution incorporates modern components with the intention of making an adaptive reuse solution that can be easily duplicated. The United States currently has more than 130 million existing housing units, most of which have been in existence since the 1970's. Our design enables aging senior to make the necessary sustainable adaptations in existing homes to allow them to age in place.

<u>IDEC: "Attention Restoration Theory"</u>

Abstract:
The purpose of this literature review is to revisit the Attention Restoration Theory and consider how changes in the work force and the work environment can benefit from recent findings. This review summarizes contemporary outcomes and explores different variables which can be incorporated in the present-day workspace to create a restorative experience and allow a worker to return to the task at hand with renewed vigor.

RESEARCH EFFORTS: NOT YET SUBMITTED FOR PUBLICATION:

BIM and Lighting Simulations

This research looks at the value of performing simulations of an existing space to analyze the quality and quantity of both natural and artificial light. Once an accurate simulation is created, it would be possible to make decisions on how to best provide appropriate exposure to daylight to maximize the user's exposure to vitamin D which has been shown to enhance health and wellbeing.

The project also includes justifications and strategies for enhancing the health and well-being of the elderly by ensuring access to a healthy amount of light. The creation of a daylight simulation of an existing space allows interior designers and constructors to anticipate the light more accurately which would be received on various types of days at different times of the year.

The importance of access to quality lighting in the built environment, both natural daylight and quality artificial lighting is becoming increasingly apparent. (L. Bellia, 2011) That importance is amplified when considering members of the aging population who often spend much of their time indoors. With the introduction of WELL Building standards which are combining with LEED standards to assist industry professionals in the effort to create quality-built environments, designers can now use BIM tools to formulate and evaluate plans to support this need. (The WELL Building Standard takes a holistic approach, 2016)

Smart Home Technology and Aging in Place

Despite the growing availability of assisted living centers, most people prefer to grow old surrounded by their own objects and communities. Nearly 14% of the US population, or 40 million Americans will be at least 65 years old by 2016. By 2040, this number will be doubled with 28 million at least 80 years old per Census Bureau projections. (Aging Statistics, 2008) Obstacles to realizing the goal of aging in place include the availability of health care services, personal security, social concerns, and issues related to mobility. It is expected that about 15.8% of persons' age 65 and over have reported disabilities which could make living independently a challenge. (Erickson & C. Lee, 2014) Smart Home technology can be designed to provide a virtual umbrella of support to improve quality of life for those aging in place. The integration of products and services highlighting smart home technology could be used through a networking device based on the Internet of Things (IoT) and needs specific to the aging consumer. (The Internet of Things, 2015) The mechanism could allow various systems and appliances in a home to communicate with the central station and provide feedback to the independent senior, as well as their children and caregivers. Being able to lock the house, turn on exterior lighting and security systems, prepare a hot cup of coffee or adjust the ambient temperature in the home could support a person's effort to live independently. The integration of a smart home system could also assist in controlling environmental systems, adjusting lighting and privacy controls, retrieve medical (tele-health) products, access social support through social media and allow access to visitors and phone calls regardless of the user's strength or mobility.

Save Our Cities and Towns

This study looks at the feasibility of investing in small cities and towns within a five-mile radius of a proposed high-speed rail line between Indiana's two largest cities, Ft. Wayne and Indianapolis. It is believed by the planners of this project that the proposed line will encourage revitalization of the towns along the rail line. This study intends to identify which towns and cities would be best suited for revitalization based on specific criteria which would make them ideal places to live.

My background as an interior designer leads me to be concerned about the limited opportunities available for residents of Indiana to live and age in their homes. Looking at the communities along the rail line, this study attempts to ascertain which communities have the features that make a community desirable for families who have one of more members who would commute to jobs in larger cities. At the same time, those same communities will support the ideal scenario of residents being able to continue to live and thrive in the same communities as they age.

Available spatial information regarding the cities and towns will allow evaluation of the following features considered for inclusion in the study:

- Proximity to farmers' markets and family farms
- Good accessible (or easily adapted) housing built between 1900 and 1980
- A walkability score of 50 or higher
- Current or previous location of a Carnegie Library
- A dynamic public library
- An accessible YMCA
- Ethnic and religious diversity
- Relatively high population density
- Low housing costs
- Evidence of community involvement such as preservation groups, historical societies, and community foundations
- At least one public park
- At least one little league park
- Located at least 20 miles away from an interstate highway
- Availability of reliable internet access

Those cities and towns which pass most of these criteria will then be studied in terms of crime rate, housing costs and access to hospitals and other medical care to determine the best locations for potential investment.

TEACHING EXPERIENCE

Spring 2017	Purdue University, Construction Plans and Measurements, Teaching Assistant
Fall 2016	Purdue University, Construction Materials and Methods, Teaching Assistant
Fall 2016	Purdue University, Introduction to Demolition and Reconstruction Management, Teaching Assistant
Spring 2015	Purdue University, Professional Practices, Teaching Assistant
Fall 2014	Purdue University, Introduction to Interior Design, Guest Lecturer
1988 to 1997	Ivy Tech State College Region 05

Interior Design Program Chair, Interior Design Instructor
Courses taught across the curriculum including but not limited to:

Introduction to Interior Design, Architectural Drafting, Materials and Methods, History of Interior Design I, History of Interior Design II, Textiles, Professional Practices, Color Theory, Composition and Design, Interior Design Studios

PROFESSIONAL EXPERIENCE

2014 – Present Purdue University
Title: Teaching Assistant
Research Assistant

2009 to Present Denise Wilder Interior Design
Title: President, Design Principal

2007 to 2009 Brenner Design, Incorporated
Title: FF&E Manager; Interior Designer; Project Manager

As FF&E Manager for Brenner Design, an architectural and interior design firm located in downtown Indianapolis, Denise was responsible for overseeing the procurement division while also serving as a project manager on interior architecture and procurement projects. Projects include The New Indianapolis Airport Midfield Terminal, Ameriana Bank, Greenfield Banking Center, and National Bank of Indianapolis's Disaster Recovery Center.

1994 to present On-A-Shoestring, Inc. (Doing business as Wilder Design Group and Shoestring Interiors)
Title: President, Design Principal

As owner of On-a-Shoestring, Inc., Denise is responsible for designing and overseeing all aspects of the business.
Projects include Ivy Tech State College, Wishard Hospital Alzheimer Unit, Medical Offices of Family Dental Practice, Dr. Tom Prather, and Purdue University Faculty Offices. Wilder Design Group was ranked 13th largest commercial design firm on the Indianapolis Business Journal List of Largest Indianapolis Commercial Design Firms in 2007.

1988 to 1997 Ivy Tech State College Region 05
Title: Interior Design Program Chair, Interior Design Instructor
Responsibilities included curriculum development, teaching interior design and architectural classes across the curriculum, course development, student counseling and program scheduling.

Designs Architectural
Title: President, Director of Interior Design
Architectural and Interior Design Merchant Firm specializing in corporate environments.

Perk Industries, LTD
Title: Interior Designer
Responsibilities included sales support, systems furniture design, furniture and finish specifications, client contact, presentation work.

CSO Architecture and Interior Design
Job Title: Jr. Project Designer
Responsibilities included architectural drafting, presentatio maintenance, programming, and client contact.

EDUCATION

2014 – Present Purdue University
M.S. in Construction Management
Thesis: Aging in Place in America: Users Needs and Related Perceptions
PhD in Technology (anticipated August 2019)
Dissertation: Virtual Reality Simulation using building information modeling: BIM Based Visualization Modeling Projecting Technology and Aging in Place

Graduate Committee Members:

Daphene Koch, PhD, Associate Professor
Purdue University, School of Construction Management

Kereshmeh Afsari, Ph.D.
Assistant Professor, School of Construction Management Technology
Assistant Professor, Department of Computer Graphics Technology
Director, Smart Building Innovation Laboratory
Purdue University

Brandon J. Pitts, Ph.D.
Assistant Professor, School of Industrial Engineering
Faculty Associate, Center on Aging and the Life Course
Purdue University

2010 to 2014 Ball State University
Bachelor of Science in Interior Design

Ivy Tech State College; Visual Communications Division
A.A.S. in Interior Design Technology

PROFESSIONAL CERTIFICATIONS:

2009 Registered Interior Designer by State of Indiana
Registration #: 066

1999 National Council for Interior Design Qualifications
Certificate #: 015413

PROFESSIONAL CREDENTIALS and AFFILIATIONS:

Environmental Design Research Association (EDRA) Member

Interior Design Educators Council (IDEC) Member

International Interior Design Association, (IIDA) Professional Member; Past President, Indiana Chapter, Vice President of Government and Regulatory Affairs, Member of Chapter Leadership Council at National Level

Interior Design Coalition of Indiana (IDCI) Vice President of Legislative Affairs

American Society of Interior Designers (ASID) Professional Member; Chair of ASID/Indianapolis Home Show Committee, Newsletter Chair, Contributing Columnist

National Council of Interior Design Qualifications (NCIDQ); Served a three-year term as a Qualified Council Juror

United States Green Building Council (USGBC) Indiana Building Green Symposium; Logistics Committee Chairman 2009, 2010, 2011; Greening the Heartland Regional Conference; Logistic Chair 2012

Indiana Subcontractors Association (ISA); Construction Networking Event of the Year Logistics Committee Chairman 2009, 2010

Indiana Building Excellence Newspaper; Contributing Columnist