A review of person-centred fall prevention: A proposal for using augmented reality to assist with co-designing home modifications as part of a service improvement strategy

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2017

A thesis submitted in fulfilment of the requirements of the degree of Doctor of Philosophy

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Abstract

The prevention of falls is a major challenge within the area of ageing in place. Previous research demonstrates a lack of compliance by older adults with clinicians’ fall prevention recommendations. This restricts the successful uptake of home safety modifications. Various studies have established that compliancy is dependent on an older adult’s level of control and engagement with falls prevention services; however, this can be difficult to achieve.

The research presented investigates the problems and barriers concerning fall prevention among older adults. It advances the understanding of older adults’ goals, and how best to use these as enabling design drivers to support person-centred fall prevention and curb compliance breakdowns. Drawing on control theory as a theoretical basis for the research, this thesis seeks answers to the following research question: how should fall prevention home modification services be delivered to achieve person-centredness? Multiple methods were employed in this research, which consists of three studies. Firstly, an extensive content analysis of fall prevention risk assessment and home modification planning documentation was conducted, based on 60 client cases. The aim of this was to understand better the fall prevention process and the goals of older adults. Based on these results, a clinical home modification design prototype tool using augmented reality was developed. Person-centred fall prevention processes and the prototype were then subject to evaluation. This was done to develop a more detailed understanding of the interaction space, with a view to designing an empowering service framework for older adults and fall prevention professionals. The evaluation was conducted via a series of semi-structured interviews with 11 fall prevention industry professionals from five separate organisations. Further evaluation and analysis of fall prevention processes and the prototype were conducted through semi-structured interviews with 10 older adults who were living in their homes and had past fall prevention and home modification experience. The final study explores individual cases in the context of the home via interaction.
The findings demonstrate that the individual goals of older adults are insufficiently detailed, and that the design processes supporting their reflection in practice do not provide adequate client control (Study One). Person-centredness within fall prevention services is emerging; however, service providers offer limited engagement mechanisms to their older clients, many older adults do not see their role as an active one (Studies Two and Three). Augmented reality provides a platform on which individual goals can easily be visually communicated to create an informed two-way discourse between client and clinician regarding proposed changes in the home (Studies Two and Three). Overall, the results demonstrate that enabling active engagement in the design process is perceived to provide older adults with greater control within fall prevention services with opportunities to raise compliancy and decrease in falls through personalised fall prevention recommendations.
Declaration

This is to certify that:

i. This thesis contains no material which has been accepted for the award to the candidate of any other degree or diploma, except where due reference is made in the text of the examinable outcome.

ii. To the best of the candidate’s knowledge this thesis contains no material previously published or written by another person except where due reference is made in the text of the examinable outcome.

iii. The thesis is less than 100,000 words in length excluding the appendices and bibliography.

iv. The thesis has been copy-edited and proof-read by Dr Jillian Graham (Articulate Writing Solutions), whose services are consistent with those outlined in Section D of the Australian Standards for Editing Practice (ASEP).

Michael Lo Bianco
Acknowledgements

I sincerely thank my supervisor Sonja Pedell for her guidance, support and trust in my abilities throughout this project. I would like to express thanks to Gianni Renda for his guidance and encouragement. I would also like to recognise Ajay Kapoor for his insight and assistance along the way.

Thanks to all of those at Swinburne University of Technology and beyond who have provided me with feedback, insight and guidance. I would like to thank the late Professor George Collins, former Deputy Vice Chancellor (Research & Development), for instigating the Cross-Faculty Scholarships, which have supported the innovative nature of this multidisciplinary research.

Special thanks to my research partners and all those who have taken time out of their busy lives to help me along the way – this is much appreciated. I am also extremely grateful to all the participants who contributed to this research.

Thank you to my family and friends for providing ongoing support and understanding. Finally, I extend my eternal gratitude to Isabel Bearlin. Her tremendous and unwavering faith in me has kept me grounded throughout this entire journey.
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Chapter 1. Introduction

“The digital landscape of the information age has created radical enablers for new types of service delivery.”

(Polaine, Lylie, & Reason, 2013, p. 24)
1.1 Overview of thesis

Chapter One provides an overview of the research conducted and presented in this thesis. The following Table 1.1 summarises the problem investigated, the aims of this thesis, the scope of the research, the expected contributions to be made and the philosophical positioning of the research.

Table 1.1 Overview of the research

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal motivation</td>
<td>First-hand experience of disempowering fall prevention design methods in family context.</td>
</tr>
<tr>
<td>Research problem</td>
<td>Falls among older adults are a serious problem that can cause both emotional and physical harm. Design methods linked to fall preventative home modifications do not account for the complexity of interventions, and therefore lead to unsatisfactory solutions and lack of take-up.</td>
</tr>
<tr>
<td>Aim of the thesis</td>
<td>Provide guidance and solutions for professionals in practice and a technology-supported service that supports person-centred approaches to fall prevention in an empowering manner.</td>
</tr>
<tr>
<td>Scope of the research</td>
<td>Older adult fall prevention. However, outcomes may be applicable to other target audiences in the longer term.</td>
</tr>
<tr>
<td>Expected contribution</td>
<td>Greater understanding of older adults' needs in the home. Service design framework and technology-supported services for fall preventative home modifications.</td>
</tr>
<tr>
<td>Research philosophy</td>
<td>Constructivist research perspective.</td>
</tr>
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</table>

1.1.1 Personal motivation

Disability does not discriminate; it will affect most people on some level within their lives. Many people go through life with conditions that affect their physical and/or cognitive abilities, and many others are fortunate not to experience these limitations. However, for those of us who are fortunate enough to live a long and able life, an inevitable decline in ability awaits us.

I see it as both necessary and worthwhile to contribute in an area where I have witnessed these difficulties first-hand. By employing a user-centred design approach to fall preventative home modifications, I explore how more enabling and person-centred methods of service delivery could be achieved to support those in need.
1.1.2 Aim of the thesis

Within this thesis, I investigate older adult fall prevention and the associated design communication methods linked to home modifications. The aim of this thesis is to examine home modification design processes that will ultimately increase the uptake of fall prevention recommendations and create safer living spaces for older adults who wish to age in place. To achieve this, a better understanding of older adults’ goals, ambitions and design preferences is required to enable person-centred fall prevention methods. Therefore, seven key phases encompass this thesis:

1. Explore the current research surrounding fall prevention and enabling technologies and their effects upon the design processes regarding age-related decline and disability (Chapter Two).
2. Extend the understanding of fall prevention processes and the design methods linked to home modification outcomes (Chapter Four).
3. Develop a technology-supported service to support both older adults and fall prevention clinicians in creating successful person-centred interactions and outcomes (Chapter Five).
4. Assess the utility of the technology-supported service among fall prevention professionals (Chapter Six).
5. Evaluate the success of the proposed technology-supported service among older adults regarding its ability to provide person-centred outcomes (Chapter Seven).
6. Based on the combined findings, develop a theoretical service framework by which the method should be utilised in practice to ensure that its use is in fact person-centred (Chapter Eight).

1.1.3 Scope of the thesis

This research focuses on the representation and reflection of the goals and individuality of older adults within fall preventative home modification design processes. This investigation does not represent a complete appraisal of the fall prevention space, as it is
targeted specifically towards older adults. However, it is anticipated that the findings of this research may offer opportunities in other areas of fall prevention and disability design.

1.1.4 Contributions

I make contributions within theory, method and practice:

My research extends the application and understanding of control theory (Schulz & Heckhausen, 1999). By applying a pragmatic, real-world and person-centred approach to older adults’ falls in the home, a contribution is made in the combination and consideration of human-computer interaction (HCI) and person-centred fall prevention.

A further contribution of my research is to build an effective method for older adults and clinicians to discuss and communicate fall prevention design ideas. My research aims to extend traditional design methods linked to fall prevention to create empowering design processes supported by technologies, and to improve services via the theoretical service framework offered.

Finally, the development and application of the above framework and the exploration of technological service support is expected to contribute to the field of fall prevention practice. The research will introduce the fall prevention field into the digital world, promote service efficiencies, and ultimately lead to client satisfaction and compliance with care solutions.

1.2 Structure of the thesis

1.2.1 Main elements of the thesis

The research presented comprises four key phases: the research background, collection of data, conceptualisation, and discussion of the related findings. The following Table 1.2 provides a summary of the research design and purpose.
Table 1.2 Research design and purpose

<table>
<thead>
<tr>
<th>Process</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research background</td>
<td></td>
</tr>
<tr>
<td>Literature review (Chapter Two)</td>
<td>Investigate the current literature and create a theoretical framework</td>
</tr>
<tr>
<td></td>
<td>for the research</td>
</tr>
<tr>
<td>Research design/methodology (Chapter Three)</td>
<td>Describe the methods and their design within the research conducted</td>
</tr>
<tr>
<td>Data collection and analysis (part one)</td>
<td></td>
</tr>
<tr>
<td>Study One: Contextualising current fall prevention practice for digital</td>
<td>Explore current older adult fall prevention practice/tools with</td>
</tr>
<tr>
<td>innovation (Chapter Four)</td>
<td>consideration of the gaps identified within the earlier review of the</td>
</tr>
<tr>
<td></td>
<td>literature</td>
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<tr>
<td>Conceptualisation of method</td>
<td></td>
</tr>
<tr>
<td>Conceptualisation phase one (Chapter Five)</td>
<td>Propose and create an appropriate design process to facilitate client</td>
</tr>
<tr>
<td></td>
<td>control in fall prevention</td>
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<tr>
<td>Data collection and analysis (part two)</td>
<td></td>
</tr>
<tr>
<td>Study Two: Industry perspectives of fall prevention and technology</td>
<td>Further contextualise the problem space beyond the literature review and</td>
</tr>
<tr>
<td>evaluation (Chapter Six)</td>
<td>evaluate the proposed design process based on strengths and weaknesses</td>
</tr>
<tr>
<td>Study Three: The individuality of older adults and empowering fall</td>
<td>Assess the person-centredness of fall prevention services and evaluate</td>
</tr>
<tr>
<td>prevention methods (Chapter Seven)</td>
<td>the proposed technology solution based on strengths and weaknesses</td>
</tr>
<tr>
<td>Conceptualisation of the theoretical service framework</td>
<td></td>
</tr>
<tr>
<td>Conceptualisation phase two (Chapter Eight)</td>
<td>Construct an appropriate person-centred service model for fall</td>
</tr>
<tr>
<td></td>
<td>prevention within which the design process can be placed</td>
</tr>
<tr>
<td>Discussion and conclusions</td>
<td></td>
</tr>
<tr>
<td>Discussion and conclusions (Chapter Nine)</td>
<td>Discuss the overall findings of the research and provide suggestions</td>
</tr>
<tr>
<td></td>
<td>for further areas of inquiry</td>
</tr>
</tbody>
</table>
1.2.2 Flow chart of chapter structure and data analysis

The following flowchart (Figure 1.1) provides an overview of the research methods undertaken within this thesis and the relationship between each of the studies.

![Flowchart of chapter structure and data analysis](image)

**Figure 1.1 Flow chart of chapter structure and analysis**

1.2.3 Chapter structure

The current chapter provides an overview of the research presented within the other chapters making up this thesis.

In Chapter Two, a review is undertaken of the associated literature and current body of knowledge related to this research. The discussion presented highlights the ageing population of Australia, the problems linked to older adult falls, the strategies and methods of person-centred fall prevention services, the emotional and physical importance of home
environments for older adults, retaining control and self-identity within our later years, as well as the opportunities provided by new technologies in enabling older adults. The review uncovered problems and barriers related to the uptake of fall prevention recommendations made by health professionals. The research body highlights an opportunity for new technologies to play a greater role in person-centred fall prevention services.

Chapter Three begins with an overview of the research design and justification of the data-gathering methods employed. Following this, the importance of design ethnography within health is discussed, and a detailed evaluation is presented of the data-gathering methods utilised. Data collection is broken down into a combination of empirical and conceptual phases, and a detailed discussion is provided of the three studies in this thesis.

Chapter Four discusses the research method applied and findings from Study One. Current fall prevention methods of practice, goal modelling and service delivery outcomes are described and mapped. There are two central outcomes of Study One: an up-to-date overview of person-centred fall prevention processes, and a detailed investigation of the role of older adults and their goals within these processes. The results deliver greater insights and rounded understandings regarding the problems identified within the literature review. Furthermore, the results provide substantiation for an Augmented Reality (AR) service tool to be developed within the subsequent chapter.

Chapter Five deals with the conceptualisation of the AR tool. A discussion is presented reporting on the justification and building of the AR tool as a person-centred design enabler within fall prevention, based on the results of Study One and gaps highlighted within the literature review.

Chapter Six is concerned with Study Two. It further investigates person-centred fall prevention from the perspective of a group of health industry professionals. The AR tool is presented for feedback and evaluation as a person-centred design mechanism that could be adopted within fall prevention services. Study Two explores the opinions regarding
person-centredness and the usefulness of augmented reality as a visualisation medium within falls prevention practice.

Chapter Seven gives an account of Study Three, the final study in this research. Study Three investigates the goals and lifestyles of older adults within their home environments, delves into the issues surrounding current falls prevention processes from the perspective of older adults, and offers the AR tool for evaluation and feedback.

Chapter Eight provides a theoretical service framework within which the AR tool should be embedded to provide a person-centred fall prevention design process. A discussion is offered, and a step-by-step summary of the service process is described.

Chapter Nine includes the concluding discussion of this research. It discusses the contributions the research has made and its impacts upon theory, methods and person-centred practice. Criticisms of the research include recommendations as to how the processes undertaken could be improved. Chapter Nine concludes with suggestions for future research, along with a summary.
Chapter 2. Literature review

“My recommendation is for inclusive design to become more open to attracting and absorbing diverse influences, to adapting and adopting more radical approaches, even those that may not at the moment be producing inclusive results. Nor is this contradictory to inclusive design’s role of exerting a strong influence on design. Quite the opposite: the more cross-fertilization there is, the more mutual influence there can be.”

(Pullin, 2009, p. 63)
2.1 Overview

Chapter Two informs and establishes the research within the related academic literature. It aims to identify problem areas, gaps and opportunities within the body of published knowledge.

Firstly, an investigation into Australia’s older adult population places the research within the wider context of fall prevention. Secondly, a discussion regarding falls is presented. This includes risk factors and hazards, and the physical and mental harm that falls can bring. Following this, the review examines fall prevention; this involves a discussion of person-centeredness, and fall prevention services and methods. The review then addresses the digitisation of health processes and services. In this section, new technologies, human-computer interaction (HCI) and methods of co-creation are discussed. Finally, the review addresses key themes of control and client empowerment through theoretical considerations. Chapter Two closes with an overview of the research questions that have been derived from the literature review.

2.2 Ageing Australia

In 1991, Rowland asserted that Australia was entering “the final, decisive decades of a revolution in the structure of its population” (p. 15). As of 2016, the population of older Australians 65 years of age or older was calculated to be 15.3% (Australian Bureau of Statistics, 2016) of the total population. By the year 2051, the older population is projected to increase to 26% (Australian Bureau of Statistics, 2013). The overall population of Australia is anticipated to rise to approximately 38 million by 2060, with Sydney and Melbourne’s populations predicted to increase by over three million people each within this period (Productivity Commission, 2013). More people are living longer, and to ensure that our extended life spans are both enjoyable and comfortable, it is imperative to research ways to achieve this. While the research presented sits within an Australian context, population aging is a global challenge; therefore, the research presented is translatable into various settings.
2.2.1 Defining older persons

Currently, there is very little consistency across the associated ageing research as to the precise definition of the term, *older person*. This terminology has been most often adopted for those over the age of 50; however, the most common description within ageing research is that the *older person* is someone aged 65 years and older (Lord, Sherrington, Menz, & Close, 2007). Age is usually measured along a chronological scale, as this is the most comparable, simple and widely-used measurement (Rowland, 1991). Additionally, in an attempt to categorise subgroups within *older people*, the older population is often broken up as the ‘young-old’ (65-74 years), the ‘old-old’ (74-84 years) and the ‘oldest-old’ (85 years and older) (Rowland, 1991). In keeping with the most consistent definition reflected in the literature, this research will define those over the age of 65 as *older people*. However, it is acknowledged that all people experience age-related decline at different rates and stages; therefore, older adults must be considered individually rather than being compartmentalised into age-segmented factions. This thesis focusses on older adults 65 years and over who are engaged with fall prevention services due to their declining health, and who are living in their own homes.

2.2.2 Ageing in place

Malmgren Fänge, Oswald, and Clemson (2012) state that “ageing in place is about being able to continue living in one’s own home or neighbourhood and to adapt to changing needs and conditions” (p. 1). The ability of older adults to continue living in their own homes is an area of concern as Australia’s ageing population is placing mounting pressure on aged care providers (Australian Institute of Health and Welfare, 2012). For ageing in place to be successful, appropriate measures and considerations must be applied within a variety of disciplines including research, policy and designing for health (Ahn, Beamish, & Goss, 2008).

Older people want to remain in their own homes. A survey conducted in America demonstrated that 89% of respondents (n=2000) aged 55 years and older indicated that they desired to grow older in their current home (Bayer & Harper, 2000). As the baby-
boomers (those born between 1946 and 1965) move into the older age bracket, the Australian population will experience a population misalignment that has not yet been seen (Rowland, 1991). A significant fraction of older adults relying on health services will place mounting strain on aged care providers and the economy, so it is imperative to provide solutions that allow older adults to remain independent and living within their own homes. However, there are many problems and barriers related to the home environments in which many older adults live. Person-environment relationships are interspersed with risk and hazards. Mitigating these barriers is essential in providing safe and appropriate living solutions.

Existing home environments can often become hazardous and contain complex design barriers for ageing people, who may be subject to present and oncoming physical and cognitive impairments (Demirkan, 2007; Lord et al., 2007). This is common, as many houses that older adults live in were initially designed and built for people without physical problems (Demirkan, 2007). Demirkan (2007) argues that “the global ageing phenomenon highlights that disparity between traditional housing and the actual standard of housing required to enable people to live in their homes as their needs change” (p. 33). Retrofitting existing environments provides an opportunity to create safer and more sustainable ageing in place living solutions for older adults (Lord et al., 2007; World Health Organisation, 2007).

The requirements of older adults are ideally considered from the initial phase of design; however, the topic of this thesis focusses on housing that needs modification, acknowledging that not all requirements can be anticipated when building new houses. Demirkan (2007) states that “research on housing highlights a growing discordance between the users’ requirements and housing standards even in western societies” (p. 34). Psychological wellbeing and the attitudes of older adults linked to new technologies are some of the most important aspects related to successful ageing in place (Ahn, 2004; Demirkan, 2007; Malmgren Fänge et al., 2012). Furthermore, considering these modification requirements as an afterthought incites segregation, and can be detrimental to an older adult’s wellbeing (Demirkan, 2007).
2.3 Falls

Falls suffered by older adults are not merely mishaps or random events; there are causative elements involved (Lord et al., 2007). Falls may seem simple to define; however, they can be difficult to contextualise due to the varying nature of their action. For example, Noury et al. (2007) describe a fall as “the rapid change from the upright/sitting position to the reclining or almost lengthened position, but not in a controlled movement” (p. 1663). Alternatively, the Kellogg International Working Group on the Prevention of Falls in the Elderly coined the widely-adopted definition that describes a fall as “unintentionally coming to ground, or some lower level not as a consequence of sustaining a violent blow, loss of consciousness, sudden onset of paralysis as in stroke or epileptic seizure” (Gibson, Andres, Isaacs, Radebaugh, & Worm-Peterson, 1987, p. 4). Fumio (2001) claims that falls are twofold: one type derives from a specific sequence of bodily actions that in turn causes the higher region of the body to descend from an upright position to the ground. The secondary definition pertains to the whole body descending from an upper level to a different level. The World Health Organisation has adopted the classification that a fall relates to “in-advertently coming to rest on the ground, floor or other lower level, excluding intentional change in position to rest in furniture, wall or other objects” (World Health Organisation, 2007, p. 1). Similarly, the Prevention of Falls Network Europe (ProFaNE) has generated an analogous description to encompass falls that happen for all possible reasons: “an unexpected event in which the participant comes to rest on the ground or lower level” (Lamb et al., 2005, p. 1619). The variance in definitions for falls is an issue in the related research, resulting in many different interpretations of falls, and inconsistencies in different sets of research data.

The World Health Organisation claims that “the operational definition of a fall with explicit inclusion and exclusion criteria, is highly important” (World Health Organisation, 2007, p. 1). Therefore, this research adopts the ProFaNE (Lamb et al., 2005) definition. It is the most transferable into the context of this research, as the qualitative data analysed in Studies One, Two and Three originate from a variety of sources that may classify falls differently.
2.3.1 Falling in numbers

Falls are common, severe and affect many older people on a global scale. Older adults are more likely to suffer from falls, as the incidence and injury rates rise in relation to age (Moreland, Julie, Charlie, & Catherine, 2004; World Health Organisation, 2007). In 2009, 25.6% of older Australians over 65 (n=5,662) experienced at least one fall during the previous year, with 65% of falls occurring at home (Centre for Health Advancement and Centre for Epidemiology and Research, 2010). Roughly 28-35% of older adults aged 65 years and over will fall each year, this probability rises to 32-42% for those older than 70 (World Health Organisation, 2007). Furthermore, the effects of falls become increasingly significant as people grow older and the risk of injuries rises (Fuller, 2000).

According to Rubenstein (2006), “older people have stiffer, less co-ordinated and more dangerous gaits\(^1\) than do younger people. Posture control, body-orienting reflexes, muscle strength and tone, and height of stepping all decline with ageing, and impair ability to avoid a fall after an unexpected trip or slip. In old age, the ‘strategy’ for maintaining balance after a slip shifts from the rapid correcting ‘hip strategy’ (fall avoidance through weight shifts at the hip) to the ‘step strategy’ (fall avoidance via a rapid step) to total loss of ability to correct in time to prevent a fall” (p. 38). Figure 2.1, taken from Rubenstein (2006), highlights the causes of falls in older adults.

\(^1\) A person’s manner of walking
<table>
<thead>
<tr>
<th>Cause</th>
<th>Mean percentage b (%)</th>
<th>Range c (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Accident'/environment-related</td>
<td>31</td>
<td>1-53</td>
</tr>
<tr>
<td>Gait/balance disorders or weakness</td>
<td>17</td>
<td>4-39</td>
</tr>
<tr>
<td>Dizziness/vertigo</td>
<td>13</td>
<td>0-30</td>
</tr>
<tr>
<td>Drop attack</td>
<td>9</td>
<td>0-52</td>
</tr>
<tr>
<td>Confusion</td>
<td>5</td>
<td>0-14</td>
</tr>
<tr>
<td>Postural hypotension</td>
<td>3</td>
<td>0-24</td>
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<tr>
<td>Visual disorder</td>
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<td>0-5</td>
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<tr>
<td>Syncope</td>
<td>0.3</td>
<td>0-3</td>
</tr>
<tr>
<td>Other specified causesd</td>
<td>15</td>
<td>2-39</td>
</tr>
<tr>
<td>Unknown</td>
<td>5</td>
<td>0-21</td>
</tr>
</tbody>
</table>

Supplementary material:

- aAdapted from (Jensen, Nyberg, Gustafson, & Lundin-Olsson, 2003)
- bMean percentage calculated from the 3,628 falls in the 12 studies.
- cRanges indicate the percentage reported in each of the 12 studies.
- dThis category includes arthritis, acute illness, drugs, alcohol, pain, epilepsy and falling from bed.

Figure 2.1 Summary of 12 studiesa that carefully evaluated elderly persons after a fall and specified a ‘most likely’ cause. Source: (Rubenstein, 2006)

2.3.2 Older adult groups

Falls affect a variety of people from all walks of life; however, they are “not just a normal part of the ageing process” (Moncada, 2011, p. 1). Falls are not limited to older people; children and athletes fall more commonly than older adults. However, falls remain more dangerous for specific demographic groups such as older adults, as these people have a greater likelihood of suffering from other debilitating circumstances such as fragile bones, muscular degeneration and social isolation (David, Gromala, Benjamin, Birnholtz, & Baecker, 2011). Older people who have trouble undertaking habitual daily living activities, and those living with health ailments that affect posture, balance and gait, are more likely to suffer a fall (World Health Organisation, 2007).

Women are more at risk of falls than men. A study by Campbell, Spears, and Borrie (1990) identified that women had a greater probability (1.5 times) of experiencing a fall. In the same study, it was found that after controlling for the physical and sociological risks associated with falls, women still had a significantly higher risk (1.55 times more likely) of
falling than men. Moreover, these findings are supported by an increase in falls in older women over age and time (Lord, Ward, Williams, & Anstey, 1993). The risk of death as a result of a fall and/or related injury also rises exponentially for all genders with increasing age (World Health Organisation, 2007).

Recovery from a fall is often a slow process for older adults, leaving them susceptible to subsequent falls during the recovery stage (Rubenstein, 2006). An older person who has recently suffered a fall is more likely to fall again (Nevitt, Cummings, Kidd, & Black, 1989). Nevitt et al. (1989) conducted a prospective study of 325 older people living their homes who had experienced a fall within the previous 12 months. It was found that 57% had a secondary fall, and 31% had experienced two or more falls within the following year. Frequent falls are an indicator that an older adult may need to transfer to an assistive care environment to live safely (Kenny, Rubenstein, Martin, & Tinetti, 2001; Rubenstein, 2006).

### 2.3.3 Locations of falls

Frail older people with restricted movement suffer the most falls within the home. These events are closely correlated with the level of exposure an older person may have to an environment while undertaking their characteristic daily activities (Lord et al., 2007). Additionally, most falls occur during high-activity periods such as the morning and afternoon; the incidence rate drops in the evening and early morning between 9pm and 7am (Lord et al., 2007). Figure 2.2, taken from the Centre for Health Advancement and Centre for Epidemiology and Research (2010), demonstrates the locations within the home environment where the most recent falls occurred within the previous 12 months in adults over 65 years of age. The findings presented in Figure 2.2 (Centre for Health Advancement and Centre for Epidemiology and Research, 2010) are based on 540 respondents in New South Wales (NSW). Answers were given to the following questions: Have you suffered a fall in the last 12 months? How many times have you fallen in the last 12 months? Thinking about your most recent fall, where did the fall occur: inside your own home, inside someone else’s home, own yard, another yard, public place, other (specify)? Where inside the home did your last fall occur? Most falls occur within the most frequently used locations in the home, and on level surfaces within the bedroom, lounge and the kitchen (Figure 2.2).
<table>
<thead>
<tr>
<th>Response</th>
<th>Males % (95% CI)</th>
<th>Females % (95% CI)</th>
<th>Persons % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hall</td>
<td>8.7 (3.9-13.5)</td>
<td>10.4 (6.7-14.1)</td>
<td>9.8 (6.9-12.7)</td>
</tr>
<tr>
<td>Laundry</td>
<td>2.9 (0.1-5.8)</td>
<td>3.6 (1.3-6.0)</td>
<td>3.4 (1.6-5.2)</td>
</tr>
<tr>
<td>Bathroom</td>
<td>10.8 (5.4-16.2)</td>
<td>9.8 (6.5-13.1)</td>
<td>10.2 (7.3-13.0)</td>
</tr>
<tr>
<td>Toilet</td>
<td>1.4 (0.0-3.2)</td>
<td>2.1 (0.7-3.6)</td>
<td>1.9 (0.7-3.0)</td>
</tr>
<tr>
<td>Dining room</td>
<td>2.6 (0.0-5.6)</td>
<td>3.9 (1.8-6.0)</td>
<td>3.4 (1.7-5.2)</td>
</tr>
<tr>
<td>Lounge or family room</td>
<td>26.7 (19.2-34.2)</td>
<td>19.4 (14.7-24.2)</td>
<td>22.0 (18.0-26.1)</td>
</tr>
<tr>
<td>Bedroom</td>
<td>17.2 (11.1-23.4)</td>
<td>19.8 (15.3-24.4)</td>
<td>18.9 (15.3-22.6)</td>
</tr>
<tr>
<td>Stairwell</td>
<td>7.9 (3.4-12.5)</td>
<td>10.1 (6.7-13.6)</td>
<td>9.3 (6.6-12.1)</td>
</tr>
<tr>
<td>Kitchen</td>
<td>11.3 (5.9-16.7)</td>
<td>13.5 (9.8-17.1)</td>
<td>12.7 (9.7-15.8)</td>
</tr>
<tr>
<td>Other</td>
<td>10.4 (5.1-15.7)</td>
<td>7.2 (4.1-10.3)</td>
<td>8.3 (5.6-11.1)</td>
</tr>
</tbody>
</table>

Figure 2.2 Where in the home the most recent fall occurred, adults aged 65 years and over who had a fall in the home in last 12 months. Source: (Centre for Health Advancement and Centre for Epidemiology and Research, 2010)

Common exterior home environmental causes for falls include uneven and cracked footpaths, misaligned gutters and steps, and uneven ground (Lord et al., 1993).

Many falls go unreported if the faller is unhurt (Centre for Health Advancement and Centre for Epidemiology and Research, 2010). However, this raises questions connected to how older adults perceive injury. If a fall does not cause bruising, bleeding, fracture or any other injury, it should still be reported and considered when screening for the prediction of future falls. This yields issues regarding the provision of appropriate proactive interventions to prevent further or more serious falls.

2.3.4 Risk factors

Over 400 known risk factors for falls currently exist (Masud & Morris, 2001). Environmental hazards, medications, metabolic factors, musculoskeletal factors, neuropsychological factors, sensory impairment and other issues such as urinary incontinence are correctable (Moncada, 2011). Some risk factors will always be unavoidable, including age, arthritics, cognitive impairment/dementia, female gender, history of falls, history of fracture and being recently discharged from hospital (Moncada,
In these situations, alternative strategies for the reduction of risk can be identified and demonstrated. Keeping a record of an older person’s falls history over the past year is the simplest method of screening for falls risk, balance assessment and mobility status, and this can easily be incorporated into routine care (Australian Commission on Safety and Quality in Healthcare, 2009).

There are two explicit risk factor classes involved: intrinsic and extrinsic (Kenny et al., 2001; Medical Advisory Secretariat, 2008).

2.3.4.1 Intrinsic risk factors

“Intrinsic factors are those that pertain to the physical, demographic, and health status of the individual, while extrinsic factors relate to the physical and socio-economic environment” (Kenny et al., 2001, p. 14). Intrinsic factors include weakness, reduced grip strength, gait problems, cognitive and functional deficiency, and vision impairments (Lord et al., 2007).

Lord et al. (2007) state that “when considering medical conditions as risk factors for falls there is a significant overlap between falls, syncope and the inherent problem of limited recall or even amnesia for an event” (p. 101). There are also other contributing factors that can lead to an amplified risk for falling. These are presented in Figure 2.3, taken from Lord et al. (2007), and constitute a comprehensive overview on the matter.
<table>
<thead>
<tr>
<th>Diseases affecting sensory input</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vision</strong></td>
<td></td>
</tr>
<tr>
<td>Age-related refractive error</td>
<td></td>
</tr>
<tr>
<td>Senile macular degeneration</td>
<td></td>
</tr>
<tr>
<td>Glaucoma</td>
<td></td>
</tr>
<tr>
<td>Cataracts</td>
<td></td>
</tr>
<tr>
<td>Stroke causing visual field defect</td>
<td></td>
</tr>
<tr>
<td><strong>Proprioception</strong></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
</tr>
<tr>
<td>Vitamin B12 deficiency</td>
<td></td>
</tr>
<tr>
<td>Syphilis (rare)</td>
<td></td>
</tr>
<tr>
<td>Degenerative joint disease, especially of neck and knees</td>
<td></td>
</tr>
<tr>
<td><strong>Vestibular</strong></td>
<td></td>
</tr>
<tr>
<td>Age-related middle and inner ear changes</td>
<td></td>
</tr>
<tr>
<td>Chronic ear infections</td>
<td></td>
</tr>
<tr>
<td>Perforated ear drum</td>
<td></td>
</tr>
<tr>
<td>Labyrinthitis</td>
<td></td>
</tr>
<tr>
<td>Meniere’s disease</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diseases affecting central processing</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cerebrum</strong></td>
<td></td>
</tr>
<tr>
<td>Cardiovascular disease (stroke)</td>
<td></td>
</tr>
<tr>
<td>Dementia</td>
<td></td>
</tr>
<tr>
<td>Brain tumour (benign and malignant)</td>
<td></td>
</tr>
<tr>
<td><strong>Cerebellum</strong></td>
<td></td>
</tr>
<tr>
<td>Cerebrovascular disease (stroke)</td>
<td></td>
</tr>
<tr>
<td>Long-term alcohol misuse</td>
<td></td>
</tr>
<tr>
<td>Idiopathic cerebellar degeneration</td>
<td></td>
</tr>
<tr>
<td><strong>Basal ganglia</strong></td>
<td></td>
</tr>
<tr>
<td>Cardiovascular disease (stroke)</td>
<td></td>
</tr>
<tr>
<td>Parkinson’s disease</td>
<td></td>
</tr>
<tr>
<td><strong>Brain stem</strong></td>
<td></td>
</tr>
<tr>
<td>Cardiovascular disease (stroke)</td>
<td></td>
</tr>
<tr>
<td>Atherosclerosis</td>
<td></td>
</tr>
<tr>
<td>Postural hypotension</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diseases affecting effector response</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spinal cord and nerves</strong></td>
<td></td>
</tr>
<tr>
<td>Any condition causing narrowing of spinal cord</td>
<td></td>
</tr>
<tr>
<td>Motor neurone disease</td>
<td></td>
</tr>
<tr>
<td>Multiple sclerosis</td>
<td></td>
</tr>
<tr>
<td>Foot drop (common peroneal nerve)</td>
<td></td>
</tr>
<tr>
<td><strong>Muscles</strong></td>
<td></td>
</tr>
<tr>
<td>Cardiovascular disease (stroke)</td>
<td></td>
</tr>
<tr>
<td>Motor neurone disease</td>
<td></td>
</tr>
<tr>
<td>Muscular dystrophy</td>
<td></td>
</tr>
<tr>
<td>Multiple sclerosis</td>
<td></td>
</tr>
<tr>
<td>Polymyalgia rheumatica</td>
<td></td>
</tr>
<tr>
<td>Polymyositis</td>
<td></td>
</tr>
<tr>
<td>Hypothyroidism</td>
<td></td>
</tr>
<tr>
<td>Vitamin D deficiency</td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
</tr>
<tr>
<td>Muscle disuse following fracture, injury or prolonged immobility</td>
<td></td>
</tr>
<tr>
<td><strong>Joints</strong></td>
<td></td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td></td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td></td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
</tr>
<tr>
<td>Foot deformities</td>
<td></td>
</tr>
<tr>
<td>Poor-fitting shoes</td>
<td></td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td></td>
</tr>
<tr>
<td>Urinary incontinence</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2.3 Diseases having a direct impact on maintenance of the upright posture. Source: (Lord et al., 2007)
2.3.4.1.1 Gait

Gait refers to a person’s manner of walking. While this may seem like a simple part of everyday life, Hamacher, Singh, Van Dieën, Heller, and Taylor (2011) contend that gait stability is essential for older people to be safe while walking, as many older people fall during this activity (Graafmans et al., 1996; Hausdorff, Rios, & Edelberg, 2001; Lord et al., 2007; Masud & Morris, 2001; Rubenstein, 2006). A range of factors can affect gait function. Rubenstein (2006) claims that these negative influences often include “simple age-related changes in gait and balance as well as from specific dysfunctions of the nervous, muscular, skeletal, circulatory and respiratory systems or from simple deconditioning following a period of inactivity” (p. 36).

“Habitual upright walking is a characteristically human trait that provides a unique set of physiological challenges. When standing erect, two-thirds of the body’s mass is located two-thirds of the body height from the ground, precariously balanced on two narrow legs with only direct contact with the ground provided by the feet. Such a structure challenges the basic principles of mechanical engineering and requires a highly developed postural control system to ensure that the body remains upright. However, in order to progress forwards, it is necessary to repeatedly initiate a forward fall and then ‘re-capture’ this momentum by the appropriate placement of the leading limb. The potential for a loss of balance when performing an apparently simply task such as walking is considerable” (Lord et al., 2007, p. 50).

There is substantial debate surrounding the appropriateness and assessment of approaches designed to identify potential falls risk in older adults (Hamacher et al., 2011). There have been various biomechanical advancements for evaluating gait functionality in older adults (see Section 2.4.2). These processes present opportunities within clinical research and practice to increase the safety of older adults who may be at risk of falling. However, these methods are rarely used, which “could be a consequence of unclear effectiveness of these approaches, together with the additional time and the effort required for their use” (Hamacher et al., 2011, p. 1691).
An understanding of gait and its role in fall prevention is critical to the research undertaken in this thesis. Many fall prevention efforts, including home modification, aim to provide physical mechanisms to enhance balance and mobility throughout the walking cycle. Therefore, it is important to consider the older adult, gait and their interaction with the environment and home modifications.

2.3.4.2 Extrinsic risk factors

The homes of older adults contain potential hazards that could increase the risk of a fall (Connell & Wolf, 1997). It has been stated that “there is a dynamic interaction between environmental conditions and behaviour involving use of the environment and its implications for falls in older people” (Connell & Wolf, 1997, p. 179). Additionally, environmental risk factors play a significant role in causing injury not only in older people who fall, but across a variety of different age groups (Fothergill, O'Driscoll, & Hashemi, 1995). This is supported by Tanner (2003), who identified that extrinsic risk factors were an influential factor in 89% of household falls.

Extrinsic factors incorporate tripping hazards (e.g. mats, cords, pets, uneven walking surfaces and unsuitable shoes), balance and slipping hazards (stairs, lack of handrails, low furniture, slippery floors, snow and ice) and vision hazards (e.g. cataracts, glasses and lighting) (Medical Advisory Secretariat, 2008). Currently “there is very little evidence surrounding the level of risk associated with extrinsic risk factors” (Medical Advisory Secretariat, 2008, p. 16). This research area has not significantly advanced since the 1990s, and practical approaches to address this complex area have not been researched. The nature of falls is multifactorial; they can stem from a wide variety of risk factors that may be present in the everyday lives of older adults (Kenny et al., 2001; Tinetti, Speechly, & Ginter, 1988).

A table of environmental risk factors for falls is shown in Figure 2.4 (adapted from Lord et al. (2007)). The extrinsic fall risks listed are associated with general living environments, and are based on accounts by older adults who have fallen (Archea, 1985; Connell, 1996;

<table>
<thead>
<tr>
<th>Category</th>
<th>Risk Factors</th>
</tr>
</thead>
</table>
| General  | Slippery floor surfaces  
Loose rugs  
Upended carpet edges  
Raised door sills  
Obstructed walkways  
Cords across walkways  
Shelves or cupboards too high or too low  
Spilt liquids  
Pets |
| Furniture | Low chairs  
Low elevated bed height  
Unstable furniture  
Use of ladders and step ladders |
| Bathroom/toilet/laundry | Lack of grab rails shower/bathtub/toilet  
Hob on shower recess  
Low toilet seat  
Outdoor toilet  
Slippery surfaces  
Use of bath oils |
| Stairs | No or inadequate handrails  
Non-contrast steps  
Stairs too steep, tread too narrow  
Distracting surroundings  
Unmodifiable stairs or individual unable to manage stairs |
| Outdoors | Sloping, slippery, obstructed or uneven pathways, ramps and stairways  
Rushing caused by inadequate time allowed for pedestrian crossings  
Crowds  
Certain weather conditions (leaves, snow, ice, rain)  
Lack of places to rest  
Unsafe garbage bin use |

Figure 2.4 Posited environmental risk factors for falls. Adapted from original diagram. Source: (Lord et al., 2007)

Carter, Campbell, Sanson-Fisher, Redman, and Gillespie (1997) offer a catalogue of environmental hazards (Figure 2.5) that pertain strictly to community-dwelling older Australians. Carter et al. (1997) catalogue the environmental hazards (Figure 2.5) present for 425 older Australians over the age of 70 living in the community. It was found that 80% (n=342) of all respondents were living with at least one hazard, and 39% (n=164) have more than five hazards present in their homes. This study was related to general hazards
within the home, many of which contribute to a higher risk of falls for a community-dwelling older adult.

<table>
<thead>
<tr>
<th>Room or area</th>
<th>Hazards assessed</th>
</tr>
</thead>
</table>
| General household    | Poor lighting (too dim)  
Lighting too bright  
Light switches hard to reach/find  
No night light(s)  
Carpet/floor coverings torn or in poor condition  
Rugs that slip  
Slippery floors  
Furniture or clutter obstructing walkways  
Cupboards/shelves too high  
Cupboards/shelves too low  
Taps hard to reach or to turn on/off  
Unstable chairs or tables  
Chairs without armrests or with low backs  
Extension cords across walkways  
Unsafe electrical appliances |
| Kitchen              | Dials on stove difficult to see |
| Bathroom/toilet/laundry | Bathtub/shower recess slippery  
Bathtub/shower recess without grab rails  
Soap, shampoo, not accessible  
Hob on shower recess  
Glass doors not safety glass  
Medicine cabinet poorly lit  
Toilet without grab rails  
Toilet seat too low  
Toilet with inward opening door  
Location of toilet in house  
Toilet located outside |
| Stairs               | Too steep  
Too long  
In need of repair  
Step edges hard to see  
Proper handrails not present  
Handrails unstable or not secured  
Handrails not long enough  
Inadequate lighting |
| Outside              | Sloping, slippery, obstructed or uneven pathways  
Steps, landings, verandas, patios or entrances slippery when wet |

Figure 2.5 Environmental hazards assessed. Source: (Carter et al., 1997)

While Figure 2.4 concerns risks and Figure 2.5 relates to hazards, both are fundamentally linked. A hazard refers to a situation or object that has the potential to cause harm to a
person; a *risk* is the possibility that harm may occur when exposed to a hazard. Consideration of both these negative factors is critical in the context of home modifications, as both risks and hazards relate to and affect each other.

### 2.3.5 Injurious consequences of falls

Falls contribute to over 40% of all injury deaths on a global scale (Rubenstein, 2006). Falls are a notorious external cause of unintentional injury (World Health Organisation, 2007). Falling is a major cause of physical harm to older Australians, and creates a significant obstacle to independent living (Johnston, Grimmer-Somers, & Sutherland, 2010; NSW Department of Health, 2003). Kenny et al. (2001) state that “falling is associated with considerable mortality, morbidity, reduced functioning, and premature nursing home admissions” (p. 664). Furthermore, Kenny et al. (2001) contend that “opportunities for prevention of falling are often overlooked with risks becoming evident only after injury and disability have already occurred” (p. 664). Falls are the principal contributing factor leading to injury-associated hospitalisations in older adults. Furthermore, they are directly responsible for 14% of emergency admittances and 4% of all hospital admissions in those over 65 years of age (Baker & Harvey, 1985).

Of those who experience a fall, 12% to 42% will suffer from a related injury (Medical Advisory Secretariat, 2008). Minor injuries from falls include bruises, abrasions, lacerations and sprains (O’Loughlin, Robitaille, Boivin, & Suissa, 1993). Approximately 4%-5% of falls produce major injuries (Close, Lord, Menz, & Sherrington, 2005; O’Loughlin et al., 1993). Throughout the ageing process, older adults become more susceptible to the harmful repercussions of falling; for example, an older adult may have a reduced ability to use their hand to break a fall and protect their hip (Medical Advisory Secretariat, 2008). This in turn leads to a higher frequency of wrist fractures in those between the ages of 65 and 75 (young-old). The likelihood of experiencing a hip fracture is higher after the age of 75 (old-old and oldest-old) (Medical Advisory Secretariat, 2008). Moreover, 81-98% of hip fractures come from falls (Parkkari et al., 1999). In Australia, approximately 19,000 people over the age of 50 are hospitalised each year because of a hip fracture (Australian Institute of Health and Welfare, 2014), resulting in a higher cost to the health care system than any
other injury in Australia (NSW Department of Health, 2003). By 2050 it is expected that the yearly hip fractures occurring globally will be 6.26 million (Cooper, Campion, & Melton, 1992). Reducing the number of hip fractures remains a common topic of international importance, given the high costs of treatment, and that the mortality rate of older people within one year of experiencing a hip fracture can increase by 33% (Hendrie, Hall, Legge, & Arena, 2003; van Schoor, Smit, Twisk, Bouter, & Lips, 2003).

The duration of hospital stays related to falls in older adults varies globally (World Health Organisation, 2007). A study focusing on older patients in Western Australia found that it ranges from four to 15 days (Hendrie et al., 2003). In regard to hip fractures, hospital stays can increase to 20 days (Parrott, 2000). Furthermore, after sustaining a fall, together with growing frailty, older adults are more likely to remain in hospital for the remainder of their life; 20% will die within one year of a hip fracture (Zuckerman, 1996).

If an older adult has suffered a fall in their home, they may be critically injured, immobile or unconscious and require assistance. The amount of time an older person may spend on the floor is referred to as the long lie (Lord et al., 2007). The morbidity-mortality rate of an older person is directly related to the duration of the long lie: how early a fall is reported as well as the amount of time a person may spend on the ground (Gurley, Lum, Sande, Lo, & Katz, 1996; Igual, Medrano, & Inmaculada, 2013; Wild, Nayak, & Isaacs, 1981). A long lie event can result in a fear of falling, pressure sores, muscular injury, pneumonia, dehydration and hypothermia (Nevitt et al., 1989). Furthermore, the long lie is also “a marker for weakness, illness and social isolation” (Lord et al., 2007, p. 16).

**2.3.6 Fear of falling**

Bhala, O'Donnell, and Thoppil (1982) examined post-fall syndrome in depth to identify, conceptualise and further understand the phenomenon of phobic responses to walking and standing. To be fearful is a natural human response and process – everyone has experienced fear at some point. When a fearful experience is disproportionate to the stresses one is subjected to, the fear is unable to be succinctly communicated and is beyond the experiencer’s control. This can lead to the evasion of particular trigger situations,
making it more in line with a phobia (Marks, 1969). Bhala et al. (1982) coined the term *ptophobia* to describe the fear of falling. This is related to, but inherently different from, acrophobia (the fear of falling from heights), which is one of the most common phobias found in human beings. The fear of falling is the most prevalent fear in 25% of older adults living in community dwellings (Walker & Howland, 1991). However, a more recent review conducted by Scheffer, Schuurmans, van Dijk, van der Hooft, and de Rooij (2008) identified a wide variance in the reported prevalence of the fear of falling in older adults, ranging from 3% to 85%. The fear of falling can result from a previous falling experience, or simply from the acknowledgement of an older adult’s own frailty (Walker & Howland, 1991). It has also been argued that the fear of falling itself may be a more dominant and severe issue affecting the lives of older adults than actual falls (Lawrence et al., 1998).

“The factors contributing to FOF [sic] (fear of falling) in older adults are numerous, although the exact causes remain unclear. Functional and physical decline and decreased quality of life are closely related to FOF, so that these factors may actually be causes of FOF or are caused by FOF. Specific measures based on a concise definition are needed, as further subtleties between fall-efficacy and FOF become evident. Multiple interventions have been recommended, with the optimal result being a cognitive-behavioral change in the older adult that results in bolstered self-confidence to perform daily activities” (Legters, 2002, p. 271).

Delbaere, Close, Brodaty, Sachdev, and Lord (2010) state that a large proportion of older adults either underestimate or overestimate their possibilities of experiencing a fall; in turn, these disparities greatly influence an older adult’s likelihood of experiencing a fall. The overcautious fear of falling carries with it possible confusion, loss of autonomy, immobilisation, increased anxiety and blood pressure, and therefore also an increased likelihood of dizzy spells, other gait control problems and a decrease in other physical activities (Rubenstein, 2006). These factors may lead to other restrictions in ordinary daily activities such as cooking and cleaning, which in turn can lead to a decline in health and environmental safety (World Health Organisation, 2007). Further ramifications may include anxiety about experiencing future falls, being hurt, requiring medical assistance,
becoming victim to the long lie, social embarrassment and losing independence due to having to move into the safety of an assisted care environment (World Health Organisation, 2007). “People who are fearful of falling also tend to lack confidence in their ability to prevent or manage falls, which increases the risk of falling again” (World Health Organisation, 2007, p. 17). Falls are an emotional and person issue. It is therefore important to consider ways in which the fear of falling may be reduced.

2.4 Fall prevention

The prevention and management of falls in the community, aged care and hospitals continues to be one the greatest challenges in the health and wellbeing of older adults (Ward, Harden, Gibson, & Byles, 2009; World Health Organisation, 2007). As the risk factors for falls can be both intrinsic and/or extrinsic, methods and strategies for fall preventions are often multifactorial (Lord et al., 2007). Efforts to prevent falls are adopted in the hope of enabling older adults to live at home for longer, and in a more independent manner (Lord et al., 2007; McCreadie & Tinker, 2005).

2.4.1 Person-centred care and fall prevention

Person-centred care includes a variety of different titles, such as person-centred planning, client-directed care and consumer-directed care. While there may be various terms for it, the fundamental ideology remains the same. Sanderson, Kennedy, Ritchie, and Goodwin (1997) are global leaders in the field of person-centredness, and state that "person-centred planning seeks to extend the range and depth of things over which people can exercise choice and control, both in the planning process itself and in the way services and supports are organised as a result of planning” (Sanderson et al., 1997, p. 17). The following quotation from Sanderson highlights the fundamental components of person-centredness:

"Person-centred planning is a process of continual listening focused on what is important to someone now, and for the future, and acting upon this in alliance with family and friends. It is not simply a collection of new techniques to replace individual program planning. It is based on a completely different way of seeing and
working with people with disability which is fundamentally about sharing power and community inclusion” (Sanderson, 2000, p. 2).

The foundation of person-centred care focuses around what the care client *can do* and their *goals*, rather than concentrating on their incapability (National Ageing Research Institute, 2006). The person-centred ideology stems from the work of psychologist Carl Rogers (Rogers, 1951, 1959); Graham (1989) argues that the Rogerian model is founded upon the notion that “no one can make decisions for another, act for them or solve their problems because these are matters of personal responsibility and choice” (p. 13). In the decades since its conceptualisation, the Rogerian model still provides an appropriate person-centred framework (Graham, 1989; Lane, 2000; National Ageing Research Institute, 2006).

The Australian government and interrelated health and policy bodies are pushing for person-centred innovation within health services (Australian Department of Human Services, 2016; National Health and Hospitals Reform Commission, 2008). The aim is to deliver services that are person-centred and personalised to the needs of the patient. This is reflected by the National Health and Hospitals Reform Commission (2008), which asserts that “the direction of our health system and the provision of health services must be shaped around the health needs of individuals, their families and communities” (p. 2).

In regard to fall prevention, Lord et al. (2007) discuss the challenges that the modern health and social care system face in order to provide effective and tailored treatments to a varied population. Lord et al. (2007) acknowledge that to move away from traditional deficit models of functional assessment, a change in fall prevention culture is required, in the hope of adopting “one that has interventions designed around and tailored to the overall needs of the older person” (p. 372).

In their publication, *Towards an enabling approach in community care – Empowering people, enhancing independence, enriching lives*, Human Services Ageing Disability and Home Care (2010) outlines their plan to move away from *traditional* approaches to adopt more person-centred and *enabling* methods. Figure 2.6 has been taken from the publication to highlight a comparison between old (traditional) and new (enabling) approaches. There
is no specific outline for person-centred fall prevention that details an approach to care as comparatively and explicitly as Figure 2.6. Therefore, Figure 2.6 is adopted as an approximate guideline to be applied to fall prevention where possible.

<table>
<thead>
<tr>
<th>Traditional approach</th>
<th>Enabling approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assessment</strong></td>
<td><strong>Assessment focuses on what the individual is able to do and wants to be able to do for himself/herself (e.g. wants to regain the ability to shower and dress himself/herself; wants to be able to prepare easy meals).</strong></td>
</tr>
<tr>
<td><strong>Care planning</strong></td>
<td><strong>Care planning focuses on what support the person needs to achieve their goals. This support is specific to the individual, and may involve informal and other support (e.g. self-care aids; strength-building exercise program; nutritional plan).</strong></td>
</tr>
<tr>
<td><strong>Service delivery</strong></td>
<td><strong>The focus is on outputs (e.g. four hours of personal care per week).</strong> <strong>Reviews occur when the situation or client’s needs change (e.g. the client’s health has declined and more support services are required).</strong> <strong>Service tends to be on-going until packaged care or residential care is needed, or the client dies.</strong></td>
</tr>
<tr>
<td><strong>The plan focuses on what the service provider will do, identifying the broad areas and the specific type of formal services to be provided.</strong></td>
<td><strong>The plan has a joint focus on what the person receiving support will do, and what the service provider will do to help achieve the person’s goals. Strategies can be either: – formal (e.g. home support services; aids and equipment; adapting the home environment) or – informal (e.g. connecting to social network supports and tapping into existing community resources).</strong></td>
</tr>
<tr>
<td><strong>The focus is on achieving outcomes (e.g. goals that are important and meaningful to the person receiving support).</strong></td>
<td><strong>Regular review is built into the care plan. The focus is on whether and to what extent the person’s goals have been achieved. New goals are established as needed.</strong></td>
</tr>
</tbody>
</table>

Figure 2.6 Comparing a traditional approach in community care with an enabling approach. Source: (Human Services Ageing Disability and Home Care, 2010)

Service providers within Australian community care are continually reforming their practices to align with more person-centred approaches of service delivery (Australian Department of Human Services, 2016; Human Services Ageing Disability and Home Care, 2010). In the same way, to design empowering outcomes, fall prevention targeted towards older adults should be driven by the abilities, goals and desires of the older adults. This is
reinforced by the value of higher-quality outcomes through client engagement and communication. It has been established that non-consideration of the insights of patients can result in compliance breakdowns and rejection of care recommendations made by health professionals (Clemson, Cusick, & Fozzard, 1999; Connell, 1996; Currin, Comans, Heathcote, & Haines, 2011; Nyman, 2011; Stevens, Holman, & Bennett, 2001; Taylor & Hawley, 2010).

### 2.4.2 Falls risk assessment

Occupational therapists play a vital role in developing and implementing fall prevention initiatives. In their practice, occupational therapists address various kinds of fall risks and hazards via prevention, assessment and treatment (Peterson & Clemson, 2008). Tzingounakis (2012) has stated that “environmental assessment and modification are typically emphasized in occupational therapy falls prevention interventions.” (p. 9). Nevertheless, due to large caseloads and the limited amount of home visits possible, occupational therapists work within considerable time restrictions, making highly comprehensive assessment of all relevant risk factors difficult (Monroe & Rushton, 2008).

Screening is an occupational therapy procedure that intends to recognise those who may be at risk of experiencing a fall (Australian Commission on Safety and Quality in Healthcare, 2009). In a community setting, screening can be used as a precursor for those who may need to undergo a more detailed falls risk assessment to identify and ameliorate factors that escalate the risk of falling. When determining the origin of a fall, it is imperative to consider that falls are multifactorial; therefore, many arise from a combination of many factors, and this amalgamation of circumstances leads to a higher overall risk (Kenny et al., 2001).

Several different health and environmental assessments exist to guide risk assessment processes. The American Geriatrics Society and British Geriatrics Society (2011) guidelines for clinical practice claim that all general practitioners should ask any patients over the age of 65 annually about falls. Details should include whether they have fallen, and if so where and how, as well as whether they have any issues with walking or gait. In order to identify
potential fallers, a gait and balance test should be performed on anyone who experiences difficulties (American Geriatrics Society & British Geriatrics Society, 2011).

While there is no evidence to suggest the superiority of one test over another, the following is a series of simple examinations to test the gait and balance of older people simply and efficiently:

- **The Timed Up and Go Test** (TUG) (Podsiadlo & Richardson, 1991) is a method to gauge the time for an older adult to rise from a chair, walk three metres in one direction at their standard speed, turn, go back to the chair and sit. A time greater than or equal to 12 seconds designates amplified risk of falling.

- **The Sit-to-Stand** (STS) (Schurr, Sherrington, Wallbank, Pamphlett, & Olivetti, 2012) is a means to measure lower limb and body strength in conjunction with speed and coordination. The older adult is timed while completing five sit-to-stand sequences. This involves moving from sitting to standing quickly. A completion time of greater than or equal to 12 seconds highlights an increased risk of falling.

- **The Alternate Step Test** (AST) (Tiedemann, Shimada, Sherrington, Murray, & Lord, 2008) is a method to measure the lateral stability of an older person by measuring the time to take eight steps, alternating between feet up onto a step with a height of 19cm and a depth of 40cm. A time greater than or equal to 11 seconds specifies a greater risk of falling.

- **FROP-Com Screen** (Russell et al., 2009) is a test that assesses three critical items: the history of falls in the previous year, stability while upright via observation, walking three metres, turning, returning to the chair and sitting down, as well as self-reporting the need for assistance in performing domestic activities of daily living. Scores are made by an independent reviewer and are subjective. A total of three marked items indicates an increased risk of falling.

However, while being time effective and moderately easy to conduct, these screening tools do have their limitations. Hamacher et al. (2011) argue that they are most commonly
utilised in “clinical settings for examining the functional status of a patient, (and) these tools are generally not capable of providing a quantitative predictive assessment of gait stability or fall risk” (p. 1684).

A falls risk assessment should be conducted for all older adults who have had a fall, report signs of unsteadiness from an initial screening process, have a history of falls, or have sought medical advice because of a fall or difficulties with mobility. A detailed falls risk assessment should incorporate a comprehensive gait assessment using one of the above-mentioned screening tools, an evaluation of muscular strength in both the upper and lower regions of the body, a neurological examination, a cardiovascular examination, a blood pressure reading, a vision test, an assessment of feet and footwear and an environmental assessment to promote home safety (Kenny et al., 2001; Moncada, 2011).

“Given the limitations in assessing fall risk using motor performance tests and questionnaires, particularly considering the increasing age of the population, the need for objective, cost-effective and clinically applicable methods, as well as methods that possess high sensitivity and specificity for assessing gait stability on a subject-specific basis, is clear … In addition, existing evidence suggests that falls in the elderly occur mostly in dynamic rather than static settings, thus indicating a need to assess dynamic characteristics during activities of daily living among elderly individuals” (Hamacher et al., 2011, pp. 1684-1685).

Hamacher et al. (2011) note that “owing to the high number of risk factors and the large number of assessment techniques, however, comparison between studies and thus appropriate selection of approaches for assessing fall risk becomes problematic” (p. 1684). These assessment techniques can be performed in a number of environments and are commonly performed in conjunction with a home risk assessment. To standardise home assessment procedures, several home hazard tools have been produced. These include the Home Environment Survey (Rodriguez et al., 1995), the Westmead Home Safety Assessment (Clemson, Roland, & Cumming, 1992), the Home Assessment Profile (Studenski et al., 1994), the Safety Assessment of Function and the Environment for Rehabilitation tool (SAFER) (Lets, Scott, Burtney, Marshall, & McKean, 1998), the Home Falls and Accidents
Screening Tool (HOME FAST) (Mackenzie, Byles, & Higginbotham, 2002), and the Home-Screen tool (Johnson, Cusick, & Chang, 2001). The content and procedures outlined in each of these tools differs considerably with respect to the number of screen items addressed, which ranges from 10-73. The consistency and reliability of many of these home hazard assessment tools have not been evaluated (Hamacher et al., 2011). These issues need to be considered when comparing findings of different studies about environmental risk factors. Furthermore, it is common for different fall prevention institutions to design and employ their own falls assessment tools, such as Peninsula Health's SAFE tool, which takes various elements from other assessment platforms. As assessment is a difficult process, a more proactive approach to the application of home modifications would be the best way to curb potential falls.

2.4.3 Independence

Independence has a variety of different definitions; it is an ambiguous term and can mean different things to different people. O’Brien and O’Brien (1998) provide two definitions. The first is rehabilitation, whereby people are trained to satisfy their own requirements with minimal assistance. The second is a support model that aims to assist people in choosing and living their own lifestyle, irrespective of the assistance required to do so. Furthermore, independence can be further classified into relevant categories: functional independence refers to an individual’s own control of their cognitive and physical abilities to live with little to no restrictions and be free from invasive control efforts (Mynatt & Rogers, 2002). Upholding functional independence is a significant goal for many older adults. For older people, the ability to remain living in their homes and age in place is key to achieving independence.

There are several formal tools and approaches that can be applied to measuring functional independence, such as Activities of Daily Living (ADLs): cooking, cleaning and ambulating; Instrumental Activities of Daily Living (IADLs): successful management of medication and preparing meals of satisfactory nutrition; and Personal Activities of Daily Living (PADLs): personal care tasks such as showering, dressing and toileting. Another series has also been added to the list, which comprises sociological factors such as readiness to accept change
and to participate in lifelong learning. These are referred to as the Enhanced Activities of Daily Living (EADLs). However, it has been argued that “functional independence, involves more than the ability to perform ADLs and IADLs” (Mynatt & Rogers, 2002, p. 22).

2.4.4 Stigma and self-identity

Stigma is a phenomenon associated with many debilitating and chronic medical conditions. Stigmatisation places a great deal of psychological strain on the individual. Furthermore, it has many far-reaching consequences that negatively affect public health, hindering the many efforts to combat the associated medical conditions. Within the literature, there are numerous and varied definitions of stigma (van Brakel, 2006). Stigma has been referred to as “the situation of the individual who is disqualified from full social acceptance” (Goffman, 1963, p. 9). Stigma can possibly be health-related, it is grounded within the ideology of “dependency, whereby older people appear deeply concerned with not being perceived as a burden on others” (Nyman, 2011, p. 50). The term faller carries with it negative connotations of one’s own frailty and morbidity; therefore, it is not uncommon to see many older people distance themselves from this label. However, it may cause older adults not to communicate their risks and fears truthfully, which in turn leads to assessment results being distorted.

Self-identity refers to how a person perceives their level of similarity to another person who is anticipated to be an emblematic subject of engagement with a particular behaviour (Conner & Armitage, 1998). Actions that are undertaken by an older person that are typical of one’s own self-identity will bolster their identity. Conversely, actions that are inconsistent create a disagreement (cognitive dissonance) concerning their perceived identity and the action (Nyman, Ballinger, Phillips, & Newton, 2013). As Nyman states:

“The preservation of self-identity and avoidance of stigma influences older people’s engagement in falls prevention interventions. Older people appear much more likely to engage in interventions that fit with a positive self-identity and emphasize the positive benefits of interventions, rather than those that seek to raise older people’s self-perceived risk of falls and motivation to reduce this risk” (Nyman, 2011, p. 50).
Quite often, health care products within gerontology\(^2\) can be stigmatising for older adults. Many of these do not take into account the aesthetics and functional requirements that older adults need to live day to day without being stigmatised as frail or of ill health (Durick et al., 2013; Leonardi, Mennecozzi, Not, Pianesi, & Zancanaro, 2008). For this reason, older people regularly disagree with fall prevention interventions, as many see assistive health interventions as stigmatising. Many miscalculate their own risk of falls, and do not consider themselves as someone who may require assistance (Plowman, Prendergast, & Roberts, 2009):

> “Many people choose not to use canes and assistive devices in the home. This is not just because these devices are socially stigmatizing in appearance, but because these devices reinforce a personal identity as someone who is sick” (Plowman et al., 2009, p. 31).

An older adult may deny their need for some assistive installations such as grab bars and ramps, as these simple modifications to a house can create an atmosphere more akin to a hospital or nursing home than to a private home.

### 2.4.5 Interventions

“Falls among older persons are associated with identifiable and modifiable risk factors” (World Health Organisation, 2007, p. 29). If risk factors are identified and modified appropriately, they have shown to be both cost effective and critical in creating safer living environments for older people (Rubenstein, 2006; Tinetti & Speechley, 1988; Todd & Skelton, 2004). “There is good evidence to show that some interventions are more effective than others and those when tailored to individual risk profiles in community, residential and acute care settings are most effective” (World Health Organisation, 2007, p. 29). This is

\(^2\) The study of old age, the process of ageing and the problems of older people (Durick, Robertson, Brereton, Vetere, & Nansen, 2013)
not unexpected given that older adults are individuals, and each will be subject to varying levels of intrinsic and extrinsic risk factors, as well as personal motivations and goals.

One of the critical elements of successful falls prevention is the identification of modifiable risk factors, and developing effective solutions to correct these (Rubenstein, Robbins, Josephson, Schulman, & Osterweil, 1990; Turner et al., 2011; World Health Organisation, 2007). Depending on the older adult, a single strategy may be effective; however, as falls are multifactorial by nature, the more at risk an older person may be, the more measures should be implemented (Australian Commission on Safety and Quality in Healthcare, 2009; Hill, Moore, Dorevitch, & Day, 2008).

Multifactorial interventions aim to minimise risks that may be identified during a falls risk assessment (Australian Commission on Safety and Quality in Healthcare, 2009; Hill et al., 2008). Many of the elements that establish a multifactorial intervention approach can be described broadly as containing exercise, medical evaluation and management, environmental modification and education (World Health Organisation, 2007). Group interventions can be tailored to individual older adults, depending on their needs and the risks they encounter on a day-to-day basis. A randomised trial (Cameron et al., 2010; Gillespie et al., 2012) established that after evaluating these strategies as a group, not only do multifactorial interventions reduce falls; they can also reduce hip and wrist fractures, head injuries, and decrease medical services required as a result of falls. Nevertheless, within the community housing setting there is conflicting evidence about which interventions are most effective (Tinetti et al., 2008).

2.4.5 Assistive technologies and the self

*Assistive technology* has previously been defined as “any device or system that allows an individual to perform a task that they would otherwise be unable to do, or increases the ease and safety with which the task can be performed” (Cowan & Turner-Smith, 1999, p. 325). This definition can also be applied to products used in home modifications. Assistive devices provoke emotional responses from users (McDonagh, Bruseberg, & Haslam, 2002). It is understood that for an assistive device to be successful, it must perform in a manner
that fulfils its functional requirements, as well as being acceptable to its user. These emotional connections with products are highly variable, and are dependent on cultural sensitivities, social values and self-perceptions (McDonagh et al., 2002). Similarly, these connections would undoubtedly be linked to other types of assistances, such as home modifications. Furthermore, the emotional bonds and opinions that an assistive device may elicit can provide researchers with qualitative data that could be used to facilitate better design outcomes for users. In turn, this would create opportunities for designers and researchers alike to create mechanisms that extend beyond purely functional realms to employ emotive knowledge at a significant level.

McDonagh et al. (2002) claim that “the emotional relationship between the user and product is determined, to a large extent, by the symbolic dimension of the product” (p. 231). This dynamic relationship is demonstrated in the often wary and hesitant attitudes of older adults towards assistive technologies. It can often be difficult to comprehend the emotive complexities that people possess in relation to assistive devices, as many of these emotions can be both intricate and internalised.

It is the symbolic significance often attached to assistive devices – with which many older people identify – that can lead to stigmatisation. Requiring an assistive device is to own an assistive device; this can create a dissonance, as possessions function as “symbolic expressions of who we are” (McDonagh et al., 2002, p. 232). As human beings, we outwardly express ourselves through our possessions, which become part of our personality and assist us in representing who we are. Possessions and products therefore have a communicative element (Dittmar, 1992), and this can be the case for assistive devices.

2.4.6 New technologies to provide enablement

As people grow older, their independence and conservation of an existing quality of life becomes threatened by declining health. Functional goals linked to these desires are not uncommon as this demographic slowly begins to cope with expansive and mounting conditions of declining health. As researchers and designers, we must be mindful of these
elements (Rogers & Marsden, 2013). Demiris et al. (2004) contend that "the challenge as we create new technologies, is to understand the personal effects of the technology in order to make it better serve our human purposes" (p. 93). In recent years, there has been an evolution within health care, meaning that many devices and services that were once confined to medical locations are expanding into community housing (Bitterman, 2011). Bitterman (2011) claims that "given the variety of potential consumer populations, designers and engineers of home health care devices should use human factors and ethnographic methodologies extensively" (p. 40).

Hernández-Encuentra, Pousada, and Gómez-Zúñiga (2009) highlight numerous methods in which older adults may learn and assess technology, they acknowledge that technology has to be “customised, modular, and saleable, especially for an older population in which the individual variability increases” (Hernández-Encuentra et al., 2009, p. 242). Older people have been identified as sharing common ageing goals and expectations of what they want their lives to be like as they age (Durick et al., 2013). Some of the most common life goals according to Durick et al. (2013) include the following:

- To continue to be physically active and well
- To be able to maintain their autonomy and independence
- To remain socially active within their families and communities
- To remain in their homes as long as possible

It is also noteworthy that in the same study, it was found that, when considering the participant’s collective views and opinions on what it means to age well, there were consistent differences in the ways in which their physical bodies changed as part of the ageing process. These differences influenced how the participants perceived what it means to age successfully, even though there were many common goals (Durick et al., 2013).

Demiris et al. (2004) conducted a study to investigate the attitudes and perceptions possessed by older people regarding selective smart technologies within the home. The study addressed which specific activities of daily living (ADLs) may be assisted with the inclusion of these technologies within their own homes. The study was an initiative placed
within the framework of ageing in place. At the foundation of this framework is the separation of type of care and the place of care (Rantz, Marek, & Zwygart-Stauffacher, 2000). Older adults in the study took part in three separate focus groups. These were audio-recorded, and the transcriptions underwent a content analysis to identify those activities that the older participants believed would be enhanced by technology. The analysis revealed several categories in the data where positive benefits from technologies were anticipated, and these included the detection and prevention of falls.

**2.4.6.1 Fall detection and smart homes**

The concept of the smart home has evolved because of the global ageing population, and the aspiration of older adults to live at home for longer with greater independence. As described by Demiris, Hensel, Skubic, and Rantz (2008), a smart home is “a residence equipped with technology that enhances safety of residents and monitors their health conditions” (p. 120). Smart homes and the new digital technologies housed within them represent a glimpse into future ways of providing care for older adults. Digital technologies such as ambient fall detection systems and other environmental sensors can be used in combination with typical non-digital assistive technologies such as walking sticks and frames.

With the advancement of health care technologies, there is an opportunity for new fall detection devices to be unobtrusive and allow users to keep their independence (Perry et al., 2010). However, fall detection devices need to be robust and work accurately with very little user input. Passive detection systems require both specific and sensitive alarm-triggering functionality that can be activated while older adults are immobile, unconscious and/or under periods of high stress.

While fall detection is a promising component in enabling older adults to continue living in their own homes, the proactive prevention of falls remains the key focus of research in Australia and internationally, and in this thesis.
There is a body of technological research linked to the prevention of falls by older adults (Gschwind et al., 2014; Lera, Rodríguez, Rodríguez, & Matellán, 2013; Marston et al., 2015). Much of this research relates to approaches to delivering exercise programs, as well as anthropometric measurements of gait and balance to determine precursors to falls.

The inclusion of Augmented Reality (AR) applications in occupational therapy is a relatively novel method of providing care for older adults. Augmented reality (AR) is a digital platform that enables visual information to be superimposed, and to communicate with the real physical environment (Billinghurst, Haller, & Thomas, 2007; Craig, 2013). Superimpositions are often displayed in accordance with real-world locations or registration points. AR is a medium that is experienced, not simply watched, felt or listened to. Craig (2013) argues that “augmented reality is interactive, so it doesn’t make sense to watch it, or listen to it. We must engage with it in order to gain the experience that it provides us” (p. 2). The distinctive characteristics of AR make it a suitable mechanism for communication (Billinghurst & Kato, 2002).

One of the fundamental characteristics of AR is that the user remains within their own physical world as part of the experience (Craig, 2013). This is where differentiation is made between AR and Virtual Reality (VR). In a recent study (Yoo, Chung, & Lee, 2013), a novel approach was undertaken to introducing the Otago exercise program into older adult fall prevention programs. The purpose of the study was to examine how effective an AR-based Otago exercise program was in measuring the balance, gait and falls efficacy of a group of older women. The Otago exercise program incorporates various muscle and balance strengthening measures, and is traditionally conducted with the help of an occupational therapist rather than an AR system. Furthermore, various new rehabilitation methods have been introduced that incorporate various AR and VR techniques and have been shown to lead to “significant functional improvement” (Yoo et al., 2013, p. 797). Following the completion of the study, it was found that the AR intervention group “showed significant increases in BBS, velocity, cadence, step length (right stride), stride length (right side and left side) and falls efficacy” (Yoo et al., 2013, p. 797). The Otago exercise program displayed
user goals and encouraged them to reach these milestones while conducting the Otago exercises. There were two intervention groups that were selected randomly. One conducted the Otago exercise program with AR, and the other followed a more traditional approach without the assistance of AR. The research conducted demonstrated that the AR-based Otago exercise program was sufficiently effective for improving balance, gait and falls efficiency in older women. It also solidified the novel idea that an AR-based Otago exercise program is “meaningful”. It is also important to note that the self-efficacy of each participant was measured, and significant increases were noted. In this study, falls efficacy was via the Falls Efficacy Scale-International (FES-I). “Self-efficacy is the self-belief or capability to create a plan and implement it. This efficacy also affects the elderly, and decreases as people grow older, and it can be a hazardous factor for falls; in addition fear, which is the most significant complication of falls, should be regarded as an important matter” (Yoo et al., 2013, p. 800). In providing a platform on which goals can be visualised and worked towards, there are greater opportunities to engage with older adults in a manner that is in accordance with their own self-identity.

2.4.7 Home modifications

The physical world lacks cohesion because of diverse and troublesome environments; this is exacerbated as we grow older and more susceptible to risks posed by hazardous environments (Demirkan, 2007). Providing older adults with mobility aids and modifying the home environment provides safer living locations, enabling many older adults to age in place (American Geriatrics Society & British Geriatrics Society, 2011; Lord et al., 2007; World Health Organisation, 2007). Falls may occur without warning, so “interventions that target environmental risk factors have the potential to benefit all individuals who use a space in which safety improvements have been made” (Connell, 1996, p. 859). Further to this, when fall prevention interventions are implemented into “multidimensional falls prevention strategies, environmental changes may complement and enhance the impact of interventions to address risk factors in other domains” (Connell, 1996, p. 859). The research presented in this thesis deals specifically with home modifications; these
commonly include the installation of ramps, handrails, bathroom modifications and other environmental alterations (Lord et al., 2007).

“Home assessment interventions that are comprehensive, are well focused, and incorporate an environmental-fit perspective with adequate follow-up can be successful in reducing falls with significant effects” (Clemson, Mackenzie, Ballinger, Close, & Cumming, 2008, p.954). However, there is currently no unified strategy for home hazard assessment (Rubenstein, 2006), and there is also “uncertainty over which older people would benefit the most from this intervention (environmental modification), and many practitioners continue to doubt it is a useful strategy to prevent falls” (Clemson, Mackenzie, Ballinger, Close, & Cumming, 2008, p. 955). Lord et al. (2007) deliver a table of environmental risk factors as well as their accompanying solutions in Figure 2.7.
<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td></td>
</tr>
<tr>
<td>Lighting (too low, excessive glare, uneven)</td>
<td>Ensure even, high, non-glare levels of illumination</td>
</tr>
<tr>
<td></td>
<td>Use of night lights</td>
</tr>
<tr>
<td>Slippery floor surfaces</td>
<td>Non-slip floor surfaces</td>
</tr>
<tr>
<td></td>
<td>Avoid excessive use of floor polish</td>
</tr>
<tr>
<td>Loose rugs</td>
<td>Removal or fixing down of loose rugs</td>
</tr>
<tr>
<td>Upended carpet edges</td>
<td>Repair upended carpet edges and other uneven floor coverings</td>
</tr>
<tr>
<td>Raised door sills</td>
<td>Modification</td>
</tr>
<tr>
<td>Obstructed walkways</td>
<td>Clear walkways obstructed by furniture or other objects</td>
</tr>
<tr>
<td>Cord across walkways</td>
<td>Change cord path</td>
</tr>
<tr>
<td>Shelves or cupboards too high or too low</td>
<td>Avoid use of shelves or cupboards which are very high or low</td>
</tr>
<tr>
<td>Spilt liquids</td>
<td>Wipe up spilt liquids immediately</td>
</tr>
<tr>
<td>Pets</td>
<td>Take care with pets</td>
</tr>
<tr>
<td></td>
<td>Training or restraint of dangerous pets</td>
</tr>
<tr>
<td>Furniture</td>
<td></td>
</tr>
<tr>
<td>Low chairs</td>
<td>Chair raisers</td>
</tr>
<tr>
<td>Low or elevated bed height</td>
<td>Bed blocks or leg modification</td>
</tr>
<tr>
<td>Unstable furniture</td>
<td>Repair or removal of unstable furniture</td>
</tr>
<tr>
<td>Use of ladders or step ladders</td>
<td>Avoid use of ladders and step ladders</td>
</tr>
<tr>
<td>Bathroom/toilet/laundry</td>
<td></td>
</tr>
<tr>
<td>Lack of grab rails shower/bathroom/toilet</td>
<td>Installation of grab rails shower/bathtub/toilet</td>
</tr>
<tr>
<td>Hob on shower recess</td>
<td>Removal of hob on shower recess</td>
</tr>
<tr>
<td></td>
<td>Shower outside shower recess are on a chair</td>
</tr>
<tr>
<td>Low toilet seat</td>
<td>Toilet seat raisers</td>
</tr>
<tr>
<td>Outdoor toilet</td>
<td>Use of commode instead of outdoor toilet</td>
</tr>
<tr>
<td>Slippery surfaces</td>
<td>Use of non-slip mats and strips</td>
</tr>
<tr>
<td>Use of bath oils</td>
<td>Avoid use of bath oils</td>
</tr>
<tr>
<td>Stairs</td>
<td></td>
</tr>
<tr>
<td>No or inadequate handrails</td>
<td>Installation of appropriate handrails</td>
</tr>
<tr>
<td>Non-contrasting steps</td>
<td>Contrasting strips on step treads</td>
</tr>
<tr>
<td>Stairs too steep, tread too narrow</td>
<td>Modification of stair and surrounding design</td>
</tr>
<tr>
<td>Distracting surroundings</td>
<td></td>
</tr>
<tr>
<td>Unmodifiable stairs or individual unable to manage stairs</td>
<td>Installation of ramps</td>
</tr>
<tr>
<td>Outdoors</td>
<td></td>
</tr>
<tr>
<td>Sloping, slippery, obstructed or uneven pathways, ramps and stairways</td>
<td>Re-design or modify pathways, ramps and stairways</td>
</tr>
<tr>
<td>Rushing caused by inadequate time allowed for pedestrian crossings</td>
<td>Longer cycles in traffic lights</td>
</tr>
<tr>
<td>Crowds</td>
<td>Care in crowds</td>
</tr>
<tr>
<td></td>
<td>Use of walking aid to highlight frailty</td>
</tr>
<tr>
<td>Certain weather conditions (leaves, snow, ice, rain)</td>
<td>Removal of fallen leaves, water, snow ice</td>
</tr>
<tr>
<td></td>
<td>Care in dangerous weather conditions</td>
</tr>
<tr>
<td>Lack of places to rest</td>
<td>More places to rest provided</td>
</tr>
<tr>
<td>Unsafe garbage bin use</td>
<td>Re-design or provide assistance with garbage bins</td>
</tr>
</tbody>
</table>

Figure 2.7 Possible strategies to address environmental hazards. Source: (Lord et al., 2007)
A systematic review conducted by Clemson et al. (2008) delivers a meta-analysis of six randomised trials (Campbell et al., 2005; Cumming et al., 1999; Day et al., 2002; Nikolaus & Bach, 2003; Pardessus et al., 2002a; Stevens, Holman, & Bennett, 2001). The aim of this review was “to determine the efficacy of environmental interventions in fall prevention and increase the precision of known results” (Clemson et al., 2008, p. 955). The trial revealed a 21% reduction in falls across all studies, and a 39% reduction among populations deemed to be at high risk.

2.4.7.1 Designing with the Australian Standards

Significant challenges are posed by stigma, insufficient assessment, multifactorial risk factors that play out very differently for individuals, and an approach of mostly reacting once falls have happened. The actual process of home modifications adds another big challenge, as they do have to comply with general building standards. The Australian Standard 1428.1 Design for access and mobility (Standards Australia, 2009) does not address housing modifications that prevent falls in older adults specifically. The AS 1428.1 currently references the essential design requirements for new building work in Australia, this is dictated by the Building Code of Australia (BCA) as well as the Disability Standards. It specifies the obligatory technical elements required to design building spaces that “achieve the level of access required for a deemed-to-satisfy solution” (Standards Australia, 2009, p. 5).

It is common for occupational therapists and disability specialist architects to refer to AS 1428.1 when designing and recommending fall preventative modifications for an older adult’s home. Adhering to AS 1428.1 is not a formal service requirement; however, no other related standard is currently applicable. Commonly, client-supported justifications for deviations from AS 1428.1 are required, and to cover liability issues, these are usually documented and signed off by an older adult.

The current issue of AS 1428.1 was most recently amended in 2009, but there are critical knowledge gaps relating to modifiable design for fall prevention that are not addressed;
nor have they been addressed in various amendments to AS 1428.1. For example, Oram (2006) comments on the 2001 version of the standard:

“The scope of the AS 1428 suite is for public buildings. AS 1428, Part 1: General requirements for access – new building work (2001) states that the standards are applicable to new building work only, excluding private residences. However, anecdotal evidence suggests that therapists and builders are referring to AS 1428 in the absence of residential housing guidelines. This presents a problem as many clients do not ‘fit’ the scope of the AS and will have individual requirements” (p. 4).

It is critical to note that AS 1428.1 “is based on data resulting from empirical testing of persons aged between 18 and 60 years and may not be appropriate when applied to persons outside this age range” (Standards Australia, 2009, p. 5). Additionally, data supporting the AS 1428.1 was collected in the 1970s, and does not account for changes in society, such as the rise of obesity, or larger and motorised mobility devices. Therefore, older Australians over 60 years of age are not represented in the Australian Standard that guides the environmental retrofitting of their home environments.

“Design data was developed to suit the physical access needs of at least 80% and 90% of users respectively. The theory is if wheelchair users are accommodated for, than [sic] most other people with disabilities are also accommodated (McAuley, 1993), however individual requirements and the extremes of the population are not considered. Therefore, referring to the AS alone may breach duty of care for client where duty of care is defined as ‘a duty to use due care toward others in order to protect them from unnecessary risk or harm’ (Merriam-Webster)” (Oram, 2006, p. 4).

The AS design specifications should be understood as non-prescriptive. For example, instead of rigidly applying the design recommendations outlined within the AS to existing community dwellings, fall prevention industry professionals should be mindful of the research underpinning the modification recommendations. For example, structural requirements such as those that dictate slope gradient should be considered and applied in
a suitable manner with possible deviations where appropriate. A ramp which exceeds the recommended 1:14 gradient is likely to negatively affect the manoeuvrability of motorised wheelchairs, the stamina of non-motorised wheelchair users as well as people who are able to walk\(^3\). However, considering the troublesome nature of retrofitting existing homes to fit within AS recommendations appropriate accommodations should be made depending on the ability of the older individual.

The Building Code of Australia (BCA) does not include any private dwelling access necessities for individuals with disabilities; however, suitable alterations to the home environment can be made to satisfy the needs of an occupant with a disability (CSIRO Division of Building Construction and Engineering, 1992; Rudnicka, 2003). Consequently, design requirements dictated within either the BCA or the AS are adoptable as guidelines. Therefore, following the AS for access modifications to an existing community dwelling safeguards the accessibility of the house for the majority of people who may visit the property. Conversely, by applying the AS recommendations too strictly, the design may inhibit the needs of the older adult.

### 2.4.8 Design, emotion and the home

There is more to building modification than applying the correct safety standards. The older inhabitant, with their feelings, attitudes and cultural values, needs to be considered. As people grow older, living arrangements become an essential part of life. In advanced age, participation roles outside the home often regress, particularly for those who may impaired in health or mobility. The household becomes the main the focus of daily life. For many older adults, preserving their own functional independence is a major objective, and remaining in their own homes is the key to this independence (Mynatt & Rogers, 2002). The human home habitat is a very complex environment. It is a reflection of ourselves, how we choose to live, the cultural norms we adhere to, and our desire for physical privacy

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\(^3\) The prevailing context is based on anecdotal evidence from interviews conducted with fall prevention industry professionals (see Chapter Six).
In European and American architectural housing design, there are reasons why bathrooms are located in discrete areas. Plowman et al. (2009) describe this phenomenon as “cultural notions of privacy and intimacy associated with care and nurturing of the body” (p. 34). Houses are not only where we base ourselves; they are nesting grounds for spiritual and personal expression (Plowman et al., 2009). The walls of a home contain memories that are only strengthened by an abundance of emplacement memories such as photo frames of loved ones present and lost. This is very common in the living spaces of older adults.

"Needs arise from the ways in which people perceive their everyday world and how they decide and act upon their own self-determined priorities. The ways in which needs arise thus depend upon the individual, but are also driven by the norms shared with other people within their social group … technological solutions must adequately account for the full complexity of human experience if they are to be useful" (Sixsmith & Sixsmith, 2000, p. 192).

As people grow older, daily routines become increasingly important (World Health Organisation, 2007). They are crucial to older people for many reasons. Basing day-to-day behaviour around a predefined structure aids with memory retention, provides lightweight exercise and motion, gives purpose to the day with tasks to focus on, and provides topics for conversation and opportunities for social interaction. Individuals follow different routines within the home environment, and develop their own habits. These mechanisms must be accounted for when prescribing fall preventative interventions. However, for independent living to be safe and functional, a safe home environment is required. Environmental housing modification for fall prevention presents an opportunity to enable older adults to remain living independently, safely, and happily at home, rather than moving into aged care (Mitka, 2001).

According to Buxton (2007), many products are being released into the public domain that assist in making lives simpler by solving a myriad of daily problems that older adults may encounter. However, the reality is that very few of these solutions last, and many fail to
deliver on their promises. The reason for this is that there is an absence of aesthetic design and an over-reliance on technology rather than on the solution.

2.4.9 Compliance

*Compliance* is the terminology used to describe older adults’ adherence with fall prevention recommendations. This terminology juxtaposes the ideals of person-centredness, as it carries connotations of disobedience or, at the very least, puts the onus of responsibility on the user and not on the provider of the solution. However, in this research, the term will be adopted for the sake of consistency with the body of literature.

Successful compliance with fall prevention recommendations made by occupational therapists and other service providers within healthcare remains a significant barrier to fall prevention (Clemson et al., 1999; Currin et al., 2011; Stevens, Holman, & Bennett, 2001). Older people may disagree with fall prevention interventions, as many see assistive health approaches as stigmatising, and do not consider themselves as people who may require assistance (Plowman et al., 2009). Additionally, fall prevention recommendations made by health professionals result in various compliance rates among older adults. Quite often these are dependent on the magnitude of the recommendations made. For example, when it comes to simplistic fall prevention recommendations (this includes the removal of rugs and floor mats), a compliance rate of 47% was determined (Stevens, Holman, & Bennett, 2001). What may seem an insignificant environmental change for some may be significant for older adults (Connell, 1996). Physically bigger interventions including ramps and railing equipment presented compliance rates as low as 13% (Stevens, Holman, & Bennett, 2001). More recently, one systematic review conducted by Nyman and Victor (2012) has suggested a home modification adherence rate from 58-59%. Whilst there is a quite a variable between these findings, there is scope to increase this rate of compliancy. While the financial implications linked to home modifications contribute to their poor uptake, there are also several government-subsidised services available for people who require financial support.
Clemson et al. (1999) have determined that older adult compliance with fall prevention recommendations made by occupational therapists is directly dependent on the perception and level of control an older person feels regarding their fall prevention planning. Gitlin (2003) has stated that “critical to the concept of personal control is a person’s engagement with his or her immediate environment to afford positive outcomes and buffer threats or actually losses to personal abilities” (p. 195).

2.5 Consideration of theory

There are a variety of theoretical models which aim to provide clarity and characterise human nature and behaviour. Within the following section several models will be presented and discussed to examine and highlight an appropriate foundational model of theory which this research will be based upon.

Social-cognitive theories provide an alternative viewpoint and focus predominantly upon the social cognitive processes and the associated models that bolster the human ability to self-regulate (Caprara & Cervone, 2000). Furthermore, social cognitive theory highlights motivational forethought patterns, these patterns guide human behaviour in both the present and future (Caprara & Cervone, 2000). There are also other theoretical models which share social-cognitive theory’s attention to personal beliefs. For example, cognitive evaluation theory (Deci & Ryan, 1985) contends that challenges and one’s capabilities generate interest in completing tasks. Furthermore, this model suggests that self-determination is a fundamental human need. By contrast, social cognitive theory suggests that self-efficacy is not a need, or a motive, rather it is a cognitive assessment (Caprara & Cervone, 2000).

Control theories relate to how human beings process information and how these mechanisms regulate our behaviour and actions (Caprara & Cervone, 2000). Furthermore, control theories commonly associate self-regulation to a feedback system (Carver & Scheier, 1998). A feedback system contains of four elements and three key steps: (i) an input function examines the given information within the environment; (ii) a comparator then compares this information against our internalised reference values; and (iii)
depending on the correlation between the inputs and values an output function is produced (Caprara & Cervone, 2000; Carver & Scheier, 1998). Remaining consistent with control’s influence upon behavioural regulation, expectations are considered a highly persuasive element in behaviour when there is a focus upon one’s self (Carver, Blaney, & Scheier, 1979).

Control theories are able to frame and encapsulate the hierarchical relationships between human standards and goals. For example, simplistic human goals can be linked and evaluated hierarchically. Caprara and Cervone (2000) provide an example which translates well into this context; they state that people have goals such as prepare dinner and be a better person, but these goals may be linked. For example, for someone, preparing dinner may be a way to make life simpler and easier for their partner, which in effect is a way to be a better person. Therefore, the relationships between goals can be both examined, measured and characterised systematically.

Whilst control theories provide many insights and benefits, they can be criticised. For example, Locke and Latham (1990) have argued that feedback systems are overly structured and do not fully account for the human capacity for choice. However, control theorists contend that goals are both dynamic and changeable, this in turn allows for control models to account for human creativity as well (Carver & Scheier, 1998).

Gitlin (2003) claims that Schulz and Heckhausen’s (1999) control theory provides a promising theoretical grounding to HCI research concerned specifically with home modifications and assistive technologies. Assumptions and medical model frameworks have restricted home modification research in exploring the use of assistive technologies within fall prevention (Gitlin, 2003). Simply viewing adaptive equipment as compensatory mechanisms to improve the functional independence of older adults limits the capabilities of the research. It has been stated that “the potential role of assistive devices in the lives of older people is more far reaching and may include improving everyday competencies and quality in a range of life domains” (Gitlin, 2003, p. 194). This is especially important considering the relationship between older adult functional independence (Mynatt &
Rogers, 2002) and the importance of perceived control in fall prevention recommendations among older adults (Clemson et al., 1999).

Control theory, according to Schulz & Heckhausen (1999), asserts that human beings are driven to preserve control over challenging circumstances in their lives. This is grounded upon the ideal that control is an essential component of being human. To uphold one’s sense of control, human beings adapt numerous strategies, including both primary and secondary mechanisms. The two are different, yet interrelated. A primary mechanism is an active behavioural effort to alter external forces or modify the immediate environment to maximise control. Secondary mechanisms related to this refer to the internal cognitive processes that are triggered to offset a loss of control. These include emotions and other cognitive reframing techniques. The relationship between these mechanisms is dependent on each other, as secondary mechanisms support and enable the use of primary active behavioural strategies.

Independence is directly related to control. In section 2.4.3, two overarching clinical definitions of independence were offered (O’Brien and O’Brien (1998). The first is a rehabilitation model, and relates to those who require assistance as a means to enabling them to assist themselves as they have previously. The second is a support model, whereby the health provider aims to assist those in need to continue living their own lifestyle regardless of their negative circumstances. Combination balances of these two models are common within fall prevention practice, and their relationship and influence on control can be broken down. For example, with a rehabilitation model, control is sought through treatment (primary mechanism) to regain one’s past ability to continue important and self-satisfying activities and tasks (secondary mechanism). Within the support model, continuance of existing abilities is the primary mechanism, while secondary mechanisms may pertain to similar ideals that are in line with the individual’s self-identify. Control retention mechanisms and independence are directly related to person-centredness and home modifications, as both service providers and consumers strive to achieve satisfactory outcomes. Empowerment through control is undoubtedly a factor in achieving this goal. However, person-centredness in fall prevention remains a contentious issue, which is
highlighted in the literature (Eissens van der Laan, van Offenbeek, Broekhuis, & Slaets, 2014; Lord et al., 2007; Scherer, 2014), and in the results of Studies One, Two and Three in this thesis.

The engagement of older adults in person-centred home modification processes would ultimately result in increased older client empowerment and an improved sense of control. Control theory (Schulz & Heckhausen, 1999) is an appropriate grounding for this research, as control is an essential element in fostering accepted fall prevention recommendations for older adults (Clemson et al., 1999). As Gitlin states that “critical to the concept of personal control is a person’s engagement with his or her immediate environment to afford positive outcomes and buffer threats or actual losses to personal abilities” (Gitlin, 2003, p. 195).

As discussed in section 2.4.1, Lord et al. (2007) contend that fall prevention service providers acknowledge that older adults are a heterogeneous group. However, providing person-centred and individualised solutions for older-adult service consumers presents a significant challenge, as it necessitates a significant change in service culture (Lord et al., 2007). To provide older adults with greater opportunities to fully exercise their own primary and secondary control retention mechanisms, it is imperative that fall prevention service providers move away from deficit models of health assessment and promote active participation. While this has been the focus of much of the person-centred research, there are still improvements to be made (Eissens van der Laan et al., 2014; Lord et al., 2007). This requires a reorientation of service focus to accommodate the goals and lifestyles of their older clientele and bolster consumer control. A change in service structure and culture requires engagement with older adults in a manner that reinforces the role of their own goals in determining appropriate fall prevention solutions. This calls into question how to research and design services to facilitate person-centredness and client control within older adult fall prevention.

Control theory (Schulz and Heckhausen, 1999) is an appropriate theoretical model upon which this research will be based. The inherent structure provided by feedback systems within control theory provide a means to evaluate and distinguish the hierarchical
relationships between goals. Furthermore, as goals are a fundamental component within person-centeredness this is a promising approach to understanding the complexities of goal driven fall prevention service structures.

2.6 Service design

Service design is a multidisciplinary field that employs an alternative way of thinking compared with other academic disciplines. Currently, there is no precise definition of service design. This is significant, because not being constrained by definition allows this evolving design domain to expand. The following words are taken from The Copenhagen Institute of Interaction Design 2008, as quoted in Stickdorn and Schneider (2010, p. 30):

“Service Design is an emerging field focused on the creation of well thought through experiences using a combination of intangible and tangible mediums. It provides numerous benefits to the end user experience when applied to sectors such as retail, banking, transportation and healthcare ... Service design as a practice generally results in the design of systems and processes aimed at providing a holistic service to the user ... This cross-disciplinary practice combines numerous skills in design, management and process engineering ... Service design is essential in a knowledge driven economy.”

Sangiorgi and Prendiville, (2014) have claimed that service design is growing in interest across within research, education and the professional community. Whilst service design is a method for internal service innovation, there is also potential for the positive effects to reach beyond organisational boundaries (Sangiorgi & Prendiville, 2014). For example, practice innovations and the associated outcomes can carry into alternative domains.

2.6.1 Services and person-centred care

Services are co-produced by interactions between people (Polaine et al., 2013). For example, an older adult does not use an occupational therapist when seeking fall prevention assistance; rather, they enter into a relationship with the service provider. All
the parties involved co-produce the service experience. Service relationships are therefore critical to consider when working to achieve greater person-centredness. As stated, a change in service structure and culture is required in person-centred fall prevention (Lord et al., 2007). For person-centredness to thrive, consideration of the hierarchical relationships between older adults and service providers is critical. Polaine et al. (2013) support this in saying that “we need to think in terms of designing for relationships and experiences that evolve and change over time, rather than just in terms of short moments of consumption or usage” (p. 36).

2.6.2 Interaction design in services

Interaction design has been defined as the process of “designing interactive products to support the way people communicate and interact in their every day and working lives” (Rogers, Sharp, & Preece, 2011, p. 3). Alternatively, a more HCI–centric interpretation of interaction design can be conceptualised as a design procedure concerned with user experience with computers. Thackara (2001) has described it as “the why as well as the how of our daily interactions using computers” (p. 50). However, Saffer (2010) has offered a more open definition which corresponds with this research: “the art of facilitating interaction between humans through products and services” (p. 4).

Service design provides an appropriate approach to consider technological development in the field. For example, digital platforms play a vital role in services today. However, consideration must be given to the ramifications of technological implementation, so that enhancements progress rather than stifle it. These opportunities and problems have provided the foundation on which service design is built today, this is reinforced by Polaine et al. (2013) stating that “good service design is key to the successful introduction of new technologies” (p. 28).

Interaction design is inherent in the delivery of services, as services generally involve a collection of interactions between users and providers throughout the service journey and experience (Stickdorn & Schneider, 2010). The overlap between service design and human-
computer interaction (HCI) is therefore dependent on this shared relationship with interaction design.

For fall prevention services to provide greater person-centredness, special consideration of the role of their older adult clientele is required to understand how they may wish to interact with the service. A co-creative service experience for older adults is required, via a shared two-way discourse that empowers older adults through constant engagement and encouragement. In this research, therefore, interaction design is highly dependent on ways of interacting with older adults. Communication is important, as this interconnects with digital interaction inside the service, which is an area of increasing importance linked to central service delivery – and a fundamental component of this thesis.

2.6.3 Service design principles

Stickdorn and Schneider (2010) provide five basic principles of service design, which should be considered when conceptualising a new service or evaluating and updating an existing one.

2.6.3.1 User-centred

Services involve people; therefore, a degree of customer participation in the structure of the service is essential. In many cases, services themselves are intangible goods and/or experiences without a physical presence in the real world. Consequently, services are grounded in human-to-human relationships, such as the interactions between service providers and customers. A focus on user-centredness within that relationship is imperative, as the integral purpose of a service process is to meet the needs and requirements of the customer to provide successful outcomes; this is especially the case with person-centred health services.

2.6.3.2 Co-creative

To provide successful services that meet the diverse needs of a heterogeneous customer base, it is essential that services themselves are designed to account for and welcome
various needs and expectations. Services can involve various touchpoints and stakeholder groups as well as non-human touchpoints. A single service offering can be dependent on multiple people within the service relationship. Therefore, it is imperative that a service design process is supported and enabled by a co-creation in developing a structure that is beneficial for all stakeholders involved.

Stakeholders must be included within the design and formation of the service. These range from people higher up in the service structure to those on the front-line, as well as the consumers. To test and assess new service ideas, these various perspectives can be explored through many methods and tools. A co-creative process paying attention to all stakeholders “is a vital aspect of design thinking and a fundamental part of service design” (Stickdorn & Schneider, 2010, p. 39). This is essential, as consumers “get the chance to add value to a service in partnership with the service provider early in the development of the service. The more a customer gets involved in the service provision, the more likely this service is of evoking co-ownership” (Stickdorn & Schneider, 2010, p. 39).

2.6.3.3 Sequenced

Services can be broken down into sequential events that progress over a period of time. The design of a suitable service timeline is a critical point to consider when dealing with consumers.

Fall prevention services are conducted under limited time constraints (Monroe & Rushton, 2008). An appropriate service structure should be able to be broken down into distinct phases. This ensures that the goals of all involved are adhered to, rather than rushing through the service, or stagnating.

2.6.3.4 Evidenced

Many elements of services are intangible events that take place in the background.

In the case of person-centred care, the involvement of the consumer is critical at all levels. This demonstrates to a person that their goals are being respected and considered in the
design of a service. In the case of home modification, much of the conceptual design phase of the service is intangible for older adults. This needs to be reversed, so that older adults can be involved and contribute. This provides them with a greater sense of control over outcomes.

2.6.3.5 Holistic

While services are intangible, they are undertaken within the physical world. Therefore, consideration must be given to the whole environment in which the service takes place.

In fall-preventative home modification, a holistic approach includes consideration of the greater ramifications of an older person’s disablement. Through rounded, person-centred assessment that includes the goals of older adults, service providers can measure and consider the consequences of their recommendations. For example, an optimal holistic fall prevention service would include a co-creative approach to home modification design that is inclusive of older adults’ goals. It would also consider both the positive and negative impacts on an older adult’s functional independence and self-identity.

2.7 Summary and research questions

The research presented in this literature review explores older adult fall prevention. The review investigates the barriers and problems linked to Australia’s ageing population, including one of the greatest problems negatively affecting older adults: falls. Person-centredness, compliance, control, application of new technologies and the design of fall prevention services that use them are also explored.

For older adults, a fall constitutes a severe barrier that restricts their ability to age in place. Falls carry risks of social isolation, stigmatisation, injury and death. Creating safer living spaces for older adults is imperative, as this is an essential component of ageing in place. Environmental home modifications are a common approach to mitigating risks and hazards within the living spaces of many older adults; however, significant barriers exist relating to
uptake of and compliance with home modifications. These are typically linked to stigmatisation and a loss of personal control.

Occupational therapists and other related fall prevention professionals aim to provide person-centred home modifications to their older clientele. A systematic review of the literature with regards to design processes and person-centred fall prevention have yielded scarce results. Therefore, empowerment through design processes linked to person-centredness may be novel and require investigation. It is essential to understand the processes underpinning this in order to investigate the service barriers that can be identified and mitigated to increase older adult control, and lead to greater person-centredness.

The insights gathered from the review of the literature, including the knowledge gaps and formulation of the research questions, were presented as part of The 6th Biennial Australian and New Zealand Falls Prevention Conference (Lo Bianco, 2014). The research question is presented in the following section.

2.7.1 Research question

Based on the review of the relevant literature, it has been deduced that there are significant issues and knowledge gaps that negatively affect the application of fall preventative home modifications for older adults. Issues pertaining to design communication, empowerment and the sustainability of self-identity restrict the compliance of older adults with home modifications. Therefore, the primary question driving this research is as follows: how should fall prevention home modification services be delivered to achieve person-centredness?
Chapter 3. Methodology

“Human beings are engaged in all kinds of efforts to make the world a better place. These efforts include assessing needs, formulating policies, passing laws, delivering programs, managing people and resources, providing therapy, developing communities, changing organizational culture, educating students, intervening in conflicts, and solving problems. In these and other efforts to make the world a better place, the question of whether the people involved are accomplishing what they want to accomplish arises. When one examines and judges accomplishments and effectiveness, one is engaged in evaluation. When this examination of effectiveness is conducted systematically and empirically through careful data collection and thoughtful analysis, one is engaged in evaluation research.”

(Patton, 2002, p. 10)
3.1 Overview

This chapter provides a summary of the research methods that have been applied to answer the primary research question and the secondary research questions in this thesis. The primary research question is presented in Chapter 2, Section 2.7.1. The sub-research questions are presented in the next section of this chapter. Chapter 3, Section 3.2 provides a summary of the research design. The positioning of this qualitative analysis, the nature of user-centred design research within the preventative health service paradigm and theoretical developments are discussed in Chapter 3, Section 3.3. Data collection is divided into three consecutive studies, with their methods described in detail in Chapter 3, Section 3.4. The three data collection studies are followed by two conceptualisation stages, and are presented in the following order: Study One, Conceptualisation Stage One, Study Two, Study Three and Conceptualisation Stage Two. Each stage within this research has its own aims and outcomes that build together as the thesis progresses. These are detailed in Sections 3.5, 3.6, 3.7 and 3.8. These various stages aim to answer the primary and subsequent research questions that guide this thesis. Table 3.1 provides an overview of the research design and accompanying research processes.

3.2 Research design

To address the primary question underpinning this research—‘how should fall prevention home modification services be delivered to achieve person-centredness?’—a combination of both empirical and conceptual research stages is undertaken. To address the primary research question, the subsequent research questions are structured in a manner that produces holistic and rounded insights. These include:

- What is the role of older adult goals in fall prevention?
- What are the contrasting ideas between industry professionals and older adults regarding fall prevention within the home?
- How can the goals of older adults guide the conceptualisation and design of fall prevention solutions?
How can new technologies for fall prevention support the interaction between older adults and industry practitioners?

<table>
<thead>
<tr>
<th>Empirical/conceptual research phase</th>
<th>Applied research method</th>
<th>Purpose and outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study One&lt;br&gt;<strong>Fall prevention industry and service delivery insights</strong></td>
<td>Document analysis: 60 cases</td>
<td>An <em>exploratory study</em> to gather insights into: &lt;br&gt;- Fall prevention industry practice based on policy &lt;br&gt;- Fall prevention service structure and delivery &lt;br&gt;- The goals of older adults and care providers &lt;br&gt;- Communication and language used to communicate goals</td>
</tr>
<tr>
<td>Conceptual Stage One&lt;br&gt;<strong>Creation of Augmented Reality Environmental Visualisation Tool (AREVT)</strong></td>
<td>Prototyping (solution development)</td>
<td>Development of a digital visual platform to facilitate goal-oriented design communication between fall prevention clinician and client</td>
</tr>
<tr>
<td>Study Two A&lt;br&gt;<strong>Industry insights</strong></td>
<td>Semi-structured interviews: 11 participants</td>
<td>An <em>in-depth field study</em> to gather detailed fall prevention industry insights into: &lt;br&gt;- Challenges and barriers in practice &lt;br&gt;- Person-centred care &lt;br&gt;- Future insights &lt;br&gt;- Contributions from multiple professionals (or professions) to fall prevention</td>
</tr>
<tr>
<td>Study Two B&lt;br&gt;<strong>AREVT assessment</strong></td>
<td>Semi-structured interviews, prototyping and observations: 11 participants</td>
<td>An <em>evaluation study</em> of the AREVT &lt;br&gt;- Insights into the use of augmented reality within fall prevention service delivery &lt;br&gt;- Prototyping to explore the potential service placement of the AREVT as a clinical home modifications design tool</td>
</tr>
<tr>
<td>Study Three A&lt;br&gt;<strong>Older adult insights</strong></td>
<td>Semi-structured interviews and observations: 10 participants</td>
<td>An <em>in-depth field study</em> to understand: &lt;br&gt;- Daily lives, routines, goals and home environments of older adults &lt;br&gt;- Older adult client experience within fall prevention services</td>
</tr>
<tr>
<td>Study Three B&lt;br&gt;<strong>AREVT assessment</strong></td>
<td>Semi-structured interviews, prototyping and observations: 10 participants</td>
<td>An evaluation of AREVT &lt;br&gt;- Insights into the use of augmented reality within fall prevention service delivery &lt;br&gt;- Prototyping to explore the potential service placement of the AREVT as a clinical home modifications design tool</td>
</tr>
<tr>
<td>Conceptual Stage Two&lt;br&gt;<strong>Creation of a service model for person-centred fall prevention</strong></td>
<td>Service model development</td>
<td>Development, justification and proposal of a novel service design process (see Chapter 7)</td>
</tr>
</tbody>
</table>
Study One is an exploratory investigation to gather an overview of the process of fall prevention from an industry perspective, and to assess the input older adults have into their own fall prevention interventions.

Conceptualisation Stage One builds on the insights gathered from Study One and the review of the related literature to create a technology prototype for evaluation and consideration in Studies Two and Three.

Study Two A investigates older adult fall prevention from a variety of industry perspectives to gather holistic insights into the specific procedures and components of service design and delivery that can be advanced. Study Two B examines the use of an augmented reality environmental visualisation tool (AREVT) within the field to gather industry insights into digital advancements to service design and delivery, and how these relate to the person-centredness of the service provided.

Study Three A comprises a series of interviews with older adults in their homes to gather insights into their daily lives, goals and habitual routines in their home environments, and how these environments contribute to their self-efficacy and perception of self-identity. The use of augmented reality as a home modification design communication tool (AREVT) is investigated in Study Three B.

Conceptualisation Stage Two refers back to the literature review and the research undertaken within the thesis. A fall prevention service model will be theorised and presented which encapsulates the findings from the thesis.

Prior to presenting the detailed methodological approaches of each of these studies, the importance of a pragmatic approach to design ethnography is discussed, as is the combination of design research and preventative healthcare.
3.3 Design ethnography and HCI

3.3.1 User-centred design

User-centred design (UCD) utilises a wide variety of research methods, such as semi-structured interviews and usability evaluations (Rosson & Carroll, 2002). It is related to human-centred design (HCD), a research and design methodology that includes human insight, empathy and input at all levels of the problem-solving process (LUMA Institute, 2012). UCD is primarily a user interface design process that targets user goals, user characteristics, the environment, tasks and workflow. UCD is a constant process where design and evaluation constitute a key focal point throughout a project. Rosson and Carroll (2002) state that the principles of UCD are initial emphasis on users and tasks, empirical measurement and assessment of product usage, and iterative design. As discussed in the literature review (section 2.4.1), person-centred care is an ideology with a distinct focus on individuals and goals (National Ageing Research Institute, 2006; Sanderson, 2000; Sanderson et al., 1997). Due to the similarly strong focus on the empowerment of users, there is an opportunity to bring these paradigms together to create enabling fall prevention technologies for older adults in the field of human-computer interaction (HCI).

However, HCI is not without its own risks and barriers. While we as researchers aim to empower those who require assistance, we must first examine our own approaches and methods to create enabling solutions. Rogers and Marsden (2013) speak out against sugar thinking in their article, Does He Take Sugar? Moving Beyond the Rhetoric of Compassion. Sugar thinking is used as a metaphor to describe the mentality of those who aim to provide help for people in need from a non-inclusive, third-person standpoint. Rogers and Marsden (2013) contend that sugar thinking is prevalent in HCI research and design, and this lack of understanding and consideration cultivates “solutions to compensate and overcome rather than to innovate” (p. 49). Jordan (2000) discusses the limitations of conventional usability-based design methodologies, and argues that these methods have the potential to be limiting and dehumanising because of their purely functional nature. As an alternative, Jordan (2000) suggests that the relationships between people, products and human factors
should be considered holistically. This accounts for the broader relationships and life experience of the individuals at the centre of the design process.

There are many generalisations and stereotypes that still exist when designing for older adults (Campbell et al., 2005; Cumming et al., 1999; Day et al., 2002; Nikolaus & Bach, 2003; Pardessus et al., 2002a, 2002b; Stevens, Holman, Bennett, & de Klerk, 2001). Durick et al. (2013) present an in-depth review of the literature to highlight many of the myths and stereotypes that persist in technology design for older adults. These myths suggest that older people are the same as each other, socially isolated, unwell, unable of learning new or existing technologies. They exist within gerontology, gerontotechnology\(^4\), HCI and associated government publications (Durick et al., 2013). Vines, Pritchard, Wright, Olivier, and Brittain (2015) conducted a critical analysis of 644 papers published within the ACM Special Interest Group on Computer-Human Interaction (SIGCHI) over the past 30 years. They found that older people are often presented as a homogenous group: “It was notable how relatively few papers explored the heterogeneity of our ageing population” (p. 13). This was especially apparent when older and younger user groups were compared.

### 3.3.2 Co-creation with older adults and HCI

According to Stegeman, Otte-Troje, Costongs, and Considine (2012) “projects and programs show the best results when older people are involved in the project design and implementations ... when older people contribute to the project as networkers ... and when the action responds to older people's feedback” (p. 3). In support of this, Bannier et al. (2013) claim that in the last half a century we have seen a dynamic shift in how society views ageing and co-creation. Co-creation will “not only increase the understanding of the perceptions of gerontotechnology and the acceptance of new technologies as we grow old, but it also systematically and sustainably maintains, advances and taps the rich knowledge and experiences base of senior citizens” (p. 3). Furthermore, Bannier et al. (2013) argue

\(^4\) Technology that answers the needs of ageing society: research, development and design in the engineering disciplines based on scientific knowledge about the ageing process.
that methods of ageing research should emphasise the positive aspects of this significant social group. For example, Bannier et al. (2013) states that “it has been clearly argued that both society as well as the older individual is responsible for creating and maintaining successful ways of ageing” (Bannier et al., 2013, p. 2). Therefore, it is imperative that researchers harness and utilise the knowledge and wisdom of older adults.

Co-creation between researchers, designers and older adults is important to achieve more robust solutions within HCI. Engaging with older adults is prevalent in the research design process (Pedell, Marshall, Miller, & Sterling, 2013; Waycott et al., 2013). Social innovation that is inclusive of older people allows for a more pragmatic approach to design for older adults, and creates various opportunities within design research. Moreover, “gerontechnology has already proved to be a perfect interdisciplinary domain for incorporating co-creation within its design and development processes” (Bannier et al., 2013, p. 7). By pushing the boundaries of co-creation, users can be empowered to interact with technology in novel and innovative ways (Rogers & Marsden, 2013).

Fisk (2003) contends that if the needs and desires of older people are not taken into consideration when designing these systems, there is a “risk of adopting approaches that are too closely associated with medical, and disempowering, models of older age” (p. 243). Vines et al. (2015) argue that by truly engaging with older adults and learning about their goals, we may gain insights into alternative measures of what success in later life means to older adults. Bannier et al. (2013) support this argument, stating that “ageing strategies should not only emphasize the importance of senior citizens participating, but also highlight the well being of this particular social group” (p. 2). The interdisciplinary field of gerontechnology offers an opportunity to utilise co-creational processes to mitigate poor design and foster harmonious user experiences that are safer.

An emerging trend in the co-creational design process is allowing vulnerable participants to have a voice, and to express their own opinions and design recommendations (Lakeman, McAndrew, MacGabhann, & Warne, 2013; Leonardi et al., 2008; Plowman et al., 2009; Waycott et al., 2012). Enabling vulnerable individuals to articulate themselves and express their own narratives and life experiences lends a voice to those who commonly perceive
themselves as being in a position of inability (Holloway & Freshwater, 2007; Sandelowski, 1994). Furthermore, the ability to express oneself is “central to the process of how human experience can be made meaningful” (Lakeman et al., 2013, p.4). It is necessary to reflect, respect and reciprocate the needs and expectations of older adults when considering and designing these novel approaches to care for older adults (Demiris & Hensel, 2008; Demiris et al., 2008).

3.3.3 Design ethnography

The research presented in this thesis follows a qualitative approach (Patton, 2002), allowing for greater specificity and detailed descriptions of the life experiences of all participants involved—directly or indirectly—with fall prevention. To gather a holistic view of the multifactorial barriers associated with falls and fall prevention, it is vital to obtain in-depth and non-adulterated insights into the lives, attitudes, beliefs, goals and experiences of both care providers and care receivers. By gathering detailed insights into their lives, qualitative research provides the opportunity to experience the activities of everyday life through the eyes of the population being studied (Patton, 2002). This is a distinctive component of this thesis.

Qualitative research typically relies on three fundamental data-gathering methods: interviews, participant observations and document/artefact analysis (Wolcott, 1995). This thesis follows a mixed method approach by employing document analysis, semi-structured interviews, prototyping and observations. Details of the specific research methods employed are described in Chapter 3, Section 3.4.

The pragmatist paradigm follows the right tool for the right job position (Patton, 2002). Pragmatism “focuses instead on ‘what works’ as the truth regarding the research questions under investigation” (Tashakkori & Teddlie, 2003, p. 713). Patton (2002) reinforces this claim:

“Being pragmatic allows one to eschew methodological orthodoxy in favour of methodological appropriateness as the primary criterion for judging methodological
quality, recognising that different methods are appropriate for different situations (p. 30).

Using a pragmatic mixed methods approach is in accordance with User-Centred Design (UCD) (Beaudouin-Lafon & Mackay, 2012; Norman & Draper, 1986). The combination of these two approaches is suitable, as the nature of the research undertaken within this thesis is highly context specific. Furthermore, UCD maintains human requirements as the dominant focus throughout the development process, and utilises a range of established research methods, including ethnographic field studies, user evaluation and iterative prototyping (Beaudouin-Lafon & Mackay, 2012). Patton (2002) supports this combination approach:

“In real-world practice, methods can be separated from the epistemology from which they have emerged ... The methods of qualitative inquiry now stand on their own as reasonable ways to find out what is happening in programs and other human settings” (pp. 136-137).

As a research methodology, ethnography has been established and used within various social sciences including sociology and anthropology. Ethnography is fundamentally a *description of people* (Stickdorn & Schneider, 2010). It has evolved substantially since Maliowski first stated that ethnographers ought to consider the point of view of their research subjects to avoid projecting their own biases upon them (Malinowski, 1922). In the context of research conducted in today’s age, ethnography has expanded to investigate a wide variety of social, urban, health and industrial research paradigms. Along with this expansion, the accompanying research methods have also progressed to incorporate “more interaction, conversation and co-creation” (Stickdorn & Schneider, 2010, p. 109).

Design ethnography differs from typical ethnography in that it is set in the design context, and “it delivers results that inform and inspire design processes ... it offers reference material on people’s everyday lives: their practices, motivations, dreams and concerns” (Stickdorn & Schneider, 2010, p. 109).
Applying a design ethnography approach to fall prevention health services generates superior real-world understandings from multiple stakeholders in this multifactorial and policy-driven health industry. In focusing on those most affected by fall prevention—older adults—the aim is to create a positive impact on people’s lives. Furthermore, it has been stated that “design ethnography explicitly aims to generate materials that communicate the insights from the research to a wide group of stakeholders, to make sure that the foundations for the designs are well understood and accepted ... Design ethnography is about facilitating empathetic conversations between users, clients and designers, as well as other experts and stakeholders involved in the service design” (Stickdorn & Schneider, 2010, pp. 109-110). Therefore, methods that focus on older adults and provide them with a voice are vital to the achievement of balanced hierarchical placement in person-centred services and empowering outcomes.

All studies in this research have received full ethics clearance from two governing ethical bodies. Details can be found in Appendix A.

3.4 Methods employed

The methods used in this research are discussed in this section. The data collection methods include document analysis, semi-structured interviews, prototyping and observations. Content analysis and concept mapping were employed during analysis, in conjunction with triangulation of the data.

3.4.1 Data collection

3.4.1.1 Document analysis

Document analysis is defined as a method to investigate documented materials that can include letters, reports, drawings, newspapers, minutes of meetings, agendas, summaries and institutional reports, among other things (Bowen, 2009). Merriam (1988) states that “documents of all types can help the researcher uncover meaning, develop understanding, and discover insights relevant to the research problem” (p. 118). To gain understandings,
insights and develop empirical knowledge, the documentation collected must be evaluated. This process itself yields data in the form of finding, selecting and deducing content found in the documentation. Following this process, these excerpts, which can take the form of quotations, textual references and entire passages, are then thematically categorised through a process called ‘content analysis’ (Labuschagne, 2003).

As a research method, document analysis has the distinct advantage that the data content is attainable without being influenced by the investigation. The content itself does not alter, and the investigation does not typically interfere with the creation of the documents in the first instance (Bowen, 2009). In addition, document analysis is typically conducted in conjunction with a variety of other research methods as a means of data triangulation through “the combination of methodologies in the study of the same phenomenon” (Denzin, 1970, p. 291). This is the case in this research, as document analysis is employed as the primary research method in the early exploratory investigation, Study One. The findings gathered from this preliminary study are further substantiated and scrutinised in the following research methods.

3.4.1.2 Semi-structured interviews

Interviews conducted to gather information from a subject can be structured, semi-structured or unstructured (Patton, 2002; Wengraf, 2001). Depending on the objectives of the interview, the level of structure of an interview procedure can vary significantly (Mason, 2004). An unstructured interview allows the researcher to alter the design, conduct and interview sequence at will within a free-flowing format. Structured interviews have a rigid and restricted set of questions to which the researcher adheres. Semi-structured interviews are the middle ground between a precise interview format and complete freedom. A semi-structured interview is adaptable, allowing new questions to emerge throughout the interview process as insights are gathered from the interview subject (Wengraf, 2001). Within the semi-structured interview format, the researcher typically follows a framework of distinct themes that will be explored in the interview (Patton, 2002; Wengraf, 2001). The interview procedure itself must be well designed. Open questions are formulated in such a way that enables questions to be asked that were not
included in the initial set of questions. These subsequent questions are improvised in a thorough and theorised manner that aligns with the aims and objectives of the interview itself. As the interview progresses through themes and areas of interest, the researcher may probe emerging areas of significance more deeply, whether these were anticipated prior to the onset, or emerge as new insights. To conduct this type of interview, questions should not be suggestive in a way that yields data imbued with the researcher's own assumptions and biases. Complete neutrality is required to allow the interview subjects to work through, distinguish their own answers and provide insights that may not have been anticipated by the researcher. Open-ended questions are asked to incite interview subjects to provide detailed answers and descriptions. This enables the researcher to investigate their motivating thought processes (Patton, 2002). While the conduct of a semi-structured interview usually differs from participant to participant, it is important for the researcher to keep to the themes of the interview. This helps ensure regularity in the findings derived from interview subjects (Mason, 2004; Patton, 2002; Wengraf, 2001). Semi-structured interviews are employed in this research in Studies Two and Three.

3.4.1.3 Prototyping

Design concepts are typically grounded in experience, and prototyping provides an opportunity to communicate to anticipated end users the tangibility of predicted design models and ideas (Koskinen, Zimmerman, Binder, Redström, & Wensveen, 2011; Yvonne. Rogers et al., 2011). Rogers (2011) stated that “a prototype is one manifestation of a design that allows stakeholders to interact with it and to explore its suitability; it is limited in that a prototype will usually emphasize one set of product characteristics and de-emphasize others” (p. 390). Prototyping is a way to understand, experience and feel an interaction, and to assist designers in understanding how people experience concepts, how they interact with them and how they feel about them through an authentic and tangible experience (Koskinen et al., 2011; Rogers et al., 2011).

As a process, design itself goes through many different iterations. Within design research, these explorations are much more common; however, they must also be structured and methodical to adhere to the overall aims of the research. Prototyping for design research
differs from its industrial counterpart. For example, it typically diverges in regard to technical testing, robustness and manufacturability. Prototypes are commonly deployed in design research as a proof-of-concept device, but this does present difficulties. For example, hypotheses in prototypes characteristically concern future usage scenarios, creating a disconnection with the present. In addition, there is the risk of ‘tunnel vision’, as the researcher may focus on the prototype itself rather than its true premise, the social characteristics linked to it, and technological development (Rogers et al., 2011).

Conceptualisation Phase One resulted in the production of a prototype for evaluation and consideration in the user context in Studies Two and Three. To mitigate the issues associated with prototyping, the prototype is based on substantiated conclusions drawn from the literature and the exploratory Study One. It is also grounded in client person-centredness, and is evaluated as a tool to assist fall prevention clinicians to communicate design in a way that is comprehensible to their clients.

### 3.4.1.4 Observation

Observation is applying distinct attentiveness to human behaviours to develop understandings about natural subject behaviours in the context of the research being conducted. Typically, observations are undertaken in the field to understand how activities occur in a real situational context. There are three steps for participatory observation (Spradley, 1980):

- Descriptive: to become familiar with the context examined;
- Focused: to focus on specific procedures and issues related to the research question;
- Selective: to highlight instances from the results of the ‘focused’ phase.

In Study Three, observation takes place as a supplementary data-gathering technique through photographic documentation to ascertain how participants moved about their own homes, and how everyday goals and physical locations are connected in the context of the home. These techniques were incorporated into the semi-structured interviews that took place in the homes of older adults. The process of conducting observations in their homes
and documenting their stories, goals and lifestyles with photographs enhances and enriches the results produced from the transcriptional data.

### 3.4.2 Data analysis

#### 3.4.2.1 Content analysis

Content analysis is a technique used to interpret material that can take many forms, including text, themes, pictures, symbols and ideas (Cavanagh, 1997; Hsieh & Shannon, 2005; Scott, 2006). Content analysis is a systematic procedure typically applied to data yielded from a document analysis. It aims to organise, categorise thematically and highlight case examples from the collected data (Labuschagne, 2003). Patton (2002) states that “content analysis is used to refer to any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings” (p. 453). Applications of content analysis typically undertake three determinative approaches: conventional, directive or summative (Hsieh & Shannon, 2005). While these three approaches differ in their method, the overall aim of content analysis is to extract meaning from the data collected (Cavanagh, 1997; Hsieh & Shannon, 2005; Patton, 2002; Scott, 2006). The three methods of content analysis are summarised in the table below:

<table>
<thead>
<tr>
<th>Type of content analysis</th>
<th>Study starts with</th>
<th>Timing of defining codes</th>
<th>Source of codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional content analysis</td>
<td>Observation</td>
<td>Codes are defined during data analysis</td>
<td>Codes are derived from data</td>
</tr>
<tr>
<td>Directed content analysis</td>
<td>Theory</td>
<td>Codes are defined before and during data analysis</td>
<td>Codes are derived from theory or relevant research findings</td>
</tr>
<tr>
<td>Summative content analysis</td>
<td>Keywords</td>
<td>Codes are identified before and during data analysis</td>
<td>Codes are derived from interest of researchers or review of literature</td>
</tr>
</tbody>
</table>

In this research, a conventional approach to content analysis is undertaken. In order to categorise fundamental consistencies and definitions, the data collected from the document
analysis is investigated to highlight frequently-used words and themes. The processes involved in content analysis include coding, categorising, classifying and labelling key patterns in the data. These patterns are considered to be repeating descriptive themes within the data (Saldaña, 2009).

Inherent in content analysis is a coding procedure. Coding begins by reading through the collected data several times. With successive readings, initial coding categories and patterns begin to emerge in the data. This process can include annotation of the data with indexes and codes (Hsieh & Shannon, 2005; Saldaña, 2009). These initial coding runs are referred to as open coding, which has been defined as “the transitional process between data collection and more extensive analysis” (Saldaña, 2009, p. 4). This process needs to be undertaken many times to arrive at a comprehensive collection of indexes and codes to summarise large portions of the data. Axial coding is then undertaken to understand the interconnections and relationships between codes and themes (Saldaña, 2009). This process develops an understanding of connections between categories and subcategories, and helps determine processes to identify a theoretical framework that reinforces the analysis. A key advantage of content analysis is that it assists in drawing consistent themes and findings from a wide variety of collected data. This is especially important when data takes many forms, such as photographs, sketches and text. This conventional content analysis procedure follows the pragmatist approach, in that it seeks to investigate the research without being influenced initially by theory or the researcher’s own biases.

In this research, content analysis is applied in Studies One, Two and Three. The method is applied to written, visual and spoken material.

**3.4.2.2 Concept mapping**

Concept mapping is a method to structure knowledge in a manner that illustrates relationships between concepts; these can be codes, themes and categories (Novak & Cañas, 2008). The product of the method—a concept map—generally denotes coded data within squares, circles or other shapes that connect with lines and/or labelled arrows so that sub-relationships can be visualised, as well as hierarchical structure in some cases.
(Novak & Cañas, 2008). The relationships between codes can be linked to identifying phrases such as *causes, requires, or contributes to* (Moon, Hoffman, Novak, & Cañas, 2011; Novak & Cañas, 2008). Concept maps are typically employed to assist in the generation of ideas (Novak & Cañas, 2008).

In this research, concept mapping is employed in Studies One, Two and Three to generate hierarchical relationship maps between codes derived from the data. Concept mapping is employed during the axial coding phase of the content analysis procedure to generate, highlight and understand the surface and sub-relationships of the codes generated during the content analysis. This process is aided by a supplementary web-based application called *Popplet*.

### 3.4.3 Data quality

Qualitative data analysis renders different outcomes that are unique to the individual researcher conducting the analysis. Substantiation of qualitative results is often a challenge, so supplementary measures are required to prove that the findings uncovered are the result of high-quality data. Qualitative inquiry’s strengths are rooted in the richness of the data gleaned through the abilities and insights of the individual(s) carrying out the analysis.

There is a danger that results may be biased towards the researcher’s own understandings of the data; this can be addressed via data triangulation.

#### 3.4.3.1 Triangulation

Triangulation is a technique that utilises multiple methods of data collection and analysis approaches to increase the credibility of the research findings by demonstrating commonality across the conclusions drawn (Guion, Diekl, & McDonald, 2011). As a process,

5 http://popplet.com/
it involves scrutinising and contrasting results against other data sources and perspectives to increase the credibility and quality of the findings. It does this by disputing discrepancies between findings that may be caused by a single, stand-alone research method, data source or researcher.

While the principle remains the same, there are different triangulation methods. When considering this research, method triangulation is adopted, as is partial researcher triangulation via the presence of a secondary researcher in Study Three. For example, different data collection methods and data types are used prior to conducting multiple analyses to generate and review research findings. Furthermore, method triangulation can be accomplished by utilising different research methods to produce similar findings. For example, applying observational methods to an interview will generate more in-depth understandings of what is being noted by the researcher. Another approach is investigator triangulation (Guion et al., 2011), whereby multiple observers aid in reducing potential biases. This provides a means to consistently assess and interpret the data (conducted in Study Three).

3.5 Study One: Contextualising current fall prevention practice

Study One addresses two of the underpinning research questions:

- What is the role of older adult goals in fall prevention?
- How can the goals of older adults guide the conceptualisation and design of fall prevention solutions?

To gain clarity and unadulterated insights into a complex and policy-driven health care field, an exploratory approach is required to answer these two research questions. A document analysis approach is used, in which 60 individual fall prevention cases are examined. Each case contains multiple document types that contribute to various fall prevention outcomes. Table 3.3 demonstrates the overall research design of Study One.
Table 3.3 Study One research design

<table>
<thead>
<tr>
<th>Empirical or conceptual phase</th>
<th>Study One: Fall prevention industry and service delivery insights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary research question</td>
<td>How are fall prevention services currently delivered to provide person-centred outcomes to their clients?</td>
</tr>
</tbody>
</table>
| Sub-research question(s)      | - How do the goals and preferences of older adults guide the conceptualisation and design of fall prevention solutions?  
|                               | - What supports and tools do fall prevention professionals have to assist them? |
| Research method applied       | Content analysis (conventional) |
| Data collection techniques    | Document analysis |
| Purpose and outcome(s)        | An exploratory study to investigate the field, legislative and safety requirements of fall prevention services, communication and comprehension of older adult goals and design preferences within those outcomes. |

Documents were sourced from two separate fall prevention service providers (Organisations A and B), and were provided anonymously in accordance with the approved ethical procedures. A numerical breakdown of the data yielded from the document analysis data collection process is summarised and presented in Chapter 4, Section 4.3.2.

This preliminary study was exploratory, and sought to generate rich data and insights about the fall prevention industry. This was essential to grounding this research in up-to-date practice, extending beyond the literature, and in contributing findings pertaining to the client journey of older adults within fall prevention services. The findings from this study generate new knowledge and ideas that can be harnessed and examined further in subsequent studies. It is beneficial to conduct such a general exploratory examination of the industry side of fall prevention, as it assists in gaining a better understanding of this policy-driven and rapidly developing industry.

Study One is undertaken to comprehend better the role of older adults in their own fall prevention, and the influence that their goals and ideas carry when designing outcomes to suit their needs. The overall aims of Study One are:
• Explore the multi-site conduct of fall prevention services and how interrelated agencies and service contributors interact within the fall prevention eco-system
• Investigate how the goals of older adults are determined and documented within fall prevention
• Examine the specific methods of fall prevention applied by service providers and clinicians, specifically home modifications
• Generate design drivers that build from the goals of older adults to enable more person-centred processes within fall prevention

Study One consists of document analysis and successive content analysis research, and includes data retrieved from two service providers. The data collected was created by fall prevention service providers prior to this project, and therefore is not influenced by this study. The advantage of the document analysis approach is that the data itself has been generated without being influenced by the investigator, and represents a real-world account of the complexities and intricacies of the fall prevention service process.

The content analysis method was chosen to analyse the data collected from the document analysis. An applied concept mapping technique was applied to the data to generate a single established hierarchical mapping tree of the themes and codes that emerged from the content analysis.

3.6 Creation of a digital visualisation tool

Conceptualisation Phase One sits between Study One and Study Two, and is concerned with the creation of a digital visualisation tool for fall preventative home modifications. This work builds on two distinctive paradigms: design theory (Gregor, 2002; Hevner, March, Park, & Ram, 2004; March & Smith 1995; Walls, Widmeyer, & El Sawy, 1992) and control theory (Schulz & Heckhausen, 1999).

Design theory promotes innovation; it aims to improve the abilities of individuals and groups by generating novel interventions and artefacts. The construction of a design artefact requires in-depth knowledge and understanding of a problematic area (Gregor,
Furthermore, artefacts grounded in design theory can take the form of constructs, models, instantiations and methods (March & Smith 1995). In conjunction with design theory, control theory delivers a theoretical grounding for HCI research concerned specifically with fall preventative home modifications for older adults (Gitlin, 2003; Schulz & Heckhausen, 1996, 1999). Control theory is applicable as a secondary foundation for this research, as control is a vital component in the development of empowering home modification outcomes for occupational therapy processes (Clemson et al., 1999; Gitlin, 2003; Lo Bianco, Pedell, Renda, & Kapoor, 2015a; Schulz & Heckhausen, 1996, 1999). Furthermore, Gitlin (2003) states that “critical to the concept of personal control is a person’s engagement with his or her immediate environment to afford positive outcomes and buffer threats or actual losses to personal abilities” (p. 195). Within this research, an Augmented Reality Environmental Visualisation Tool (AREVT) is conceptualised, generated and evaluated. This contributes to occupational therapy methods as well as to ways in which empowerment and person-centredness can be encapsulated and improved through the use of digital technologies.

Gregor (2002) has described design theory as an “applied discipline, one in which our work should provide guidance to people who have to take action in the world” (p. 20). When applying design theory to a problem area, one goal is to generate novel innovations that outline methods in which the design can be conducted in a manner that is both effective and efficient (Hevner et al., 2004). This is in line with the pragmatist paradigm. As March and Smith (1995) have stated, instead of modelling and contributing new theories, designers aim to create innovative models, methods and implementations.

Design theory addresses the conceptualisation and construction of a design artefact as well as the aesthetic result; these two aspects of the design process are connected. The initial phase is concerned with development process knowledge, mindfulness of the processes involved in fall risk assessment, the implementation of interventions and recommendations, and the goals of older adults that should be driving these person-centred processes. Secondary to this, it is necessary to understand the limitations of fall prevention services, and to determine how the home environment can be modified within
the scope of the service. Based on this knowledge from the fall prevention field, the research aims to develop a tool to address the gaps highlighted within the preceding Study One.

Gitlin (2003) proposes that control theory (Schulz & Heckhausen, 1999) is an appropriate grounding for HCI research concerning home modifications for older adults. In Chapter 2, the problems and gaps in fall prevention practices are uncovered through the literature review. These insights form the basis of my rationale for Study One. Building on the findings from the literature and the field investigation in Chapter 2, I have produced a prototype tool. The tool is a digital platform that allows fall prevention providers to communicate and reflect the goals of adults through a shared design experience. This ultimately allows adults to be active contributors to their own fall prevention, rather than passive receivers. There were three overarching aims of this conceptualisation phase:

- Substantiate the use of digital visualisation technologies within fall prevention, and how they can be utilised in an empowering manner
- Allow for various environments, goals, lifestyles and circumstances
- Create a portable platform where the design process can be a tangible and empowering experience for older adults

Guidelines for proper conduct, evaluation and implementation provide grounding and scope within the generation of design artefacts. Hevner et al. (2004) developed a series of guidelines, the first two of which are applicable to the first conceptualisation stage: design as an artefact and problem relevance. Furthermore, Lo Bianco et al. (2015a) provide a series of HCI guidelines to empower older adults with considered and designed fall preventative technologies. In Conceptualisation Phase One, the guidelines of Hevner et al. (2004) and Lo Bianco et al. (2015a) are considered, and are embedded in the generation of the AREVT. Using both approaches is advantageous, as Hevner et al. (2004) address design theory and artefact generation, whereas Lo Bianco et al. (2015a) focus on empowerment and the role of the individual within person-centred HCI. The guidelines employed are as follows:
• *Design as an artefact:* Hevner et al. (2004) state that “design-science research must produce a viable artefact in the form of a construct, a model, a method or an instantiation” (p. 86).

This guideline asserts that the generation of novel design artefacts is obligatory when conducting design research. In this research, the data from Study One has been used to generate, substantiate and reaffirm the use of an innovative platform to deliver services in an innovative manner. Furthermore, the fundamental hypothesis is that use of the ARVET will ultimately lead to better understanding, safer and more empowering fall prevention solutions through enhanced engagement between clinicians and clients. This assumption is reinforced by the literature. For example, Clemson et al. (1999) argue that the level of control an older adult perceives they have in their own home leads to a higher level of compliance and acceptance of fall prevention recommendations. Nyman (2011) reinforces this by asserting that the likelihood of older adults engaging with fall prevention services is increased if recommendations are seen to be in line with their own self-identity, goals and preferences. Therefore, I expect that the AREVT will assist older adults to be active contributors to their own fall prevention outcomes, and that it fosters solutions that are in accordance with the client’s goals, objectives and self-identity.

• *Problem relevance:* Hevner et al. (2004) contends that “the objective of design science research is to develop technology-based solutions to important and relevant business problems” (p. 86).

The design artefact is required to be specific to the problem it aims to solve. In the case of this research, this aim is ultimately to prevent falls of older adults. However, as fall prevention is a process that involves many key stakeholders, the entire eco-system within which the AREVT is to be used must be considered. Otherwise, there may be problems with typical fall prevention workflow. It is important to understand this eco-system and how various role players contribute to final outcomes, especially in the health context. While this tool is intended for use by clinicians as a supplementary design communication tool, recommendations must be made to ensure that its use is not too disruptive to the pre-
established, policy-driven service procedures. This aspect is further investigated in Studies Two and Three. In Chapter 8, I propose an alternative model of service delivery, one that is loosely based on current practice, but accommodates the use of AREVT in the service journey.

### 3.7 Study Two: Interviews with fall prevention industry professionals

Study Two is presented in Chapter 6, and is segmented into two Stages: A and B. Stage A is an investigation into the barriers and limitations of fall prevention procedures in industry. Stage B involves the assessment and refinement of the AREVT based on an evaluation of the prototype.

The overall aims of Study Two A are:

- Examine the current state of person-centred care and how it is applied in older adult fall prevention
- To investigate how the goals of older adults are perceived by industry professionals, and how these are related in fall prevention design practice
- To explore the barriers and problems in current fall prevention processes

The overall aims of Study Two B are:

- To discuss and evaluate alternative design methods against current practice
- To assess the augmented reality tool as a supplementary fall prevention design communication aid to investigate its strengths and weaknesses

Study Two is focused on the role of fall prevention providers in generating detailed understandings from within the falls prevention field. This is to gauge the role of older adults and the current opportunities for digital innovations that encourage person-centredness in fall prevention. It evaluates the contrasting goals of older adults against the requirements inherent in service delivery, as well as the policy ramifications. It also examines multi-site processes and various stakeholder insights from management, business development, occupational therapy and disability specialist architecture. The
individuals who have contributed to this research all work in these fields. Another objective is to evaluate the AREVT to further substantiate its use and appropriateness as a supplementary tool in fall prevention service delivery. The research design for Study Two is summarised in Table 3.4.

**Table 3.4 Study Two research design**

<table>
<thead>
<tr>
<th>Study Two A</th>
<th>Fall prevention industry insights</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Empirical or conceptual phase</strong></td>
<td>The current barriers within older adult fall prevention</td>
</tr>
<tr>
<td><strong>Primary research question</strong></td>
<td>How are fall prevention services currently conducted?</td>
</tr>
</tbody>
</table>
| **Sub-research question(s)** | - How is person-centred care currently realised in practice?  
- How are the goals of older adults reflected in final outcomes?  
- What are the main challenges in current fall prevention practice? |
| **Research method applied** | Content analysis (conventional) |
| **Data collection techniques** | Semi-structured interviews |
| **Purpose and outcome(s)** | To generate understandings that assist in drawing comparisons against the findings from Study One. Mixed method triangulation of results is undertaken to ensure rigorous and holistic data and outcomes. |

<table>
<thead>
<tr>
<th>Study Two B</th>
<th>AREVT assessment in industry context</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Empirical or conceptual phase</strong></td>
<td>Augmented reality within the fall prevention design context</td>
</tr>
<tr>
<td><strong>Primary research question</strong></td>
<td>How can the AREVT best empower older adults in fall prevention?</td>
</tr>
</tbody>
</table>
| **Sub-research question(s)** | - What is the suitability of the augmented reality medium in communicating client goals to facilitate a sense of control?  
- What are the benefits of the AREVT?  
- How could the AREVT be improved? |
| **Research method applied** | Content analysis (conventional) |
| **Data collection techniques** | Semi-structured interviews and prototyping |
| **Purpose and outcome(s)** | To generate findings that can then be further refined, incorporated into the AREVT, and used with older adults for further future evaluation |
As indicated by the findings from Study One, this research addresses the communication gap between clinician and client in the field of fall prevention. The data collected in Study Two A is juxtaposed against the findings from Study One in order to triangulate the findings and generate holistic industry insights.

The underlying assumption is that the information gathered from Studies One and Two can be drawn together to create a fall prevention service design process that utilises an augmented reality communication tool. In turn, this will create a more empowering person-centred process of delivering fall prevention services to older adults living in the community.

### 3.8 Study Three: Interviews with older adults

Study Three is presented in Chapter 7, and explores the journey of older adults through the fall prevention process. It investigates their home environments, daily lifestyles and individual personalities with the aim of understanding how their surroundings contribute to their self-identity, and what sustains them as individuals. Study Three investigates the communication disparities that exist between older adults and fall prevention clinicians.

The overall aims of Study Three A are:

- To investigate older adults’ perceptions of their own goals within their fall prevention recommendations
- To gather in-depth understandings pertaining to the relationship between older individuals and their home environments
- To evaluate and understand older adults’ journey through the fall prevention service, and to examine its strengths and weaknesses

The overall aims of Study Three B are:

- To draw on the knowledge gathered about older individuals, and define a fall prevention design process that would benefit them
• To assess the augmented reality tool as a supplementary fall prevention design communication aid, and investigate its strengths and weaknesses

The research design for Study 3 is detailed in Table 3.5.

<table>
<thead>
<tr>
<th>Study Three A</th>
<th>Fall prevention older adult insights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical or conceptual phase</td>
<td>The fall prevention process and the impact it has on older individuals and their homes</td>
</tr>
<tr>
<td>Primary research question</td>
<td>How are the goals of older adults reflected in their fall preventative home modifications?</td>
</tr>
<tr>
<td>Sub-research question(s)</td>
<td>What is the fall prevention experience of the participants?</td>
</tr>
<tr>
<td>Purpose and outcome(s)</td>
<td>To generate an understanding about the individual nature of older adults, and how assistive changes to their homes environments might affect their self-identity and quality of life.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study Three B</th>
<th>AREVT assessment in industry context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical or conceptual phase</td>
<td>Augmented reality within fall prevention design context</td>
</tr>
<tr>
<td>Primary research question</td>
<td>How suitable is augmented reality as a platform to communicate goals for older adults within fall prevention?</td>
</tr>
</tbody>
</table>
| Sub-research question(s) | - How does the use of such a tool differ from traditional methods?  
- What refinements could be made to the AREVT? |
| Research method applied | Content analysis (conventional) |
| Data collection techniques | Semi-structured interviews and prototyping |
| Purpose and outcome(s) | To evaluate the use of augmented reality in the fall prevention design context of older adults. |
It is to be expected that there will be a level of person-centredness previously applied to each participant. However, it is difficult to measure person-centredness completely objectively, as there is no baseline measurement for this ideology. Therefore, it is necessary to conduct Study Three A, as this preliminary study (prior to the AREVT evaluation—Stage B) will aid in creating a user profile of the participant that goes beyond medical models, including the intrinsic/extrinsic falls risks linked to these individuals. Once I am familiar with the participant, their goals and their lifestyles, the AREVT evaluation will be conducted to establish, discuss and evaluate their ideas about fall prevention in their homes. This process is also intended to loosely mirror the fall prevention risk assessment process within which the AREVT is envisioned to operate.

### 3.9 Summary

Chapter 3 provides an overview of the three studies conducted to investigate person-centred fall prevention, the design and delivery of services, and the creation of a digital prototype to empower older adults through enhanced service techniques. The chapter has also presented the set of methods selected for this investigation, the reasons why these methods are appropriate, and how each method relates to the research questions.

The following chapters will provide further details about the collection of data, the data analysis procedures, and the results and findings. Chapter 4 presents Study One and the specific procedures regarding the collection of documented data, as well as detailed findings that support the generation of the AREVT prototype. The AREVT is discussed in Chapter 5. Chapter 6 explores in more depth the details and findings from the fall prevention industry, and evaluates the AREVT. Chapter 7 describes the fall prevention journey of many older adults, including their evaluation of the AREVT.
Chapter 4. Study 1: Contextualising current fall prevention practice for digital innovation

“Everybody in this world today needs support of one kind or another. People need support to go ahead and do things whether this support comes from a good friend, parents, a social worker, or guardian. There is no person so independent in the world that they don’t need anybody. We all need support, but with that support, we don’t want somebody coming in and taking over our lives.”

(Sanderson et al., 1997, p. 18)
4.1 Overview

As highlighted in Chapter 2, the increasing urgency to address Australia’s ageing population and to develop sustainable living solutions for older adults is a paramount concern that is echoed around the world (Ahn et al., 2008; Australian Bureau of Statistics, 2013; Australian Institute of Health and Welfare, 2012; Productivity Commission, 2013). It is agreed in the literature that the optimal solution is to provide opportunities for older adults to remain living in their own homes with safe and enabling support (Ahn, 2004; Bayer & Harper, 2000; Demirkan, 2007; Malmgren Fänge et al., 2012). The research discussed examines one method of doing so: home modifications (American Geriatrics Society & British Geriatrics Society, 2011; Lord et al., 2007; World Health Organisation, 2007). However, the processes linked to the retrofitting of older adults’ homes can be invasive for some older adults, and detrimental to their self-identity, pre-established lifestyles and goals (Nyman, 2011). Home modifications, assistive equipment, exercise programmes and other in-home preventative health care solutions have been discussed in relation to their ability to allow older adults to live in a safer manner (see Chapter 2.4). What is missing is a greater understanding of the goals and heterogeneity of older adults, as many older individuals classify their ambitions and aspirations differently. One-size-fits-all solutions do not satisfy the complex needs of older adults (Lopez-Lorca et al., 2014), and tailoring fall preventative home modification processes to the needs of individuals is critical to rethinking and increasing the person-centredness of current fall prevention processes.

This chapter presents Study One, an exploratory study to investigate fall prevention through in-depth studies of client cases via the analysis of commonly-used assessment tools and documents. Study One and its findings have been published and presented in two double-blind peer-reviewed long papers, and presented at their respective conferences. These include OzCHI—Being Human (Lo Bianco et al., 2015a) and the International Association of Societies of Design Research—Interplay (Lo Bianco, Pedell, Renda, & Kapoor, 2015b).
4.2 Study 1: Contextualising current fall prevention practice for digital innovation

4.2.1 Aims

Study One examines the methods and approaches being applied in the current fall risk assessment process to determine how fall prevention recommendations for older adults are produced and realised in modifications. This generates understandings pertaining to how goals are understood, measured and reflected in fall preventative home modification recommendations.

The aims of Study One can be categorised into contributory objectives to generate new understandings. This is done to further contextualise the overarching research gap and problem, as there is limited research on the person-centred design tools that drive fall prevention processes. The first three aims (A – C) generate insights from fall prevention service delivery to substantiate an appropriate way to examine and increase the person-centredness of fall prevention services. This is reflected in the fourth aim, D:

- **Aim (A):** explore the multi-site conduct of fall prevention services and how interrelated agencies and service contributors interact within the fall prevention eco-system
- **Aim (B):** investigate how the goals of older adults are determined and documented within fall prevention
- **Aim (C):** examine the specific methods of fall prevention applied by service providers and clinicians, specifically home modifications
- **Aim (D):** generate design drivers that build from the goals of older adults to allow for more person-centred processes within fall prevention

The expectation is to gain an understanding of the fall prevention field from documentation and policy, as well as the consequent journeys of clients through the health services. These aims inform the research questions to be answered in this study.
The primary research question is as follows:

- How are fall prevention services currently delivered to provide person-centred outcomes to their clients?

The secondary research questions are:

- How do the goals and preferences of older adults guide the conceptualisation and design of fall prevention solutions?
- What supports and tools do fall prevention professionals have to assist them?

Table 4.1 provides an overview of the research design for Study One.

<table>
<thead>
<tr>
<th>Case sites</th>
<th>Two fall prevention service providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units of Analysis</td>
<td>60 fall prevention client cases</td>
</tr>
<tr>
<td>Data Collection</td>
<td>Document analysis (60+ supporting documents) (see Chapter 4, Section 4.3.3)</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>Content analysis and applied concept mapping (see Chapter 4, Section 4.3.3) (Moon et al., 2011)</td>
</tr>
<tr>
<td>Data Quality</td>
<td>Multi-site triangulation, creation of data prior to collection within any research influence or bias, substantiation via member checking with original creators of the documents</td>
</tr>
</tbody>
</table>

The anticipated outcomes are that insights will be produced into the delivery of fall prevention services that are up to date in a real-world context. This is important in creating solutions that are applicable within the scope of fall prevention service practice. Therefore, it is imperative to learn about current practice, the tools applied, the service shortcomings and the benefits.

Study One generates understanding about the goals of older adults, drawing particular attention to how they are documented within the fall risk assessment process, and the influence that they have on recommended fall prevention interventions. It is advantageous
to undertake this exploratory study first to ground the research in up-to-date knowledge and practice in this complex field.

4.3 Method

4.3.1 Data collection

Study One explores older adult fall prevention through 60 different client cases to obtain a broad view and understanding of every practice in two fall prevention services, their internal processes, and the legal and policy ramifications guiding service delivery and care recommendations. The document analysis includes an assortment of fall prevention assessment and planning documentation, and was conducted to thoroughly investigate the fall prevention practice and generate understandings.

As part of any fall risk assessment, a screening process is undertaken and documented by a clinician for the service record. The document analysis includes artefacts that are sources of rich and detailed information taken directly from real-world cases, which existed prior this investigation, and are therefore not influenced by it. Examples of each document type can be found in Appendix B.1. Fall prevention industry professionals operate under constraints due to the demands and mounting pressures of the industry, such as time restrictions and limited funding. Examining uninfluenced real-world data provides an insight into this multifactorial industry. In addition, it provides an opportunity to explore multiple cases at various stages of completion to compare and contrast methods, circumstances and consequential service delivery approaches.

All documents were de-identified and supplied in a hard-copy format from two fall prevention service providers (Organisations A and B). Both service providers supplied documentation from older adults aged 65 and over who received care, and had fall prevention modifications proposed for or applied to their home environments. Collecting and analysing documents linked directly to fall prevention home modifications creates a sample in line with the aims and objectives of this thesis.
In Organisations A and B, there are different service levels and organisational structures, with sub-departments for in-organisation referral.

### 4.3.1.1 Organisation A

Organisation A is a fall prevention service provider in a hospital. While all documents came from the fall prevention service, there are sub-services and referral systems available for older clients who enter the fall prevention service. These include occupational therapy, domiciliary care, physiotherapy and other methods of rehabilitation.

### 4.3.1.2 Organisation B

Organisation B assists those in need, providing community and residential aged care. In Organisation B’s documentation, the 20 client cases include goal-planning and goal-setting sections that specifically target the needs of their older clients. Furthermore, the 20 documents contain descriptions of client goals and related service planning and outcomes.

### 4.3.2 Data sample

All fall risk assessment documents collected are reports of real-world client cases that were either current or completed fall prevention projects. It is important to gather information from various instances to understand and appreciate the current practice and assessment involvement, and to gain insights into service delivery and structure.

Documents from both fall prevention service providers (Organisations A and B) were given in a manner in accordance with the ethical considerations approved for this research. Gathering data from two separate sites, rather than only one, provides more rounded insights into service delivery and structure.

The results and insights identified were subjected to member checking (Dervin, 1997) with the original creators of the documents in the ensuing Study Two: participants employed in Organisations A and B.
The sample consisted of 60 client cases of older adults at various points of their fall prevention journeys. Sixty client cases were sufficient to gain detailed insights into the lives and journeys of older adults, as this preliminary study is exploratory in nature. Seven hundred and one pages of detailed client medical history (anonymised prior to handover) and fall prevention planning are documented in the sampling. The collection of data from two separate fall prevention service providers added to the all-inclusive nature of the data.

The assessment process is not required to be strictly formal. There are leniencies available for the older client, which aid in creating a comfortable assessment environment throughout the documentation process. The assessments can and are usually conducted as informal and non-linear chats. This open process creates a more free-flowing and conversational assessment style rather than a rigid process, and is beneficial in discussing and creating a dialogue about the older clients’ goals and their service options. Assessment procedures can be conducted over multiple sessions. Furthermore, these assessments are typically carried out within the home environment of the older adult. It is also possible for the assessments to take place in a clinical office; however, this is rarely done.

A numerical breakdown of the material yielded from the document analysis data collection process is summarised in Table 4.2. Descriptions of document types and frequency are detailed to provide an in-depth view of the quality and breadth of the documents examined. Examples of each document type can be found in Appendix B.1.
<table>
<thead>
<tr>
<th>Document type</th>
<th>Number</th>
<th>Content description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organisation A</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupational therapy home assessment reports</td>
<td>19</td>
<td>Reasons for fall risk assessment, existing supports in place, falls history, living situation, hazard/risk assessment, barriers/actions/recommendations, care plans, diagrams and proposed interventions</td>
</tr>
<tr>
<td>Deviation from AS 1428.1 forms</td>
<td>2</td>
<td>Justifications for deviations from Australian Standard 1428.1 2009 regarding proposed housing modifications</td>
</tr>
<tr>
<td>Occupational therapy electronic progress notes</td>
<td>16</td>
<td>Journal-like documentation of consumer journey through the fall prevention service</td>
</tr>
<tr>
<td>Screening assessment for fall evaluation reports</td>
<td>21</td>
<td>Reasons for fall risk assessment, existing supports in place, falls history, medical history, intrinsic/extrinsic risk factors, activities of daily living, living situation and management plans</td>
</tr>
<tr>
<td><strong>Organisation B</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Care assessment forms (pre-person centred care driven)</td>
<td>10</td>
<td>Health and wellbeing profile, care goals, relationships, assessment summaries, home risk assessment profile and task list</td>
</tr>
<tr>
<td>Consumer-directed care assessment forms (post-person centred care driven)</td>
<td>10</td>
<td>Relationships, social and community access, care goals, health history, pain management/medications, mobility assessment profile, cognition and behaviour, communication, assistive equipment/technology, nutrition, continence/toileting, personal care, advanced care planning, emergency/evacuation planning, assessment summary, home risk assessment profile and task list</td>
</tr>
</tbody>
</table>

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6 40 client cases were examined. There are an odd number of associated documents as each client case may have required different documentation – this is sporadic and dependant on the particular circumstances of the case.
4.3.3 Data analysis

For a document and the ensuing content analysis to be insightful, a shift must be made to distinguish the difference from what is contained in the document to the information that the content can disclose. It has been argued that “this analytic approach allows the study to be guided by key concepts and variables and is flexible enough to allow for the emergence of key categories from the documents” (Willis, Small, & Brown, 2012, p. 1224). The content analysis procedure undertaken is driven by the aims of Study One, as well as the research questions supporting those aims, to identify significant insights (see Section 4.2.1). The following Figure 4.1 demonstrates the document analysis guideline and examples of the research questions to provide an overview of the analysis procedures and rationale specified during the content analysis.

<table>
<thead>
<tr>
<th>Study One document analysis guideline: Contextualising current fall prevention practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>How are fall prevention services currently delivered to provide person-centred outcomes to their clients?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fall prevention service conduct (aims A, B and C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>What supports and tools do fall prevention professionals have within the field to assist them?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The role of goals in person-centred fall prevention (aims B and D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>How do the goals and preferences of older adults guide the conceptualisation and design of fall prevention solutions?</td>
</tr>
</tbody>
</table>

Figure 4.1 Document analysis guideline

A conventional content analysis was conducted to analyse the data obtained from the documents (Hsieh & Shannon, 2005; Patton, 2002). As all data was supplied in a hard copy format, relevant text sections and imagery were copied verbatim or scanned into a series of spreadsheets. These excerpts were catalogued with direct references to the original documents, and linked to the source in case further data clarification is required. Each
client case, including multiple document types, was read (see Table 4.2). Following several readings of a case, an open coding process was applied to the document set to highlight the key points, sections, quotes and themes contained within it (Saldaña, 2009). Open coding is “the transitional process between data collection and more extensive analysis” (Saldaña, 2009, p. 4). This process creates provisional markers for large portions of data, or to summarise large sections of the documents for analysis. This initial analysis provided common concepts about the care goals of older adults, their distinct lifestyle, medical factors and common environmental home risks, as well as service delivery approaches. To supplement the qualitative findings, the resulting data was then quantified to identify common trends and notable circumstances.

Once each client case had been open coded (Appendix B.1.2, B.1.6, B.1.8, B.1.10), the data sample was then divided to refine the focus of each document and case type. For example, Organisations A and B differ in their processes and their goal discovery techniques. Therefore, once I had achieved immersion and familiarisation with the data sample via the open-coding process, it was then possible to divide the sampling into separate sections to further analyse them according to aims A-D of this study.

The codes derived from the open coding process linked to client goals are sorted into common themes through a card-sorting process (Martin, 2012). Card sorting is a technique that allows for the structuring of information and evaluation of data to validate common categories identified (Martin, 2012). Additionally, each card is colour coded: green for a traditional approach, and blue for a person-centred/enabling approach. For example, the traditional approach focuses on the inabilities and issues of the individual, whereas a person-centred method utilises client goals as a driving service motivation to achieve re-enablement (Human Services Ageing Disability and Home Care, 2010). A greater breakdown of these definitions is provided in the Literature Review (see Chapter 2, Section 2.4.1).

Overall, this process allowed me to refer back to the client case if further circumstantial investigation was required into the client’s medical background. This helped in understanding the origin and influential factors underpinning the identified goal. The
procedure undertaken assisted in identifying significant recurring codes, which were then catalogued and sub-divided into categories and themes. These were digitised with the assistance of an online application, Popplet,7 in preparation for a deeper secondary coding process.

Following this stage, the codes within these categorical themes underwent an axial coding process (Saldaña, 2009) (see Appendix B.2 and B.3). This provides a further categorical breakdown relating to the interrelationships and connecting attributes of the goals identified within the primary themes. This axial coding process was conducted using an applied concept mapping procedure (Moon et al., 2011). Using the Popplet software throughout the concept mapping procedure was advantageous, as it allowed me to visualise and sort through key concepts and ideas in a manner that was time-efficient and visually comprehensible. The axial coding process presented greater understandings of the interrelationships between the primary categories and goals underpinning them. Both codes and categories were colour coded in a manner that enabled me to visualise and refer back to individual client cases. This also allowed for the identification of the specific questions and circumstances that produce particular goals/codes.

Following an overall mapping of goals, case-by-case client mapping commenced, with open coding of each individual client case to identify tentative labels and circumstantial data related to each client. This process encompassed all 20 community aged care documents provided by Organisation B, as these client documents explicitly addressed goal-setting with clients. Client maps followed the same visual sorting format as the previous goal-oriented axial coding process.

Following this, a secondary axial coding process enabled me to design circumstantial care maps for each client. This process provided rich and detailed descriptions of each older

7 www.popplet.com
adult care client’s narrative, allowing me to fully comprehend and visually explore each client’s life and care journey. These client care maps can be found in Appendix B.3.

4.3.4 Data quality

The quality of the data was improved by employing several approaches:

- Incorporating data from two sites creates further roundedness to the findings. This is preferable to generating isolated results from one organisation related to their own individual processes.
- The data was originally generated without any prior influence of this investigation. This provided me with unadulterated insights into fall prevention services that have not been tailored to the research profile.
- Member checking (Dervin, 1997) related to Study One was conducted as part of Study Two in this thesis (see Study Two: Chapter 6, Section 6.4.2.1). Member checking is a procedure that is critical to confirming the quality of the data. Member checking helps to determine what the original creators of the documents thought about my interpretations (Dervin, 1997). This aided my understanding, and helped clarify some of the findings of this study.

4.4 Results

4.4.1 The interplay and importance of goals

Table 4.3 provides a summary of the older adult goals. The data sample in Table 4.3 is derived from the 20 older adult client cases linked to Organisation B. In this instance, the organisations are separated because of the distinct goal-modelling method of Organisation B. I argue that isolating this data sample is beneficial to the research and its findings, as the distinctive goal-modelling approach employed by Organisation B is based on the person-centred strategies specified by the Victorian Department of Health in their Strengthening assessment and care planning guidelines (Victorian Government Department of Health,
Organisation B’s 20 community aged care documents contain descriptions of older adult goals based on responses to the following questions:

- What are your most important requirements to assist you living at home?
- What do you think would prevent you from staying at home safely?
- What can we do to support you living at home?
- What do you want in your life?
- What is not working well and what needs to happen to change?

In Table 4.3, each distinct code and its frequency are listed. The codes portrayed were derived from the answers older adults gave to the above questions concerning their desires regarding their care planning. At a base level, these could be categorised into three broad themes founded on their subjectivity and implications: support, negative influences, and desires and goals. Within each of the major themes are related sub-themes, and the frequency of the codes within the sub-themes was shared where appropriate. For example, a coded goal that addressed transport to the local shops would apply to both the transport and shopping sub-themes within the major support theme. Furthermore, it is critical to note that while some goals may appear similar on the surface, the placement of the coded goals was based on two factors: (i) the question being asked; (ii) the wider circumstances of the individual older adult. As an example, some transport-related goals are placed within support > transport, and others are placed within desires and goals > access, as the wider ramifications surrounding transport are what are desired (re-engagement with the community etc.). These circumstances are evident in the individual older adult care maps, examples of which are in Appendix B.3. An extrapolated diagram of the relationships between each of the themes, sub-themes and codes can be found in Appendix B.2.
Table 4.3 Care planning and goal setting code-type frequency

<table>
<thead>
<tr>
<th>Support</th>
<th>Code frequency</th>
<th>Negative influences</th>
<th>Code frequency</th>
<th>Desires and goals</th>
<th>Code frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respite</td>
<td>1</td>
<td>Falls</td>
<td>2</td>
<td>Social connectedness</td>
<td>7</td>
</tr>
<tr>
<td>Financial support</td>
<td>2</td>
<td>ADL / IADL dysfunction</td>
<td>17</td>
<td>Access</td>
<td>5</td>
</tr>
<tr>
<td>Shopping</td>
<td>7</td>
<td>Lifestyle / Habits / Sociability</td>
<td>7</td>
<td>Helping others</td>
<td>6</td>
</tr>
<tr>
<td>Transport</td>
<td>13</td>
<td>Support</td>
<td>6</td>
<td>Fall prevention</td>
<td>1</td>
</tr>
<tr>
<td>Medical / Health</td>
<td>17</td>
<td>Stresses</td>
<td>6</td>
<td>Requirements</td>
<td>22</td>
</tr>
<tr>
<td>Home care / Maintenance</td>
<td>13</td>
<td>Family</td>
<td>4</td>
<td>Future planning</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>53</td>
<td>Total</td>
<td>42</td>
<td>Maintaining independence</td>
<td>20</td>
</tr>
</tbody>
</table>

| Keeping at home                | 18             | Personal / Emotive           | 11             | Total                    | 95             |

4.4.1.1 Support

The theme of support accumulated a total of 53 codes. The dominant sub-theme was medical / health (n=17), followed closely by transport (n=13) and home care / maintenance (n=12). The codes and subthemes within support were typically related to older adults’ daily requirements and the areas where they needed assistance from Organisation B.

4.4.1.1.1 Medical / health

Medical / health (n=17) was the dominant sub theme within support. Broadly, it included goals related to issues from transport to health appointments (n=9), as well as more medically-related areas of assistance (n=8). These include such things as personal care, management of medications and pharmacy requirements.
4.4.1.2 Transport

The transport (n=13) sub-theme within support typically concerned transportation as a requirement to get to medical appointments (n=9), and included transport to doctors, dentists etc. Other types of transport were also noted, including general transportation (n=2) and access to shopping centres (n=2).

4.4.1.3 Home care / maintenance

The home care / maintenance (n=13) sub-theme included assistance required in the home environment. This encompassed home care, gardening assistance and support to maintain the home environment.

4.4.1.2 Negative influences

Negative influences amassed a total of 42 codes. The leading sub-theme was ADL / IADL dysfunction (n=17). The next-closest sub themes were lifestyle / habits / sociability (n=7). The negative influence theme broadly highlights the factors that negatively affect older adults in a variety of ways. A sub-theme of support can be found in this theme, as support in this instance was negatively perceived.

4.4.1.2.1 ADL / IADL dysfunction

ADL / IADL dysfunction (n=17) is the largest sub-theme within negative influences. It includes a variety of negative impacts at play in older adults’ lives that affect their Activities of Daily Living and Independent Activities of Daily Living (see Section 2.4.3 for extended definitions). These include cognition difficulties, such as memory loss, and inability to cook, as well as a general decline in health.

4.4.1.3 Desires and goals

Desires was the dominant theme, accumulating a total of 95 codes. The leading sub-theme was requirements (n=22), followed by maintaining independence (n=20), and then remaining at home (n=18).
4.4.1.3.1 Requirements

*Requirements* \((n=22)\) was the largest sub-theme within *desires*; however, this is a broad category that includes many general types of support identified by the older adults as desires or goals. The codes in this sub-section are included in the major *desires and goals* theme rather than *support*, as the codes considered are directly dependent on client needs/goals, rather than on specific care outcomes. This is evident when examining the wider circumstantial evidence found in the individual care maps, see Appendix B.3.

4.4.1.3.2 Maintaining independence

*Maintaining independence* \((n=20)\) was the second-largest sub theme. As evident in the extended goal relationship map (see Appendix B.2), independence was a term that was applied in many instances in various ways. For example, some older adults classified it simply as a desire to maintain their independence, whereas others stated that they wished to continue to visit art galleries, or to be able to support their spouse. Independence was a sub-theme that was reflected in most other areas within *desires and goals*, and requires further consideration.

4.4.1.3.3 Remaining at home

*Remaining at home* amassed a total of 18 codes. The codes linked to this subtheme were commonly directly connected with *maintaining independence*, as many older adults either stated simply that they wish to remain living at home, or explicitly stated that they wished to do so independently.

4.4.1.3.4 Personal / Emotive

*Personal / emotive* \((n=11)\) was a noteworthy sub-theme. The codes within this sub-theme were not typically related to each other; rather they signified an emotive desire to continue or be able to do something they deemed important. For example, one older adult stated that they wished to feel useful again; another, an ex-painter, wished to attend art galleries again; another simply wanted to have fun again.
4.4.1.4 Independence

It was found that the three themes of support, negative influences, and desires and goals share common ground regarding independence and how it is perceived. As a sub-theme, maintaining independence is addressed within desires and goals. However, independence’s influence is apparent throughout each of the major themes. For example:

Support: This theme relates to both the support and rehabilitation models of independence, whereby vulnerable people are provided with assistance so that they may live in a manner that requires less or minimal support.

Negative influences: This theme correlates with issues of functional independence, whereby the negative factors that inhibit an individual’s lifestyle can be broken down into issues pertaining to cognitive and physical dysfunction.

Desires and goals: Within this theme, independence is addressed directly through the sub-theme maintaining independence.

Further investigation into the lives of each individual adult via the client mapping process revealed that older adults classify their own independence in various ways depending on individual circumstances. However, it would commonly be listed simply as the overarching term of independence in their care planning, as documented by a clinician.

Maintaining independence was the second-highest overall goal. However, this terminology is fluid, and requires precise definition to distinguish the heterogeneity of older adults and the circumstances underpinning the broad use of the term. In inspecting the individual client care maps and the interplay of positive and negative circumstances in their lives, I investigated the multitude of definitions underpinning the term. For example, for one older adult, the ability to remain independent was linked to their aptitude to retain the capacity to eat and drink unassisted. For other older adults, independence could be projected through outward tasks and contributions, including a desire to continue cooking and baking for the family. For others, abstract expressions of independence were sought, including; [I] would like to have a garden that is filled with vegetables and flowers so [I] can
sit in [my] chair and look out the window at [my] achievements. For some older adults, their desire for independence stems from a yearning to do what was once easy and habitual for them. For example, in response to what do you want in your life?, one answer was, to be able to do what I used to do independently – eating and drinking. This is impacting on my social life. When this statement is further examined, the factors influencing the older adult’s desire for independence become apparent, and might result in completely different requirements regarding home modifications. These include a longing for social interaction, as well as a solution for their dysphagia (difficulty swallowing). However, the fundamental claim underpinning this statement is an aspiration for control in their life that they have lost.

In another instance, an older adult stated that they wished to have supported independence where possible. This statement was part of the answer to what are your most important requirements to assist you living at home? This older person is a retired nurse, and has full awareness of [their] health needs, as noted by the health care provider. Additionally, this older adult is understanding and willing to relinquish control to an extent. The respondent has been noted as managing their medication independently. Conversely, another older adult is a retired general practitioner, and has been described as very stubborn in a clinician’s opinion. The contrast between these two older people is interesting to consider, in particular that their emotions, knowledge, individuality and past life experience affect their willingness to relinquish control and accept support. It may be that the “stubborn” individual requires a different course of action, whereby their experience in the health process allows them to engage at a higher level.

In response to question two, what do you think would prevent you from staying at home safely?, two of the 20 older adults reported their own risk of falling as a negative influence that would prevent them from living at home safely. However, further analysis of the client care maps identified that eight of the 20 older clients have a falls history, and 14 are living with either mobility issues that affect their daily activities and/or assistive technologies to support their functional independence. The data suggests that older people do not raise the issue of falls when questioned.
4.4.2 Uptake of fall prevention recommendations

Throughout the analysis, Organisation A and B’s documents underwent a separate examination in accordance with the procedures outlined in Section 4.3.3. This is because the documents from each institution differed. The data presented in the stories below has been taken from Organisation A, and has been summarised based on insights into each client’s detailed medical history, fall risk assessment and electronic progress notes, which detail each specific step through the fall prevention process.

In the following section, four detailed older adult fall prevention stories are presented as examples to demonstrate and explore the complexity of the barriers and problems affecting both the uptake of and compliance with fall prevention recommendations.

These four cases are emphasised, as their documentation featured highly-detailed progress notes alongside the clinical assessment. For example, each service interaction between the service and the older adult was noted in detail; therefore, it was possible to contextualise the older adult’s journey throughout the fall prevention service. While other clients featured progress notes, the four presented deal explicitly with home modifications in rich detail.

All identifiers were removed prior to the data disclosure; genders have been assigned to the clients to benefit each narrative.

4.4.2.1 Client A fall risk and home modification assessment

*Client A lives alone in a privately-owned single-story brick property. While Client A has no documented falls history, she is interested in a series of home modifications and assistive technologies; these include handrails at both the front and rear access areas of the house, as well as for the shower, bathroom and toilet. In the fall risk assessment, Client A is noted as being “fairly independent” in her home. However, increasing assistance is required for her to walk long distances, ascend and descend steps, and bath herself. Client A aims to increase safety and independence in her home.*
Client A would prefer to have handrails and an accompanying ramp installed at the rear access of the property. However, there are significant issues with this, due to the height of the rear decking. The occupational therapist has suggested modifying the steps as an alternative option, but this was promptly declined by Client A. After careful deliberation, the front access was then discussed as a viable alternative. It was decided that this entrance would be the most suitable for modification. Detailed instructions were then sent to an architect to report and quote options for modification.

The proposed front access modification includes a ramp and side-by-side handrails. This will extend from the front porch, over the established pathway and into Client A’s front garden bed (which will need to be removed). Client A has advised that she does not think she will use the ramp at the front. Client A has reiterated that she would prefer the ramp at the rear of the property. The occupational therapist echoed that this would not be feasible or appropriate given the height of the decking. Client A has agreed to remain on the waitlist for the home modification to be completed.

4.4.2.2 Client B fall risk and home modification assessment

Client B wishes to have safe access to her home. She has been noted as falling quite frequently—on average one fall each month since her MS diagnosis. Client B reports growing difficulty leaving the house, and has expressed that she is sad and fed up with the situation. As part of the assessment, the occupational therapist has recommended several home modifications and assistive technologies. Client B has reported that she does not want to be perceived as disabled or vulnerable; therefore, she does not want to go ahead with the recommended power wheelchair, bed poles and assistive handrails recommended to her. Client B is adamant that she will never use a power wheelchair due to her perception of appearing “disabled”. However, Client B is open to the idea of wearing hip-protector undergarments.
4.4.2.3 Perceived disability

In the above case descriptions of Clients A and B, it is apparent that the perception of disability is a contributing factor to their reluctance to take up fall prevention recommendations.

It is noteworthy that in the case of Client A, a much larger and unsuitable ramp at the rear access of the property was favoured over a more safety-appropriate solution at the front. While the front access modification of the property may have been deemed most appropriate, it is a cumbersome structure with the potential to stigmatise. Furthermore, compliance with this recommendation may possibly be compromised prior to implementation. While the care goals of the older client—*increased safety and independence within her home*—are being adhered to, the intrusive nature of the proposed front access modification presents a possible issue relating to design communication and comprehension.

Similarly, for Client B, *perceived disability* was noted as the primary factor for the rejection of several assistive solutions in the home environment. Client B is noted as being semi-restricted in her home due to her debilitating physical condition. However, the installation of home modifications and the use of assistive technologies, as well as the accompanying stigma attached to these interventions, are enough for the client to reject their use prior to implementation. Intriguingly, Client B is willing to trial hip protector undergarments. This demonstrates considerable understanding of the ramifications of the recommendation rejection.

4.4.3 Communication methods and the visual language of fall prevention

The following fall prevention experiences are offered to highlight the visual communication methods used in fall prevention across all cases linked to Organisation A. These two cases were selected, as the electronic progress notes were highly detailed, and offered rich insights into the service journey.
All identifiers were removed prior to the data disclosure; genders have been assigned to the clients to benefit each narrative.

4.4.3.1 Client C fall risk and home modification assessment

Client C currently lives with his wife in their single-story property. Client C needs to modify the ensuite for disability access to the shower. Currently, he is using the shower in the main bathroom, which presents a number of hazards. The domiciliary carpenter informed Client C that a railing could not be installed in the shower in the main bathroom because of the large tiles. As an alternative, Client C has purchased a suction handrail to use in the shower, but finds it “useless”. In addition, the occupational therapist has recommended a grab rail for the toilet. This was declined; Client C prefers to use his walking stick to assist with transferring on and off the toilet. Client C has reported a number of near falls, and increasing unsteadiness around the house.

The following Figures show two sketches on blank paper that are documented on the forms. They detail the proposed modifications to the ensuite. A total of six sketches are included in Client C’s documentation.
“Drawing not to scale, rails into studs. Remove screen door and all glass. Replace with weighted shower curtain (which you could close sitting down to avoid losing balance). Installing rail from outside of shower, all along shower head wall.”

“Screen door reversed, so that it opens from the right. This will make it easier to reach a properly installed grab rail inside the shower.”
4.4.3.2 Client D fall risk and home modification assessment

Client D is an ex-nurse. Her health started to diminish after she turned 50. She suffers chronic pain, which stems from a car accident 30 years ago. Client D requires mobility scooter access to the front entrance of her home. She lives alone, and has suffered several falls recently. Furthermore, Client D is becoming apprehensive about leaving her home, and would like to remain social and active in the community. Client D already has several home modifications and assistive technologies; these include rails in the shower and toilet, shower stool, hand-held showerhead and a 4-wheeled walker.

Figure 4.4 is a digital sketch superimposed on a photograph taken of Client D’s front access. The digital edit was made in Microsoft Work, using lines to represent a ramp and a handrail. Figure 4.4 details a proposed home modification recommendation to allow Client D access to the front door with her mobility scooter.
4.4.3.3 Insufficient design communication methods

Figures 4.2, 4.3 and 4.4 demonstrate the visual language often used to communicate home modification recommendations to older adults. Further examples can be found in Appendix B.1.1. While these images are accompanied by verbal support and descriptions of proposed environmental changes, from the perspective of communication design, this is poor visual language and needs improvement. The inability for clinicians to communicate complex design ideas to their older clients makes older adults unsure about final outcomes. Without an alternative and realistic medium to communicate complex environmental retrofitting for fall prevention and safety, the design processes currently embedded in fall prevention practice are not person-centred.

4.5 Discussion

4.5.1 The value of goals in fall prevention planning and recommendations

The results from Study One have demonstrated with strong examples that older adults cannot be viewed as a homogenous group. Rather, each older adult is an individual with their own goals, motivations and lifestyle that result from a lifetime of independent decision-making, free choice and personal expression; these factors do not diminish with age or time.

The goals of older adults were commonly discussed between clinician and older client, and this is well established in the documentation analysed. However, throughout the analysis of each service journey, it was difficult to see these reflected in the recommendations for interventions. Often solutions would revert to address issues of functional decline, rather than emphasising possibilities of re-enablement and sustainability of the older adult’s lifestyle and goals. Greater specificity and more examination of goals are required to move

8 Data triangulation in Studies Two and Three confirmed the problem with these kinds of depictions: that it is very likely that design discrepancies and misunderstandings will arise between clinician and older client.
beyond the stereotypical definitions used to describe complex goals such as independence. As stated in the results, many of the goals expressed by older adults are metaphorical and abstract reflections of their cultural and individual norms. The key to successful fall prevention is to consider older adults’ goals in terms of achieving their daily activities. To do so, we need a simple shared language to enable older adults to express their goals, and co-create their own goal-driven fall prevention solutions.

To move beyond stigmatisation and disempowerment, designing fall prevention recommendations that retain older adults’ self-identity and sustain them as individuals is imperative. There currently exists no common visual language between clinician and client, where goals can be communicated effectively and interpreted in more detail. Present methods of communication design in fall prevention are limited, and restrict an older individual’s understanding of clinical recommendations. The service drivers in current fall prevention practice have the potential to create dissention between an older adult’s understanding and comprehension of their own goals.

4.5.2 Co-design methods in fall prevention design

Based on the results, the appropriateness of a co-design method and/or technology in fall prevention would assist service providers in delivering more person-centred experiences. At present, the placement of co-design methods in fall prevention services is limited, and further consideration and engagement would benefit older adults and service providers alike. Bannier et al. (2013) reinforce this in stating that co-creation will “not only increase the understanding of the perceptions of gerontechnology and the acceptance of new technologies as we grow old, but it also systematically and sustainably maintains, advances and taps the rich knowledge and experience base of senior citizens” (p. 3). In keeping with this theme, service relationships and outcomes must move from a prescription-based model to a structure that aims for co-creative home modification outcomes. Therefore, it is imperative that we deliver a means for older adults to remain engaged in their own fall prevention. The research suggests that the key to successful fall prevention is to consider older adults’ goals in terms of achieving their daily activities. To do so, we need a simple
shared language to enable older adults to express their goals, and co-create their own goal-driven fall prevention solutions.

As illustrated in the results, the freedom and desire to exert control over the world around us does not diminish with age. This is one of the critical issues in designing environmental modifications for older adults rather than with them. An older individual with many decades of independent decision-making and life design experience will not simply relinquish control in their own home. The human home habitat is a complex environment. It reflects ourselves, how we choose to live, the cultural norms we adhere to, and our desire for physical privacy. Houses are not only where we base ourselves; they constitute nesting grounds for spiritual and personal expression (Plowman et al., 2009). Providing older adults with a service mechanism that enhances their level of engagement in their own fall prevention is a promising approach that could transform them from passive receivers into informed and active contributors in control of their own decisions. This is critical to this research. As Clemson et al. (1999) state, older adults’ perceived levels of control in fall prevention solutions contribute to greater acceptance and compliance rates.

Based on the research undertaken, it is strongly suggested that HCI presents an opportunity to allow older adults to remain or become designers. Referring back to Figures 4.2, 4.3 and 4.4, a possible solution that could raise compliance rates with environmental retrofitting recommendations is a visualisation tool. The technology associated with such a tool may assist older adults in anticipating changes to their home environments. Furthermore, it could provide them with choices between alternative solutions. As part of a person-centred fall prevention process, this visualisation technology could be used to empower those who wish to have a say in the retrofitting of their home environment.

Novel fall prevention service tools are required that permit older adults to express themselves and participate in decisions and planning for their own fall prevention. There is a lack of modern technology use in this field, but there are promising opportunities to apply novel visualisation techniques for communication. An inclusive visual language between all parties must be considered as a viable option to allow older adults to comprehend the results of environment retrofitting within the home. This tool or
technology will be used to visually demonstrate care outcomes based on individual goals of older adults. It should be used by both occupational therapists and older people as part of an enhanced person-centred fall risk and environmental assessment process. The opportunities that HCI presents will be further explored in Conceptualisation Phase One (Chapter 5) and Studies Two and Three (Chapters 6 and 7).

4.5.3 Towards an approach for person-centred language development

Based on the findings from Study One, it can be deduced that designing fall prevention solutions that are in accordance with the goals of older adults may increase the level of person-centredness in the service experience. A shared method focussing on goals is a promising approach to create a language that is also in alignment with person-centred care. A person-centred language between medical practitioners and older adults currently exists: the VIPS framework developed by Brooker (2007). The VIPS model can be summarised as follows:

- **Value**: Understanding the unrestricted value of all older people regardless of circumstance or cognitive ability
- **Individualised**: Recognising and respecting the uniqueness of older adults
- **Perspective**: Being empathetic of the day-to-day reality of older adults
- **Social**: Understanding that human beings by nature are social animals who communicate in various ways

The framework outlines a clinical method to deliver individualised care to older adults with dementia, and is applicable to the presented research. The VIPS framework clearly suggests *very important persons*, and Brooker (2007) has extended this connotation and applied it to a four-step guided model. The VIPS model respects the individuality and uniqueness of older adults, and provides an already established guiding service structure (Røsvik, Kirkevold, Engedal, Brooker, & Kirkevold, 2011).

As stated, the VIPS model has been formulated for dementia care. The model communicates a humanistic ideology that is translatable to other types of goal-driven health care services.
Therefore, I contend that the VIPS model provides an informative foundation upon which the results of Study One can be further contextualised to establish person-centred design guidelines in the context of fall prevention. There are obvious links between dementia and fall prevention, as these issues are commonly connected to age-related decline. However, the relationship goes beyond surface-level similarities, and extends to the manner in which older adults can be patronised in discussions and considerations of their own health and well-being (Rogers & Marsden, 2013). The overlap of these two areas and the results from Study One motivate a series of design drivers, directly addressing Aim D of Study One:

- **Aim (D):** generate design drivers that build from the goals of older adults to allow for more person-centred processes within fall prevention

### 4.5.3.1 HCI design guidelines for fall prevention

In the following section, a series of HCI design guidelines for fall prevention are offered. The guidelines recognise older adults as individuals with their own ambitions and goals, and these are motivating considerations in this research. The flexibility and willingness to accommodate for the innumerable life and health circumstances of older adults must be considered when designing home modifications and assistive technology solutions for fall prevention. Within HCI, goals are traditionally viewed as a high-level factor in design (Rogers et al., 2011). Therefore, to design a technological solution to address the problems highlighted, goals must be considered and embedded in the motivational structure of any potential technological solution.

Based on the findings from Study One, consideration of the already established VIPS model (Brooker, 2007), as well as the previous review of the literature (See Chapter 2), I offer a series of HCI design guidelines below. The guidelines are directly transferable to the rationale and utility of an HCI design solution that avoids the design communication issues uncovered in Study One. These guidelines provide the foundation of a method to permit older adults to participate in a co-creative and person-centred manner that allows their goals to be addressed:
Adaptive. The research and design processes must be able to be altered according to the goals of the older user, anticipating and understanding that there may be various reasons underpinning their desire for independence.

Human. The older user must be respected as an individual human being. The emotional complexities and goals of the older user must be appreciated, respected and reflected in the design process.

Accurate. The goals of the older user must be accounted for and reflected truthfully in practice.

Collaborative. The older user must have a voice in the design process that is heard and reflected in practice. The balance of power must be equal between all parties.

Visual language. The technology should be able to be communicated visually and truthfully to ensure understanding by the older user.

Aesthetically pleasing. The technology must allow for aesthetically-pleasing solutions from the perspective of the older adult; taking into account the possible limitations of the older user.

The guidelines presented are expected to support the development of a more person-centred HCI design processes and subsequent fall prevention recommendations.

4.6 Conclusion

Study One has been presented in this chapter. An investigation of older adult community fall prevention was conducted via a document and content analysis of fall risk assessment documentation. Study One has explored and presented the goals, as well as the various health and life circumstances that relate to community fall prevention among older adults.

Addressing and reflecting the goals of older people is necessary in fall prevention to raise acceptance rates and to design goal-driven recommendations. In order not to perpetuate
existing stereotypes, we must listen to older adults and understand their goals. Older adults are not a standardised group of possible end users; they are a diverse group of individuals whose ideas and lifestyles must be respected, reflected and designed for. Older adult independence extends beyond the limitations and surface understandings of functional independence. Greater emphasis must be placed upon control, the service processes and the linked to home modification design to achieve and continue daily personal goals. Ubiquitous fall prevention solutions for older adults are not appropriate for such a large and diverse population. Co-creative HCI methods have the potential to provide novel, individualised approaches to fall prevention. Study One provided a foundation upon which the potential of HCI methods to enhance person-centred fall prevention for older adults could be based.

A series of HCI-motivated, person-centred design guidelines for home co-creative design technologies is proposed. These guidelines are founded on humanistic, person-centred care values. Novel tools and technologies that facilitate a common visual language that addresses, communicates and ultimately reflects the goals of older adults is imperative if we are to use their aspirations as design drivers.
Chapter 5. Conceptualisation of the Augmented Reality Environmental Visualisation Tool

“Still lacking is an instrument grounded in theory that captures person-environment transaction as a way of describing older people’s fit within their homes and identifying appropriate intervention approaches.”

(Gitlin, 2003, p. 195)
5.1 Overview

This chapter introduces augmented reality as a promising design medium and an extension of fall prevention practice. This is referred to as Conceptualisation Phase One in this thesis. The Augmented Reality Environmental Visualisation Tool (AREVT) and its use builds upon the knowledge gaps and considerations presented in the literature review (Chapter 2), and on the results of Study One (Chapter 4). In this chapter, the rationale supporting the use of augmented reality in fall prevention home modification design is presented and explored from both the practical and theoretical standpoints. In addition, the primary question driving this thesis—how should fall prevention services be delivered to empower older adults?—is addressed to assist in creating such a tool. In doing so, the fundamental principles between person-centred care and novel digital tools for fall prevention are discussed.

5.2 Recasting the findings of Study One

Study One (Chapter 4) further explored the gaps highlighted in the literature review (Chapter 2), and uncovered the barriers and problems related to fall preventative home modification design processes. These include the importance of goal reflection in the recommendations made by clinicians. Many of the challenges associated with fall prevention home modifications stem from the restrictive design processes in fall prevention services. Currently, analogue methods of service delivery and design communication, such as sketch work, limit fall prevention home modification design communication, and have the potential to generate misunderstandings between clinician and client. In turn, this creates a dissonance between the goals of both parties, leading to outcomes that may not be as person-centred as originally intended.

The results indicate that the current processes driving fall prevention recommendations present specific challenges related to design communication and the representation of older clients’ goals. The visual communication mechanisms of a typical fall prevention health professional are lacking; therefore, their good intentions are not well communicated and understood by older adults. While fall prevention health professionals acknowledge
that the goals of older adults are important, these goals commonly become lost in the process, and fail to become the driving element of the fall prevention home modification process. Communicating the reasoning behind a recommendation made to an older client is often a point of contention between clinician and older client. In a person-centred model of fall prevention, older adults are encouraged to express their goals and ambitions in order to have a resounding voice regarding the service being offered. While clinicians understand these models of fall prevention service delivery, older adults may misinterpret their significance in this care relationship. Current analogue methods of design communication in fall prevention prevent this balanced hierarchy from being completely understood among older clients, and restrict the person-centredness of the service being provided.

To provide a more person-centred service for older adult consumers, it is important to consider what is ultimately deliverable in fall prevention services. This generates understandings pertaining to the requirements of the fall prevention industry—specifically occupational therapists, as they are often the first point of in-home contact. The requirements linked to supplementary service tools for fall prevention practitioners include:

- A means to generate a two-way discourse, in which older adults are fully aware and strongly encouraged to express their own opinions and design preferences
- A systematic tool that fits seamlessly into current methods of service delivery, and is easy to use
- An innovative approach to home modification design that is grounded in person-centredness and promotes the values of this ideology. This will hopefully generate outcomes that raise compliance with and successful uptake of recommendations

5.3 Providing control in fall prevention

Since the 1970s, there has been a significant amount of research addressing ageing and control. Most of this work falls into three distinct research domains. These include normative age changes regarding human perceptions of control, the connection between control and functional processes (these include health and cognition), and control’s role in
the human life course (Schulz & Heckhausen, 1996, 1999). These important relationships exist in conjunction with an interplay of life factors related to functional independence and older adults’ sense of control. This is commonly related to older individuals’ ability to continue to conduct everyday lifestyle tasks that they consider important (Clemson et al., 1999).

Various assumptions, together with limited medical model frameworks, have restricted research regarding the design and production of technological solutions to meet the demands of older adult functional independence (Durick et al., 2013; Lindley, Harper, & Sellen, 2008; Rogers & Marsden, 2013; Vines et al., 2015). These contextual limitations extend to home modification research that explores the use of assistive technologies (Gitlin, 2003). Viewing assistive equipment and home modifications as compensatory devices aimed at improving the functional independence of older adults without considering their intrinsic limitations restricts the potential of the research. This argument is supported by Gitlin (2003), who states that “the potential role of assistive devices in the lives of older people is more far reaching and may include improving everyday competencies and quality in a range of life domains” (p. 194).

5.4 What is augmented reality?

Augmented reality (AR) enables and facilitates free-flowing communication between human beings and computers via artificially-generated visual enhancements (Billinghurst & Kato, 2002). Azuma (1997) has defined three elements that define augmented reality: it brings together both the real and virtual, it is interactive in real time, and is registered in 3D. The reflexive relationship between users or experimenters and augmented reality is dependent on both user interaction and the technological process behind the superimposition. For this relationship to exist, AR is dependent on technology to provide a means for humans and computers or other visualisation devices to communicate. Currently, there are various technologies available, and numerous means to augment reality, ranging from smart phones and tablet computers, as well as gaming consoles and other types of interaction systems (Billinghurst, Haller, & Thomas, 2007). For example,
mobile devices provide an augmented viewpoint through the camera and screen working in unison. The position and orientation of the device is critical in determining the environmental augmentation displayed. By contrast, head mounted displays provide an alternative form of environmental augmentation, whereby experiences are viewed from a screen which is orientated and positioned from the wearer’s head. There are various ways in which the physical environment may be augmented, which creates difficulties in defining a precise purpose for augmented reality. However, it is critical to understand that augmentations of reality are commonly used either to tell a story, evoke an emotion, or to communicate and demonstrate experiences that may be in the past, present or future. The ability to communicate is important, a design communication medium such as AR enables both client and clinician to engage with each other to discuss and visualise design ideas for future modification in accordance with the lifestyles of the older adult.

AR is not new; the processes and ideas around it have existed for a number of decades. Only recently, with the rise of higher-powered portable computing devices, has the world of augmented reality become an actual reality for many people, and important for this research. Using novel and practical approaches, AR is applicable to and used in a variety of fields such as education, entertainment, medicine, advertising, construction and numerous other disciplines.

5.4.1 Augmenting experiences

An experiential augmentation may be audible, visible, tactile, appeal to sense of smell or taste, or a combination of these elements. However, in the case of this research, the augmentation will be strictly limited to visibility. AR is promising as a visual language to empower older adults to communicate their goals. Additionally, the information experience can be dynamic, involving complex interactions and animations, or it can be static with simplistic models, images and information (Billinghurst, Haller, & Thomas, 2007). As Craig (2013, p. 16) says: “In augmented reality, you see, hear, smell, touch and taste the physical world in exactly the same way that you would if there was no augmented reality involved.”
One of the fundamental characteristics of augmented reality is that the user remains in their own physical world. This is where AR and virtual reality (VR) are different. In AR, there should be no explicit attempt to convince the experiencer that they are somewhere they are not at that present moment. The real physical environment of the experiencer must be represented. However, the clarity of this vision is not obligatory. In contrast, VR aims to transport the user to a different location and/or situation through various technological means, such as head-mounted displays and other fully-immersive reality systems. However, head-mounted displays can be utilised for look-through environmental augmentations, whereby the experiencer’s environment remains truthful but both visual and sonic adaptations can be made.

Another fundamental component of AR relates to the awareness of special registration (Craig, 2013). Therefore, depending on an individual’s perspective, an artefact that has been augmented into a physical environment must remain faithful to its intended and original position, no matter where the viewpoint originates. If a handrail were to be placed on a real-world wall in the physical environment, no matter where the AR viewpoint is positioned, the handrail will remain faithful to its original, intended placement (see Figure 5.1). The handrail would not change position unless a user actively chose to alter the handrail’s 3-Dimensional registration point.

![Figure 5.1 Handrail remaining in position when viewed from various positions](image-url)
Temporal registration is equally important to a successful augmentation environment. The perspective of an object depends wholly on the position of the viewpoint. Therefore, the augmentation must be re-rendered following every change in viewpoint position to remain faithful to its originally-intended position. For example, if one walked in a circle around the table with the apple on top of it, the apple would remain in its place no matter what the viewing angle is (see Figure 5.1). The inclusion of special and temporal registration is imperative to a functional AR system, and hence relevant for this research. Craig (2013) has represented it in his own definition of AR: “A medium in which digital information is overlaid on the physical world that is in both spatial and temporal registration with the physical world and that is interactive in real time” (p. 20). This definition will be employed throughout this thesis.

5.5 Conceptualisation of an augmented reality prototype

5.5.1 Method

Design theory supports innovation, and provides a platform for the justification of the creation of deployable design artefacts that aim to solve targeted problems, and to satisfy the requirements of both users and the technological domain (Hevner et al., 2004). Design theory considers both the planning and building of a design artefact which, in the case of this research, is an AR application prototype. The application of novel and innovative technological tools in the fall prevention domain is gaining momentum as studies show the benefits of novelising typical medical procedures (Gschwind et al., 2014; Marston et al., 2015). There are several studies which deal specifically with augmented reality (Lera et al., 2013; Quintana & Favela, 2013; Yoo et al., 2013); however, after a wide search of the literature the researcher has not found anything which combines augmented reality, home modifications and fall prevention.

As part of the creative process supporting the generation of a designed artefact, the makers must be mindful of the relationship between design processes and their influence on the outcome (Hevner et al., 2004). In this thesis, the Augmented Reality Environmental Tool (AREVT) aims to curb issues of lack of client compliance in fall prevention home
modification design processes by instilling a sense of control in older fall prevention clientele. This important gap in knowledge and practice was identified in the preceding Study One (see Chapter 4). Consequently, there are various stakeholders and influences to consider in this diverse eco-system. This raises questions regarding the best approach to constructing a design artefact that satisfies the requirements of multiple stakeholders.

Gitlin (2003) argues that to develop successful technologies in fall prevention, the connections artefacts have with the overall service eco-system must be considered. This includes individuals—both clinical and client—and service delivery requirements, as well the theoretical groundings that support the placement and use of technologies in the fall prevention field. The following passage summarises the importance of considering the interplay between these stakeholders when designing such a technological tool:

“The task of developing and testing home modifications and new types of technologies for older people is indeed complex and involves multiple steps. Researchers must not only develop the viable technology or home modification service, but also must substantiate the theoretical base for the effectiveness of the technology or program, demonstrate its acceptability and compliance in use, its utility for older adults, caregivers, or health professionals, the specific anticipated outcomes, the training needs of the user, and its cost and cost-effectiveness” (Gitlin, 2003, p. 197).

It has been stated that “knowledge and understanding of a design problem and its solutions are acquired in the building and application of an artefact” (Hevner et al., 2004, p. 85). Knowledge has been gathered in the literature review (see Chapter 2), and is further investigated and detailed through the findings of Study One (Chapter 4). This has provided me with an informed platform upon which the AREVT can be conceptualised and created to target areas of person-centredness, practicality and efficiency in fall prevention practice.

Conceptualisation Phase One commenced after this preliminary research stage (Study One), the conceptualisation is an ongoing process throughout the thesis. The AREVT has been under continuous redevelopment (technological content) and constant
conceptualisation refinement (deployment usage and design rationale) throughout the course of the subsequent Studies Two and Three as new knowledge has been gathered. I have accounted for the evolving and ever-changing environment in which the AREVT would be used, which is reflective of the tool’s intended real-world usage environment. An iterative approach to design artefact generation marries well with the fall prevention space, as I have been required continuously to fine-tune and redefine the problem in light of new findings in the succeeding two studies. This is supported by the statement that “the process by which it is created, and often the artefact itself, incorporates or enables a search process whereby a problem space is constructed and a mechanism posed to find an effective solution” (Hevner et al., 2004, p. 86). The AREVT is grounded in the fall prevention experience; the barriers and problems connected with fall prevention can be investigated and solved through the use of design artefacts and prototyping (Koskinen et al., 2011). In turn connecting my predictions of end users and the appropriateness of proposed home modification design concepts.

Using an iterative, open and creative process in which ideas can be freely expressed and explored is supported by the design research literature. For example, the developmental process of creating design artefacts enables design researchers to comprehend the problem space better by addressing the artefact, as well as its practicability as a solution (Nunamaker, Dennis, Valacich, Vogel, & George, 1991). Hevner et al. (2004) state that “reliance on creativity and trial and error research are characteristic of such research efforts” (Hevner et al., 2004, p. 88). This is further supported by Walls et al. (1992), as resolving design problems necessitates creativity, experience and various problem-solving skills.

### 5.5.2 Augmented Reality Environmental Visualisation Tool (AREVT)

Augmented reality provides an opportunity to communicate complex environmental retrofitting design concepts in a manner that is transparent and experiential for both older clients and occupational therapists. To curb the problems and barriers in goal reflection, home modification and design communication in fall prevention (see Chapter 4), I have produced an iPad-based Augmented Reality Environmental Visualisation Tool, or AREVT.
5.5.2.1 Base application

The base application of the tool is Augment.\textsuperscript{9} This existing application has been equipped for use in this research.

Based on the insights from Study One, a collection of over 20 common home modification models have been created in the 3D modelling program Google Sketch Up. The models created include various types of handrails in a range of colours and textures, as well as a selection of disability ramps. These are the most common home modifications for fall prevention in older adults’ homes. The 3D model files are then loaded onto the Augment application via the web portal. The home modification model library becomes a portable tool that contains various models for users to choose from and place in the augmented environment. Clinicians and older adults can access this home modification bank in order

\textsuperscript{9} www.augmentedev.com
to superimpose a proposed recommendation into the home environment for evaluation and discussion.

Figure 5.3 A sample from the home modification model library (in application iPad screen)

5.5.2.2 Person-centred HCI design principles

The AREVT aims to provide a design and communication experience to fall prevention clients where health care professionals can clearly visualise and discuss, identify and relate consumer goals back in a manner that is visually effective and engaging. The AREVT and its use are grounded in the person-centred HCI design principles created from the findings of Study One and presented in the previous chapter:

Adaptive: The AREVT should facilitate an iterative process whereby continual transparent communication of client goals and the goals of the service provider are communicated and discussed in a flexible format. Different options may be tried and tested through scenarios and environmental walk-throughs. This creates a malleable process whereby an individual and person-centred fall prevention experience can be achieved to meet the needs of the older adult and the requirements of the service provider.

Human: The AREVT is intended as an accompanying design communication tool that an occupational therapist may employ in walking through the home environment with the
client to discuss environmental changes according to real, everyday scenarios throughout a falls risk assessment process. This provides a role for older adults, and a platform where they are encouraged to provide input into their fall prevention. It also enables them to comprehend better the impact that environmental change in their homes may have on their lifestyles and goals.

**Accurate:** The AREVT facilitates a process whereby goals can be communicated accurately. As established in Chapter 4, goals can be abstract. The AREVT is to be used by clinicians to communicate how to meet those goals that relate to the functional and safety needs of the individual.

**Collaborative:** Both parties contribute to the design experience by applying their goals to the visual discussion process. It is envisaged that the AREVT would be used by occupational therapists with older adults as a means to communicate and explore proposed environmental changes. However, depending on the technological capability of the older adult, they are invited to pilot the AREVT themselves.

**Visual language:** The AREVT renders real-life representation of proposed home modifications that are faithful to context and embedded in the real-world environments of those who will be using them. Providing such a mechanism is a step beyond the limited, paper-based method currently used.

**Aesthetically pleasing:** The AREVT communicates the capability of home modifications and provides options for pleasing aesthetic solutions. The cataloguing feature allows older adults to know what aesthetic options are available to them within the scope of the service and their health and safety needs.

### 5.6 Conclusions

The combination of augmented reality, home modifications and fall prevention amongst older adults is novel. Following a systematic review of the literature between these fields no similar studies have been found. Augmented reality provides a unique contribution to
fall prevention design methods. As an experience, it is expected to provide vastly different health care experiences when compared to the current analogue methods of home modification design. The AREVT provides the platform from which person-centredness can move forward, without being inhibited by the limitations of current methods of service delivery. The AREVT is expected to be an appropriate design communication and engagement mechanism to provide older adults with greater information and control when it comes to home modification design. The AREVT provides an experiential design communication platform that generates more person-centred design processes in fall prevention. This is investigated in the studies reported later in this thesis.

In this chapter, I have introduced augmented reality and contextualised and justified its use in fall prevention through close exploration of the theoretical considerations underpinning this research and the results of the preceding Study One. The following two chapters aim to investigate its applicability and utility in practice. In the next chapter, current fall prevention methods, as well as their barriers and problems, are investigated with a series of health industry professionals. The AREVT is presented to this group as one instance of a developed technology evaluation that can be considered and further refined.
Chapter 6. Study 2: Industry practice in fall prevention

“To deliver services, a certain degree of customer participation is necessary ... Services are not tangible or standardised goods that can be stored away in an inventory. Instead, services are created through interaction between a service provider and a customer. The inherent intention of a service is to meet the customer’s needs and, as a result, be used frequently and recommended heartily. This is often not the case.”

(Stickdorn & Schneider, 2010, p. 36)
6.1 Overview

The previous chapter presented the rationale and development of the Augmented Reality Environmental Visualisation Tool (AREVT) as a design communication medium to increase the person-centredness of fall prevention services. The AREVT has been conceptualised and generated based on several theoretical considerations (see Chapter 5), the gaps highlighted in the literature (see Chapter 2) and the results of the previous Study One (see Chapter 4).

The use of augmented reality in fall prevention utilises the real-world home environments of older adults to transform home modification design processes. This technique encourages older adults to participate actively in the design of their home modifications and engage with fall prevention design processes, retain control of their home environments and increase the person-centredness of the services offered by clinicians.

Study Two is presented in this chapter. It explores fall prevention, person-centredness, innovation and an evaluation of the AREVT as a clinical fall prevention design tool as used by a series of interrelated fall prevention professionals. Study Two is separated into two Stages—A and B—where a variety of interrelated industry professionals discuss fall prevention, person-centredness and innovation, and evaluate the AREVT as a clinical design tool. Both stages are conducted in one interview session, but vary in their aims, objectives and methodology.

Study Two A aims to further investigate the person-centred fall prevention domain. The data examined in the preceding Study One was secondary data; however, to understand the wider service field, it is necessary to extend this evaluation to those who originally populated and use these documents. Stage B evaluates the AREVT from an industry perspective. Overall, Study Two seeks to examine the strengths and weaknesses of the AREVT in order to evaluate and refine its use in the complex fall prevention service ecosystem.
The findings from Study Two have been published and presented in a double-blind peer-reviewed long paper at the *International Symposium on Interactive Technology and Ageing Populations Conference* (Lo Bianco, Pedell, & Renda, 2016b), and presented at *The 7th Biennial Australian and New Zealand Fall Prevention Conference* (Lo Bianco, Pedell, & Renda, 2016c).

### 6.1.1 Study Two aims

#### 6.1.1.1 Stage A

Study Two A aims to explore fall prevention from several clinical standpoints to survey this multifactorial service eco-system. In Stage A, I examine the service structures, clinical goals, person-centredness and design methods linked to older adult fall prevention. This research stage aims to give insights into service approaches that provide older adults with person-centred outcomes and control in care recommendations. The evaluation also includes the identification of service barriers for consideration and reflection in the ongoing conceptualisation of the AREVT.

#### 6.1.1.2 Stage B

Study Two B aims to assess the AREVT and its method as a design communication mechanism in fall prevention home modification services. As a secondary interview phase, Stage B uses the information and insights gathered in the previous Stage A to reflect, assess, extend and refine the design rationale for the suggested AREVT tool (Chapter 5).

The overall aims of Study Two are summarised and presented in Figure 6.1.
Aims of Study Two A: Fall prevention industry insights
(A) To examine the current state of person-centred care and how it is applied in older adult fall prevention
(B) To investigate how the goals of older adults are perceived by industry professionals and how these relate to fall prevention design practice
(C) To explore the barriers and problems in current fall prevention processes

Aims of Study Two B: AREVT evaluation
(D) To explore and discuss alternative design methods against current practice
(E) To assess the augmented reality tool as a supplementary fall prevention design communication aid to investigate its strengths and weaknesses

Figure 6.1 Aims of Study Two

6.1.2 Research questions

6.1.2.1 Stage A

Study Two A addresses the following research question:

- How are fall prevention services currently conducted?

There are several subsequent research questions that provide a lens to analyse the findings presented:

- How is person-centred care currently realised in practice?
- How are the goals of older adults reflected in final outcomes?
- What are the main challenges in current fall prevention practice?

6.1.2.2 Stage B

Study Two B seeks to investigate the following research question:

- How can the AREVT best empower older adults in fall prevention?

There are several sub questions paired with this:
• What is the suitability of the augmented reality medium in communicating client goals to facilitate a sense on control?
• What are the benefits of the AREVT?
• How could the AREVT be improved?

6.1.3 Participants

Eleven industry participants were recruited for Study Two from five separate fall prevention service providers. All participants who took part in Stage A also completed Stage B, as both parts were conducted in the same interview setting. It was advantageous to do this, as occupational therapists work under limited time constraints (Monroe & Rushton, 2008; Tzingounakis, 2012), and the findings from each Stage A interview would drive discussion when evaluating the AREVT in Stage B.

Participants include individuals from the areas of occupational therapy, physiotherapy, specialist disability architecture, aged care business development, and management/team leadership. It was common for these participants to play multiple roles in their industry positions. Between them, the participants have 170+ years of experience working in the health sector. Participants were recruited through two ongoing research partnerships, as well as from expressions of interest from individuals in separate institutions who wished to contribute to the research.

Including research participants from various interrelated fields is critical and beneficial to the findings of this research, as fall prevention processes are often dependent on several contributors from complementary areas (American Geriatrics Society & British Geriatrics Society, 2011; World Health Organisation, 2007). Furthermore, participant sampling from multiple institutions provides a more holistic overview of the field, as well as insights from different practising organisations. Participants were presented with appropriate pseudonyms for presentation of the qualitative results. A detailed breakdown of the participants is provided in Table 6.1 below.
Table 6.1 Study Two participant breakdown

<table>
<thead>
<tr>
<th>Industry participants</th>
<th>Gender</th>
<th>Experience (years)</th>
<th>Position</th>
<th>Role and daily tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Male</td>
<td>10</td>
<td>Business development manager (health services)</td>
<td>Developing organisational efficiencies to provide innovation and development opportunities. Communicating with community, government and other organisations in the sector to develop collaborations and partnerships that would benefit the organisation.</td>
</tr>
<tr>
<td>B</td>
<td>Male</td>
<td>10</td>
<td>Regional manager (community services)</td>
<td>Community services / home care packages management for regional district.</td>
</tr>
<tr>
<td>C</td>
<td>Female</td>
<td>20</td>
<td>Occupational therapist</td>
<td>Visiting older adults in their homes and delivering comprehensive assessments; looking at all the risk factors to prevent falls and provide solutions or further referral to appropriate care service.</td>
</tr>
<tr>
<td>D</td>
<td>Female</td>
<td>10</td>
<td>Physiotherapist</td>
<td>Coordination of fall prevention exercise groups, assessments of older adults in their homes/clinic for their risk of falling, and training of allied health professionals and volunteers leading exercise groups.</td>
</tr>
<tr>
<td>E</td>
<td>Female</td>
<td>6</td>
<td>Occupational therapist (domiciliary care)</td>
<td>Visiting older adults in their homes to deliver occupational and domiciliary assessments, providing equipment/home modification recommendations.</td>
</tr>
<tr>
<td>F</td>
<td>Female</td>
<td>6</td>
<td>Physiotherapist / management</td>
<td>Providing physiotherapy for older adults who are frail/suffer falls. Co-ordination of a falls and balance clinic – a multidisciplinary team of two physiotherapists, two occupational therapists and two dieticians.</td>
</tr>
<tr>
<td>G</td>
<td>Female</td>
<td>15</td>
<td>Occupational therapist / management (domiciliary care)</td>
<td>Visiting older clients in their homes who experience difficulty in their activities of daily living. Co-ordination of domiciliary care fall prevention team.</td>
</tr>
<tr>
<td>H</td>
<td>Female</td>
<td>36</td>
<td>Occupational therapist / management (domiciliary care)</td>
<td>Domiciliary care occupational therapist specialising in fall prevention among older adults. Management of nine programs that deliver rehabilitation or specialist care, primarily to older people.</td>
</tr>
<tr>
<td>I</td>
<td>Male</td>
<td>10</td>
<td>Occupational therapist</td>
<td>Occupational community fall prevention for older adults and younger clientele, focusing on home modifications.</td>
</tr>
<tr>
<td>J</td>
<td>Female</td>
<td>23</td>
<td>Occupational therapist</td>
<td>Visiting older adults in their homes delivering comprehensive assessments; looking at all the risk factors and providing solutions to prevent falls.</td>
</tr>
<tr>
<td>K</td>
<td>Male</td>
<td>30</td>
<td>Disability specialist architect</td>
<td>Specialist disabled-design architecture providing home modifications that aim to keep older adults living at home for as long as possible.</td>
</tr>
</tbody>
</table>

6.2 Study Two A: Fall prevention industry practice

Study Two A presents the results of a series of semi-structured interviews with fall prevention industry professionals. The interviews explore and investigate the strengths and weaknesses of current fall prevention methods and person-centredness, as well as other service insights extending beyond the literature and the previous Study One.
6.3 Method (Stage A)

6.3.1 Data collection

Study Two A includes 11 semi-structured interviews with fall prevention industry professionals conducted at their place of employment. All interviews were audio recorded on two separate devices to ensure a backup was available if needed. Each interview was approximately 90 minutes in duration, including Stages A and B.

Stage A was designed around three areas of investigation. These included: (i) employment history and the landscape of aged health care; (ii) fall prevention and person-centred care; and (iii) fall prevention intervention or service strategies, and the strengths and weaknesses. In Figure 6.2, a summary of the interview questions is presented. A detailed interview guideline is available in Appendix C.1.

<table>
<thead>
<tr>
<th>Sample interview questions from Study Two A</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the current landscape of person-centred care in Australia?</td>
</tr>
<tr>
<td>Can you please describe for me in some detail falls and community fall prevention?</td>
</tr>
<tr>
<td>What kinds of fall prevention recommendations are commonly made?</td>
</tr>
<tr>
<td>What are the biggest barriers to the acceptance of fall prevention interventions?</td>
</tr>
<tr>
<td>What determines the appropriateness of particular interventions?</td>
</tr>
</tbody>
</table>

Figure 6.2 Summary of Study Two A interview guideline

6.3.2 Data analysis

The data collected as part of Study Two A consisted of audio recordings. These were transcribed verbatim by me.

Engagement with thematic analysis was critical to the procedures associated with Study Two (Patton, 2002; Saldaña, 2009). All 11 interview transcripts underwent the same analysis procedure:
Transcripts (Appendix C.3) were open coded (Saldaña, 2009) into a series of Microsoft Excel spreadsheets to disseminate the data into fragments that had been identified (see Appendix C.4.1).

- The initial open coding process is beneficial in working with large portions of data. Each interview transcript was approximately 10 pages in length, and required simplification to create a workable format. Open coding allowed me to focus on the important and relevant data.

Following this, the data was cross-referenced and catalogued to assist in the identification of appropriate thematic correlations (axial coding) (Saldaña, 2009). This was predominately undertaken through a series of hard-copy spreadsheet printouts and a supplementary software program, Annotations (see Appendix C.4.2).

Significant themes were then taken from the data, and substantiated with central quotes from the industry participants via a content analysis (Patton, 2002).

<table>
<thead>
<tr>
<th>Study Two A analysis guideline: Fall prevention insights</th>
</tr>
</thead>
<tbody>
<tr>
<td>How are fall prevention services currently conducted?</td>
</tr>
<tr>
<td>Aim A: Examine the current state of person-centred care and how it is applied in older adult fall prevention</td>
</tr>
<tr>
<td>How is person-centred care currently realised in practice?</td>
</tr>
<tr>
<td>Aim B: To investigate how the goals of older adults are perceived by industry professionals, and how these relate to fall prevention design practice</td>
</tr>
<tr>
<td>How are the goals of older adults reflected in final outcomes?</td>
</tr>
<tr>
<td>Aim C: To explore the barriers and problems in current fall prevention processes</td>
</tr>
<tr>
<td>What are the main challenges in current fall prevention practice?</td>
</tr>
</tbody>
</table>

Figure 6.3 Study Two A analysis guideline
6.4 Results (Stage A)

6.4.1 Person-centred fall prevention

Between all industry participants, a shared definition of person-centred care was identified. All 11 industry participants felt that a person-centred approach to the delivery of fall prevention services is dependent upon engaging with older adults in several ways. The following quotation from Participant B (regional manager – community services) encapsulates an overall definition of person-centredness shared by the industry participant group:

“Person-centred approaches are very much around identifying what is important to the consumer, identifying what works for them, identifying who are the important relationships in their life and working out with the consumer a plan to let them move forward in their lives to let them maintain their independence to achieve what they want to achieve in their life—taking all those factors into account.”

Engagement in service processes is therefore a critical element in the delivery of person-centred outcomes. However, in the reformulation of fall prevention services from a traditional to a person-centred model, various limitations were uncovered. The following section highlights and presents these restrictions.

6.4.1.1 The need for improved implementation strategies

Person-centredness was recognised by all industry participants as a developing and encouraging approach to the delivery of fall prevention services. All industry participants claimed that person-centredness is advantageous for both older adults and fall prevention service providers. However, transition from traditional approaches to more person-centred service structures is currently evolving. The following selection of quotations support and highlight this.

Participant F (physiotherapist / management):

“[Person-centred fall prevention] is evolving. I think we are moving steadily towards it ... If
you asked me if I was doing person-centred care before two years ago I would have said yes ... But now I know that it must come from [the older adult] more, what they think is important and that they can drive the care; I can be a facilitator. So, I think that change is happening—we are moving more towards it. We definitely can do better; it is an evolving area and we are all learning.”

Participant B (regional manager – community services):
“There’s a lot of shift in policy and process; the organisations that are embracing [person-centredness] are going back and looking at their procedures. They’re looking at a lot of the theory around person-centred thinking. There is a lot being done on it.”

Three of the managerial participants acknowledged that a lot of the research around person-centred theory plays an important role in the renewing of existing services. From a managerial stance, these changes are typically reinforced to satisfy accreditation guidelines and requirements. The following quotation from Participant F (physiotherapist / management) highlights this:

“All healthcare services must satisfy a set of 10 mandatory standards, and number two is consumer participation, which is essentially person-centred care.”

Industry professionals are becoming more mindful of person-centred care and its role in fall prevention services. Reflection on the more traditional methods of the past echoes sentiments of a service approach that was based on inability rather than goals. The following three quotations explore this and further highlight that the fall prevention industry maintains its traditional foundations.

Participant C (occupational therapist):
“[Person-centred care] is emerging; it certainly is something we are wanting to address, going from a very medically-based model, where the experts tell the people what they need, to realising that patients and clients are an integral part of the healthcare experience. People with their own thoughts, volition and ability to make choices need to be involved in the process, particularly with coming up with solutions to issues that they may face.”
Participant H (occupational therapist / management - domiciliary care):

“I think there is a great deal of good intent and planning, but we still have a way to go to actually bring about the changes if we are to truly offer person-centred care.”

Participant A (business development manager - health services):

“In practice, I don’t know if [person-centred care] was as well included as it probably should have been. There was certainly a will to have it there, but I guess because it was relatively new, the value of it—there was a bit of disconnect sometimes.”

All participants stated that person-centred fall prevention is currently in a transitional period. However, Participant B (regional manager - community services) argues that throughout this transitional period, fall prevention services have failed to address the wider circumstances surrounding falls, and how to engage with older adults. The following quotation highlights this:

“I have not seen [a person-centred approach to fall prevention]. I think it’s just losing that person-centredness about what is important to somebody in their life ... I think that there’s a one-size-fits-all approach—there is a range of products that can be used to prevent falls, but I think that there have been huge gaps in that process regarding what we need to do to support somebody in their own life and find out what is important to them to put the appropriate things in place to support them to avoid falls .... I don’t think the management of falls has been very person-centred. I think it needs to be.”

The results provided in this section highlight the acknowledgement among industry participants that there are substantial gaps in the embedding and employment of person-centredness in fall prevention services. Commonly, these issues pertain to different mind-sets between industry professionals. This issue is explored in the next section.

6.4.1.2 Person-centredness in industry groups

All industry participants saw value in person-centred fall prevention. However, its usefulness was measured differently between participant groups. For example, all participants in more senior and managerial positions identified person-centredness as an
essential series of humanistic values to guide the overall fall prevention process. However, there were differences between clinicians working in the field. All shared the same fundamental values as those in managerial positions. However, as a group, clinicians were more likely to identify and discuss the barriers and problems associated with new service models and delivery approaches. For four occupational therapists, these new procedures were perceived as undermining them and their existing person-centred training. The following excerpt from Participant E (occupational therapist - domiciliary care) highlights these sentiments that were shared by four occupational therapists:

“[Service management] keep pushing it as, “it’s holistic and client-centred and all that”, but I don’t know. It is coming from the top down and it is about meeting certain accreditation standards and requirements ... It does have benefits for the clients, but I think when it comes down from there it becomes a requirement.”

Four occupational therapists stated that their profession is person-centred from its foundations, and that new models of service delivery undermine their natural abilities, as well as their traditionally person-centred workflow and mind-set. Participant E (occupational therapist - domiciliary care) had the following to say:

“It really disregards the fact that we as occupational therapists already have been trained as client-centred—that’s one of our fundamental skills. It is just in us; we already know it ... I understand that other clinicians, teams and professionals might not have that thinking already, but we have, and we don’t necessarily need this enforced on us, because we are already practising that way.”

The above statement was supported by three other occupational therapists, as their skill sets, daily tasks and workflow are involved and inclusive of their older clientele. In the following excerpt, Participant J (occupational therapist) expresses this viewpoint:

“I think that the occupational therapy focus has always been person-centred, because you’re looking at what people do in their lives and what has been interrupted by their health
problems or their injuries—whatever it is that has affected their ability to do things—and then you look at what they want to get back to doing. It just naturally is person-centred.”

Regarding the adjustment of existing occupational therapy fall prevention processes, it was noted by one occupational therapist that person-centred methods have the potential to be detrimental to well-established service frameworks, such as timeliness. Participant E (occupational therapist - domiciliary care) states that:

“We are losing our occupational therapy specialty in these requirements and what we have to do—this approach. It means that we are addressing specific things the client has requested, then looking at these broader health and social needs, yet we don’t get to go into the real occupational therapy, where we are looking at the client’s quality of life, role in their life and how we can improve their social wellbeing. We don’t have time to do that because we’re so stuck on these [person-centred] requirements for what we have to do.”

The person-centred nature of occupational therapy processes was reflected by some of those in more managerial positions, and an acknowledgement of the issue of service timeliness is supported in more detail in Participant G’s (occupational therapist / management - domiciliary care) quote:

“As occupational therapists, we are trained anyway to be very holistic, and to be looking at the person’s needs in terms of their family, their environment, their social work, so we look at all the needs a person has. I think that we are all trained that way ... Sometimes that means that our intervention is longer with somebody, which I think is contributing to our long waitlists.”

Participant H (occupational therapist / management - domiciliary care) is a trained occupational therapist with over 36 years of industry experience. Participant H reflects on the value of conducting in-depth fall risk assessments beyond initial surface-level requests and examination of the overall need for assistance that an older adult may have. This participant felt that this latter approach was meeting the current and foreseeable needs of
the older adult, and addressing their needs proactively rather than reactively, ultimately reducing service time. The following anecdote from Participant H highlights this:

“I had a colleague; she was known to be able to see a lot of clients in one day, but the comment that came back from one of the clients was that she didn’t even put her bag down. What that shows is that she would get a referral that said: “Mr Jones needs a handrail in toilet.” So she would go to the patient and say: “I have a referral for a hand rail in the toilet.” She would go and assess the person, write the work order and discharge. If I get a referral for a hand rail for Mr Jones’ toilet, I will look at the toilet and discuss that, but I will also access [the] lounge room, bedroom, kitchen and do a comprehensive assessment. If he is having problems with that, you must understand that all his daily activities will be affected, because in a couple of weeks you will get another referral for Mr Jones because now he can’t get off his lounge chair.”

On the surface, person-centredness and its implementation in fall prevention has been described as evolving. However, there is an undertone of reluctance to accept new thinking, new approaches and new models of service delivery that differ from the traditional methods of the past. For example, occupational therapists who commonly work in the field can become accustomed to their own workflow and habits, which they fall into automatically. Recommendations may be made to their older clientele based on their own clinical experience, rather than exploring the needs of the older client in depth. The following quotations are taken from two occupational therapists who work in the field. These excerpts highlight this automatic process:

Participant E (occupational therapist - domiciliary care):

“Sometimes when you are just doing rails and things you can kind of get in the habit of just doing them, and putting them in the usual spot that you would put them in for any client … I think in some cases the clients do benefit from that broader health and social check, and that we are involved in many parts of their lives; then it is beneficial for them and they do enjoy it. But there are also a lot that just get referred because they just want a rail next to the toilet and that’s it. We are required to do everything else and it is not relevant to them. I understand
why they have implemented this approach but it only applies to certain clients, not all of them.”

Participant C (occupational therapist):
“These are the things that you don’t even consider now because it is like you’ve been in this box for so long that it is hard to see outside of the walls ... I think sometimes I might jump in quickly because this is what I recommend, but I don’t say to them, “What would you like to do about that?” ... So, giving them the option of coming up with a solution, I probably am not very good at that.”

These examples of habitual workflow provided by occupational therapists were acknowledged by three senior managers in fall prevention services as a problem that requires mitigation if truly person-centred practice is to be implemented. For example, Participant B (regional manager - community services) states that hierarchical service issues inhibit the redesign of traditional allied health services:

“There’s a view amongst professional people, particularly in allied health, that they understand what might be important for the client without asking if it’s important to them. That’s challenging a lot of people in the workplace—the thought of going and asking somebody, “What’s important to you in your life and what can I do to assist you in that?” .... That’s actually challenging a lot of people and that is proving very hard to work through.”

Participant F (physiotherapist / management) extends this theme by acknowledging traditional habitual workflow as a current issue that could be corrected by properly engaging the older client:

“I think that we can definitely do it better. I think that we still operate on a hierarchical model where a clinician tells you what is good for you rather than involving you, being led by you or guided by you, or investing the time in educating you on what is available, what my role is and you telling me what will help you—that kind of thing. I would say we are moving towards that, but we can definitely do a lot better in that area.”
All managerial service participants are mindful that ongoing clinician education on the importance of person-centredness and service delivery is essential. It is necessary to rethink and remodel traditional methods and values in fall prevention to encourage services to be more person-centred. As described in an earlier quote from Participant E (occupational therapist - domiciliary care), this top-down approach is evident; however, it is also necessary to enact positive change. The following quotation from Participant F (physiotherapist / management) supports this:

“That is what we try to do now with the managers and the team leaders; it goes down to the clinician, the training in person-centred care, the talk about participation. I think it is slowly going down to a clinician’s level, and I think that change is happening. That is my perception. I don’t know what other clinicians think. But that is definitely what I intend to do with my team.”

As stated at the beginning of the Results section, person-centredness relates directly to the level of engagement that is adopted by a health professional. This section has highlighted some of the issues that impinge upon that. These findings show that there is a contradiction between the fundamental definition of person-centredness and what fall prevention service providers are required to promote—engagement with older adults.

6.4.2 Engagement and goals

This section presents the findings linked to person-centred engagement. It is divided into four parts, including service procedures and assessment tools, communicating goals, client control retention and design processes.

6.4.2.1 Service procedures and assessment tools

As demonstrated so far, person-centredness is dependent on the level of engagement of an older adult in the fall prevention service. Therefore, it is imperative to consider the mechanisms and tools that drive and assist in the design of recommendation outcomes throughout the fall risk assessment process. In this section, the industry participants
elaborate and comment on the service procedures linked to the assessment tools that are commonly used to identify client goals and drive their fall prevention processes.

When asked how fall prevention industry professionals promote engagement with older clients, all industry participants referred to the risk assessment process and the supporting documentation. The documents discussed in the interviews were originally analysed as part of Study One. The following results act as a member-checking process (Dervin, 1997) to substantiate the previous findings and build on the knowledge gained in Study One (Chapter 4). Examples of these documents can be found in Appendix B.1. In terms of the overall procedure, the appraisal of risks and hazards was the dominant purpose of the assessment documentation. This is highlighted in the following quotation from Participant B (regional manager – community services):

“It is all around assessment; assessment of the risk, people going around and talking and finding out what the actual risk is in the home and coming up with a range of solutions around that. That’s where I think some of the gaps are. I don’t know that every client who is at risk of falls being assessed for supports in the home is actually being engaged in how those aids might work for them or might not work for them.”

Regarding the assessment procedures that aim to promote engagement, four of the five fall prevention service providers have redesigned their assessment documents to encapsulate a more person-centred approach. The fifth provider is Participant K, an independent disability specialist architect. Participant K works as an independent contractor to assist other fall prevention service providers, who do operate according to a person-centred model.

The assessment process is not required to be strictly formal; there are leniencies available for the older client. This aids in creating a comfortable assessment environment throughout the documentation process. The assessments can be, and usually are, conducted as informal and non-linear chats. This open process creates a more free-flowing and conversational assessment style rather than a rigid process. This is beneficial in
discussing and creating a dialogue about the older clients’ goals and their service options. The following quotation stresses this:

Participant G (occupational therapist / management - domiciliary care):

“We have a structured assessment form, which is tick boxes, and we do have to complete it, but you can carry that out in more of a chat; it doesn’t have to be [formal]—that depends on the client. Some people like that more structured assessment; other people don’t like you sitting there and looking at your sheet.”

Service structures and their accompanying assessment documents enable goal-orientated discussion. It is a specific part of the service process that must be investigated. Participant F (physiotherapist / management) confirms this:

“There is a section for goal setting with the client. In our e-care plan we document the consent from what the client has agreed on ... So, I think that is our way of keeping it more person-centred ...”

While the efforts to recognise and reflect client goals in fall prevention recommendations is obvious, the difficulties in communicating these goal-oriented ideas were acknowledged by all the industry participants. As highlighted in the earlier results, management associates these problems with a lack of training in new ways of thinking. Participant F supports this finding:

“... I still think that clinicians need more education on person-centred care being driven from the person’s end, because it is so easy to think “I know what is wrong with you and I can tell you how to fix this”. I think that we are doing okay; the tools that we have got now are cooperating with person-centred care and goal setting to make sure that it is happening with every client.”

To move away from medical models in the assessment process, all managerial participants noted the importance of acknowledging and permitting individuality. This was recognised as a critical part of reconsidering how person-centred fall prevention processes are delivered.
Participant B (regional manager - community services):

“It comes back to ‘what’s happening for you that sustains you?’ ‘Why are you driven to stay at home rather than to out yourself into an institution and live out the rest of your life there?’, and finding out what those things are. It’s about people telling their stories. It’s about people coming out of that and finding out what’s important to them. It’s all those types of things, as well as understanding why people do what they do, and do it differently.”

As noted in Section 6.4.1, barriers and problems still exist regarding the implementation of new person-centred service procedures and the documents that guide the fall risk assessment process. One occupational therapist expressed that the documentation requirements are now beyond the scope of what they deemed necessary, given their earlier perception that occupational therapy is inherently person-centred. Participant E (occupational therapist - domiciliary care) demonstrates this view:

“There’s a lot of paperwork requirements; there’s all these questions that we have to go through with every single client, and then with that comes all the documentation, which takes double the amount of time as I remembered doing … we’ve had to upskill in broader counselling areas to be able to address these broader social and health needs … With the care plans we are making it work for our team (domiciliary care), but it is not well designed for what we do … in the history of domiciliary care, we have purely provided home modifications and equipment and that was it—and now we do anything and everything.”

All participants acknowledged that, to a large extent, the person-centred process depends on the conduct of the professional guiding the service for older adults. The professional could be a clinician, an architect or anyone else acting as the face of a fall prevention service. Participant K (disability specialist architect) supports this view:

“It is a bit like doctors and bedside manners: some architects have good ones that get along well with the clients and can explain things, and others who just charge in there and say: ‘Well I am the professional; this is what you will do’, and not even get their input. We do have a problem with them … [they] get complained about because ‘they didn’t listen to me, they
didn’t do anything I said, they didn’t put forth ideas that I like, they did not take me into consideration.’”

All industry participants expressed that there are communication issues surrounding the conduct of fall prevention services, and these barriers go far beyond the scope of home modifications, which are just one component of a bigger fall prevention service problem. Participant F (physiotherapist / management) is a fall prevention team leader, and is constantly looking to upgrade the team’s skills. However, while all participants acknowledged that significant communication problems persist, Participant F states that the training provided still falls short.

“Even with all the training, now the focus is on how to communicate motivational interviewing and all of that, because as clinicians we are trained to look at and investigate—we don’t get trained to communicate ... you head out to the real world and you think ... ‘I know what is wrong with you, but how am I going to communicate that to you and get you to see that?’”

Based on the observation above, it is probable that clinicians working in the field would benefit from a communication tool such as the AREVT, which would offset some of the problems linked to communicating home modifications and goals.

6.4.2.2 Communicating goals

All participants acknowledged that person-centred fall prevention service procedures aim to identify older adult goals as a platform upon which clinical recommendations can be grounded to facilitate a process that acknowledges the individuality of their older adult clientele. However, goal modelling and the discussion of goals is a distant concept for many older adults; this was acknowledged by all industry participants. The following quotations highlight some of the practical barriers encountered by fall prevention services in trying to communicate with their older clients about goals.

Participant C (occupational therapist):

“We have a question on our assessment that asks what their goals are. Many older people are
unable to articulate goals ... I always rephrase it; I don’t use that terminology. I usually ask them, ‘Was there anything in particular that you want to achieve through our visit today? Or, is there anything that you were hoping that I would cover or that you were going to get from this visit?’ That is how I would say it ... I don’t think that goal setting is something that a lot of older people would be familiar with as a term, I think that it is relatively specific.”

Participant J (occupational therapist):

“The language of talking about goals with older people and people from backgrounds where they have never talked about goals before is a very new concept for a lot of people, especially for the older generation. We use words like ‘What is important to you? What do you want to work on together?’ Although we talk about goals, often that word doesn’t mean much to people who have never used that term before.”

All fall prevention service providers have their own service goals as well: to deliver the highest-quality service possible with the safest outcomes, while meeting the service and accreditation standards. Often these clinical goals are difficult to communicate to older service consumers. A balance is needed that satisfies both client and service. The following passage from Participant C relates to this issue:

Participant C (occupational therapist):

“We’re not about convincing people; we’re about giving them the information on what we do and how we can go about it and what it involves and then making a choice, however it does happen ... There is quite often a lot of discussion around why have I identified this as a risk factor.”

The barriers linked to communication about goals are in line with the findings from Study One (Chapter 4). All industry participants acknowledged that goals can be, and often are, abstract, with older adults communicating their wishes as normative tasks according to their own lifestyles. These tasks provide a great opportunity for occupational therapists and other fall prevention service providers to address the functional needs of an individual. This is achieved by making it a primary objective to meet those abstract criteria, while satisfying the underlying physical and health-oriented needs of the individual. This
iterative approach is explored in the following quotation from Participant G (occupational therapist / management - domiciliary care):

“The goal might not be to get off the toilet safely; it might be that they want to get out and visit their granddaughter—that is what motivates them. They’re not going to comply with something that they do not feel is important to them ... We had someone the other day that wanted to be able to look after their dog and cut their dog’s toenails. To her that was the most important thing, and she was not able to focus on anything else because to her that was paramount ... So, the goals are not always related to what [occupational therapists] see, which is typically the real functional issues such as getting on and off the toilet or a bed ... It must be something that has come from their own intrinsic motivation.”

In some cases, it is a matter of presenting older adults with informed choices; however, if these options conflict with their lifestyles and individuality, this will affect the acceptance and uptake of a recommendation. The following anecdote from Participant K (disability specialist architect) demonstrates this:

“I had an Italian family, and they were struggling to get up and down the back stairs. We were supposed to put a ramp in. They had a veggie patch from one side of the house to the other, and they just wouldn’t let me take any of that space. They had a massive garden. I said: ‘Could we put a ramp around here?’ No. In the end they said thank you very much, but go. I tried every which way I could think of and they said: ‘I am not losing any veggie space.’ All you can do is put it to them—you can’t force them.”

There is a substantial difference in the clinical approach between smaller recommendations, such as moving rugs, and suggesting assistive equipment and more cumbersome and permanent fixings such as the ramp solution described in Participant K’s anecdote. The following quotation from Participant G (occupational therapist / management - domiciliary care) discusses the advantage of equipment-trailing programs:

“If you can relate [the recommendation] back to what their goal is and how it will impact their functionality, then usually [older adults] are pretty receptive. So, trials are important, so
"you’re trialling something with someone to start with rather than just presenting a piece of equipment to them."

Equipment trials are beneficial for older adults, especially in breaking down initial hesitations. However, without a transparent and engaging tool, it is difficult for older adults to visualise and understand the effect that home modifications may have on their lifestyles.

6.4.2.3 Client control retention

When taken up by older fall prevention clients, proper engagement mechanisms permit a greater sense of control. The current methods of conducting and delivering fall prevention services to older clientele prevent them from feeling in control. Control was acknowledged by all industry participants as a critical element in the delivery of person-centred interventions. However, it became evident that there is a disconnect among industry professionals regarding the value of control, and how it can be embedded in the older client engagement experience. Participant B (regional manager - community services) demonstrates this in the following quotation:

“The control has been taken away from the consumer, and for a long time it has been in the hands of the professionals who are working in those industries—not ill-intentioned, but thinking that this is the best way for the consumer to go forward, and the consumer hasn’t been that well consulted in that process.”

Providing person-centred control correlates directly with delivering fall prevention recommendations that inform older clients of their choices and demonstrate awareness of the value of their input, goals and motivations. Participant B goes on to state:

“People know that they don’t want to have falls, but what they don’t know is what is out there to help them. I think that is where it relies on the professional being very focused on giving the client informed choice around what might work and what doesn’t.”

Fall prevention service processes must be in line with the internal goals and motivations of the older individuals. It is imperative to ensure that older adults are cognisant that their
own lifestyles, and that motivations and goals are being recognised as a fundamental service foundation; all industry participants acknowledged this. Participant C (occupational therapist) supports this claim:

“Whereas my approach would be if you want to keep doing this and it is something that brings you joy, and you don’t feel as though you’re putting your health at risk while doing it, I encourage you to do it. It is keeping you active; it gives you a reason for living; it makes you feel like you’re involved in the stuff that you have been doing for years and years. You’re a contributor.”

Reminding older adults that they are contributors to the service process is important. Through the framework of this research, it can be deduced that this barrier is related to the design processes in fall prevention services. This is explored in the next section.

6.4.2.4 Design processes

6.4.2.4.1 Service barriers

As stated by all fall prevention industry participants, two primary barriers restrict successful compliance with and uptake of fall prevention interventions. The first is the relevance of the service recommendations as perceived by the older adult, and the second is aesthetics. These are connected to the stigmatising nature of assistive equipment. Participant H (occupational therapist / management - domiciliary care) contextualises these service barriers:

“I had a client once who declined to have a handrail installed because we didn’t have it in a gold colour. This person had fallen in the shower and sustained an injury, and because of aesthetics, they chose not to reduce their risk of having further falls.”

In the above example, it is possible that an alternative method of communicating different handrail designs and colours would have met the needs of the older adult. By demonstrating other aesthetic choices, an alternative could have been found that met their needs. This raises issues of design communication.
6.4.2.4.2 Design communication and technology use

Regarding detailed and complex home modifications, all participants stated that recommendations are typically communicated verbally with 2D or 3D drawings as support (see Appendix B.1.1). As highlighted in the findings from Study One, it was predicted that these methods of design communication would be difficult for older adults to interpret. This was affirmed in Study Two A, where all participants reported difficulty in getting older adults to understand both complex and simple home modification designs. In the following quotation, Participant K (disability specialist architect) comments on how older clientele are engaged with the design processes, leading to environmental change:

“(Recommendations) are verbally communicated, or we prepare what is called a sketch plan, which details existing conditions. Then we draw what our proposal is ... they always get to see it and they always get to comment ... it is tricky; a lot of clients can’t read 2D drawings, no matter how much you try to explain them. So, in a lot of cases I will take them into the bathroom and try to explain: ‘Well, this is not going to be here, it will be here like that.’ Some get it, but most don’t. It is very difficult.”

Occupational therapy design procedures have not evolved far. For example, Participant H (occupational therapist / management - domiciliary care) describes a design communication process over three decades:

“We used to have to carry a bag full of brochures and things like that, so if we were describing things to a client, we would have to get out the supplier’s brochure and look it up and show it to them. These days you can put everything up on a tablet.”

The current utilisation of portable tablet technology is mostly limited to digital catalogues and photographs of completed modifications in other people's home environments. The inclusion of iPads in occupational therapy home modification services has aided in digitising pamphlet-based design communication, but has not achieved move much than that.
Participant G (occupational therapist / management - domiciliary care):
“We now have access to iPads when we go out to see clients, and that has helped ... I would just go on the supplier’s website and show them a video or some pictures. It has a relatively large screen, compared to looking at it on the phone. We also use iPads for taking photos of proposed modifications. We might take a photo of someone’s toilet and then come back and include a drawing of a rail.”

As noted by all but one occupational therapist, their digital design and photo retouching skills are lacking. Commonly, images are edited using non-traditional photo retouching software such as Microsoft Word, with lines used to represent ramps, railings, and so on.

Other more traditional methods are also still being applied. These include the use of chalk and tape to measure and demonstrate the size and placement of modifications. Participant E (occupational therapist - domiciliary care) provides an anecdote about their own design processes, and how a blend of both traditional and technological methods may be utilised:

“I get up pictures of ramps (on an iPad), so if we are going to do a ramp that doubles back onto itself ... I try to bring up pictures to show them what it is going to look like. It is hard, because it’s not the actual ramp, and it’s not on their house. So, it is hard to get them to understand that, but it does give them just a little bit of understanding. Other than that, all we have got is chalk and a tape measure to show them how long it is going to be, and that’s all we have got now to use, and if we can’t get them to understand that, that’s all we’ve got.”

The current use of portable technology in occupational therapy is emerging, and is under-utilised. The operation of new technologies is restricted by limitations in technical know-how among fall prevention professionals. An acknowledgement of the benefits of using digital technology was recognised by all participants; it was seen as way forward for the industry. However, all but one clinician in feels as though their technological proficiency is lacking.
Participant D (physiotherapist):

“I feel very much under-skilled in terms of technology. However, I am aware that there is much more that can be done regarding technology.”

By contrast, Participant I is an occupational therapist who is self-trained in Google Sketch Up\(^{10}\), and uses this software as a supplementary design tool to communicate with clients, architects and local council bodies. Participant I uses this software on a portable laptop, and claims that this process provides a more person-centred service experience for fall prevention clients. Participant I (occupational therapist) describes how the fall risk assessment process and Google Sketch Up can be used in conjunction with each other:

“I will go and do my initial assessment, have a discussion with the client and assess how they perform functionally. I will work out what their goals are in terms of being more independent and safe, and then I will talk to them about how to make the space safer and easier for them to manage. So, if it is a bathroom, doing a level-entry shower, I will go back and create a 3D image using Sketch Up. I will then drop those images into a report that I show to the client ... it gives them a better idea of how the space will look to the client rather than just static images.”

Participant I (occupational therapist) stated that only a handful of occupational therapists in Australia use Sketch Up, and says that there are foreseeable issues in the mainstream uptake of the technology because of the knowledge required to operate and design full 3D environments:

“Because of the complexity of [Google Sketch Up] I don’t think a lot of [occupational therapists] would use it because there is a very steep learning curve.”

\(^{10}\) www.sketchup.com
Participant I (occupational therapist) said that when fall prevention recommendations are communicated via Google Sketch Up, this enhances the ability to engage with fall prevention clientele and represent their goals in service recommendations.

Participant I (occupational therapist):

“It really gives them a real assurance that you are working with them in a really consultative process. I make sure that they are a part of it, and that they give the final feedback before I send it off to whoever is doing the work … I think it really fits into that process really neatly.”

Embedding a proposed fall prevention environmental modification in a digital representation of a client’s home is beneficial, as it encourages older adults’ awareness and acceptance of the forthcoming changes to their home environment and lifestyle. Participant I (occupational therapist) stated that this personal design method originated from issues with client expectations and understanding of architectural plans. These communication design issues have been consistent in the findings from Studies One and Two.

“They weren’t able to ascertain from an architect’s drawing, which they often get. It is just a 2D bird’s-eye view of the plan, whereas with Sketch Up, they can instantly get a much better projection of what it will look like and what they are actually getting.”

Engaging with older adults and offering them digital visualisations is valuable, because it offers transparency in recommendation and solution. It allows older adults to remain in control and contribute to the process, and instils a sense of ownership. The following quotation from Participant J (occupational therapist) shows the value of ownership:

“Sometimes people just want to invent their own thing. It doesn’t matter what you give them—they must change it just a little bit and then it becomes their own … They are used to coming up with their own solutions … occasionally you come across people who have a lot of little inventions at home that they have already stuck together with sticky tape, or have used something that they have found in the hard rubbish, and then when you bring a piece of equipment, they change it just a little bit, and then it becomes exactly right for them. So, there are all kinds of individuals.”
6.4.2.4.3 Accommodating for Australian Standards

Home modification designs and outcomes are dictated by Australian Standard 1428.1 Design for Access and Mobility (Standards Australia, 2009). It was understood prior to the interviews that there are problems with this standard (see Chapter 2.4.7.1). These issues were investigated, and many practical and day-to-day design communication barriers were uncovered.

Australian Standard 1428.1 Design for Access and Mobility (Standards Australia, 2009) is the only design standard applicable to the retrofitting of older adult homes, but problems persist regarding its suitability. The following quotations highlight these practical barriers:

Participant K (disability specialist architect):

“The tricky part is that (Australian Standard 1428.1) is for public buildings and new works ... the 2001 issue quite clearly states this in the first paragraph, that this Standard does not apply to domestic. However, it is the only standard that we can refer to; what we need is to have another standard for retrofitting existing houses.”

Participant E (occupational therapist - domiciliary care):

“I don’t even think I have been to a household or many households that allow enough room to apply the Australian Standards to it.”

Typical barriers relate to the applicability of the Standard in community homes rather than new building works. Some of these barriers relate to ramps, specifically the communication of the size of a 1:14 gradient ramp:

Participant K (disability specialist architect):

“[Older adults] always underestimate the size of the ramp, every time.”

Advised circulation spaces are also problematic, particularly landing size. A minimum is specified; however, it is too small:
Participant K (disability specialist architect):
“*I have had people tie string into the key to pull it out, or put a tie around their neck to shut the door behind them. That hasn’t been addressed and is major a problem.*”

Deviations from Standard 1428.1 can be made depending on circumstances; however, these must be signed off by the older adult to cover liability issues:

Participant E (occupational therapist - domiciliary care):
“*You must work with the space you have got, and it is the same with the front steps and ramps—you’re always having to adapt what you’re meant to do, to what can be possible.*”

There are issues of applicability to older adults of the current generation, as 1428.1 is based on data from people aged from 18-60 years of age:

Participant K (disability specialist architect):
“*Most of my clients are way over that ... It is based on old data which was done back in the 70s and 80s, so much has changed.*”

Furthermore, since the collection of the data supporting Standard 1428.1, significant advances have been made in other related fields, including assistive technologies. For example, wheelchairs and walkers are commonly used in conjunction with ramps, but the Standard does not reflect this:

Participant K (disability specialist architect):
“*It is also based on someone who is self-propelling in a wheelchair; what about someone who is assisted? What about motorised chairs, scooters, motorised beds—these other modes of getting around that aren’t covered. What about walkers?*”

All non-managerial participants expressed issues with the use of Standard 1428.1 in fall prevention, and advise that an amendment or separate Standard is required that better accounts for individual circumstances. These ideas were shared among those in more senior positions. However, as a participant group, this faction was not as aware of the day-to-day problems faced by those in the field. Alternative approaches have been taken by
clinicians to communicate and cover liability issues linked to the widespread deviation from the Standard, as Participant E (occupational therapist - domiciliary care) demonstrates:

“There are a few forms about deviating from the Standard; it is not a formal form at all (see Appendix B.1.3). It is something that I created several years ago because this came up all the time, usually to do with ramps ... because we’re deviating from what the standards are doing but we have a reason for it. We also want the client’s permission that they are happy to.”

Industry participants all agree that they need to comply with the Australian Standard. However, there is an overall acknowledgement by the industry professionals that application of the Standard may not be in the spirit of person-centred care. Occupational therapists and architects commonly work around the Standard to create outcomes that are more person-centred and applicable to their older clientele. However, the argument is that the fundamental disability design Standard that is being applied to the homes of older adults does not align with person-centredness, as the data supporting it is not related to older adults in any way. Hence, the Australian Standard 1428.1 fails to engage with older adults on the most basic levels.

6.5 Discussion (Stage A)

6.5.1 Communication in context

Fall prevention service providers aim to deliver a person-centred service through the representation of older client goals in their recommendations. While this was acknowledged by all fall prevention industry participants, there is great potential to enhance the co-creative design component to develop more person-centred fall prevention outcomes. As highlighted in the results, there are true service barriers that cannot easily be corrected, and there are significant service problems relating to the applicability of Australian Standard 1428.1 Design for Access and Mobility (Standards Australia, 2009). These barriers are outlined to demonstrate the magnitude of design-related issues in fall prevention services. Within the scope of this research, issues pertaining to communication
design and person-centredness are addressed, as solutions can be implemented immediately.

Occupational therapists are proud of the person-centred elements embedded in their role. For an individual to dedicate their working life to assisting people requires a mind-set that is empathetic and focused on helping those in need. However, as identified in the results, the methods of engagement employed by most occupational therapists to interact and communicate with their older clients can be improved, as they are typically based more on a medical model than on goals.

Acknowledging the expertise and experience of Participant I (occupational therapist), it is evident that the use of assistive digital visualisation tools to support supplementary service techniques can provide informed engagement and design communication between clinicians and their clients. As highlighted in the results, Google Sketch Up is an appropriate tool to create environmental visualisations. However, this program may be too complex and outside the everyday technological skill set of many occupational therapists. Google Sketch Up is also dependent on the competency of the clinical user in accurately depicting and rendering a recreation of a client’s home. Furthermore, using Google Sketch Up requires time, which is difficult for clinicians who are already busy. This could create communication barriers not unlike those noted in the use of pamphlet and digital catalogues, with older clients being required imagine design recommendations in their homes. While onsite with an older adult, it is very important to be able to represent a client’s home environment and fall prevention recommendations accurately, simply, and in a timely manner.

While many older adults struggle to articulate their own goals, occupational therapists apply an industrious approach in exploring and substantiating their client’s goals through an open dialogue about their lifestyles and desires. However, the abstract nature of goals can raise a significant communication barrier; fall prevention industry professionals work through these goals to tailor the service to the older adult’s motivations. Participant G’s (occupational therapist – management - domiciliary care) anecdote about the older adult whose primary desire was to retain the ability to clip her dog’s nails is a supreme example
of this. By addressing that goal as the target objective, and identifying the fall risk factors that require mitigation, industry professionals can tailor a service experience to the wishes of their clients, and simultaneously address their own goals regarding functional and safety requirements.

The industry perceives that there is tremendous value in the ability to communicate fall prevention recommendations, while maintaining the goals of older adults as primary objectives. For example, because of the difficulty in communicating goals, it might be more beneficial to talk through and visualise daily scenarios. Traditional methods of fall prevention do not allow for this.

6.5.2 Providing a means to retain control

According to Schulz and Heckhausen (1999), to retain control older adults adopt primary and secondary mechanisms to counter many of the intrinsic and extrinsic fall risks and hazards that may be present in their lives. These two mechanisms are dissimilar; however, they are fundamentally connected. For example, a primary control mechanism can be described as an active behavioural effort to alter external forces or modify the immediate environment to maximise control. Correspondingly, secondary mechanisms pertain to the intrinsic cognitive processes that are activated to counterbalance loss of control, such as emotions. As stated, a delicate and reactionary relationship exists between these control processes, as secondary mechanisms support and enable the use of primary active behavioural strategies.

A balance between these mechanisms is necessary for fall prevention service providers to provide a means for older adults to remain in control of their own care outcomes. Therefore, the relationship between the person-centred procedures of fall prevention services, and the effects that these actions have on the control retention mechanisms of older adults, is supremely important. However, as highlighted in the results, a significant opportunity remains to improve the ways in which fall prevention service providers engage with and enable older adults throughout home modification design processes for fall prevention.
All participants in this study stated that successful person-centred fall prevention outcomes are directly dependent on the representation and reflection of the goals of older clientele in service outcomes. Both stakeholder groups—service providers and older adults—need to be mindful that older adult goals are life goals. These are substantiated activities and tasks that they want to retain, or regain the ability to do. These goals may appear abstract in nature or negatively formulated, such as “avoid falls” or “reduce risks”. However, these desired outcomes are necessary if these self-sustaining activities are to continue, and if the modifications that enable these are to be accepted.

Therefore, the goals of older adults have a role to play in our efforts to provide fall prevention clientele with greater control. For example, while a primary mechanism for an older adult may include a goal to modify the rear access of their property, an accompanying secondary mechanism or sub-goal might be to continue the upkeep of their garden as a visual confirmation of their ongoing capability and independence. Many older adults see the home environment as a reflection of themselves, and the upkeep of immediate environments serve as constant reminders of their remaining abilities. Equally, fall prevention home modifications have the potential to serve as constant reminders to older adults of their disability, can lead to a sense of disconnection from their own environment, and may compromise self-identity and self-efficacy.

As the results show, fall prevention industry professionals are mindful that older adults struggle to communicate their goals for a variety of reasons. Commonly, these issues are related to the language used by service providers in formulating and communicating goals to their clientele—older adults are simply not aware of how to talk about their goals. However, this finding is based on the fall prevention industry’s perception of older adult goal communication, and has not been compared with the perceptions of older adults. In the assessment process, older adult goals may be interpreted as abstract, as they do not fit into the medical model and traditional fall prevention service framework. This was identified by the more senior fall prevention industry professionals as an issue that requires attention if more person-centred services are to be provided.
6.5.3 Preview of the AREVT

Based on the data collected to date and the design rationale for conceptualising the AREVT (Chapter 5), it is possible to anticipate how the AREVT could address some of the overarching service barriers and issues identified in the results so far:

- Design communication
  - As highlighted in the results, the design processes in current fall prevention service structures are limiting for older adults. As conceptualised, the AREVT will operate as a supplementary service platform, whereby older adults are invited to engage with the design process, which would create greater opportunity to understand the functional and aesthetic impacts of their design decisions. This extends beyond the current methods of communication design in older adult fall prevention, and creates opportunities for better comprehension of design.

- Engagement and goal communication
  - The AREVT is conceptualised as a service tool that welcomes engagement by older adults as service receivers. The conceptual method for its use is dependent on older adult engagement in services. For example, the AREVT is an engagement platform that allows clinicians to simulate walkthrough scenarios in home environments. This enables clinicians to establish with greater certainty the fall prevention requirements that are needed to address and engage more deeply with the goals of older adults.

- Control
  - A combination of the above points will formulate a fall prevention service structure that incorporates the goals of older adults and invites engagement and contribution from them as individuals. These fundamental characteristics are critical in creating a service process that upholds the needs and goals of older adults in a way that is hierarchically balanced and person-centred. This could lead to greater uptake of fall prevention recommendations.
In the remainder of this chapter, Study Two B is presented, and the effectiveness of the AREVT is assessed, using data gleaned from the same fall prevention industry group.

6.6 Study Two B: AREVT evaluation

Study Two B aims to evaluate the AREVT as a person-centred design communication mechanism to be applied in older adult fall prevention. Comparisons are drawn between the strengths and weaknesses of current fall prevention practices identified in Stage A and the findings of Stage B.

6.7 Method (Stage B)

6.7.1 Data collection and sample

The interview questions in Stage B are designed to evaluate the AREVT. The questions were open, inviting feedback and encouraging participants to generate and share their own ideas. Stage B was conducted immediately after Stage A. In each Stage A interview, troublesome areas of fall prevention practice were identified; these were then extrapolated and explored in the Stage B interviews.

The AREVT was introduced to the participants as a supplementary occupational therapy co-design tool—one that would require their input. Each Stage B interview commenced with a demonstration of the AREVT prototype to show its capabilities. It was presented by the researcher as a home modification design tool, a basic overview of the AREVT's features and functionality was provided to each of the participants. The participants were then invited to pilot, explore and add environmental enhancements to environments within which the interviews took place. Participants were then invited to use and comment on the AREVT. A summary of Stage B interview questions is presented in Figure 6.4 below, and a comprehensive interview guideline is available in Appendix C.2.
**Sample interview questions from Study Two B**

Do you have any comments on the application?

If you could change something about it, what would it be?

Given your history working in aged care, how do you think a system like this would benefit older adults? And what about aged care providers?

How can digital technologies enhance person-centred care in fall prevention?

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**6.7.2 Data analysis**

The data sample collected in Stage B included semi-structured interview audio files, which were transcribed by me prior to analysis.

The data collected in Stage B underwent the same thematic analysis procedure as Stage A (see section 6.3.2 for a detailed description).

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**Study Two B analysis guideline: AREVT evaluation**

How can the AREVT best empower older adults in fall prevention?

**Aim D: To explore and discuss alternative design methods against current practice**

What is the suitability of the augmented reality medium in communicating client goals to facilitate a sense on control?

**Aim E: To assess the augmented reality tool as a supplementary fall prevention design communication aid to investigate its strengths and weaknesses**

What are the benefits of the AREVT?

How could the AREVT be improved?

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Figure 6.4 Summary of Study Two B interview guideline

Figure 6.5 Study Two B analysis guideline
6.8 Results (Stage B)

The results of the AREVT evaluation by the fall prevention industry participants have been categorised into benefits and barriers. These are presented in the following sections.

6.8.1 Benefits

6.8.1.1 Engagement and communication

One of the main benefits expressed by all industry participants was that the AREVT is foreseen to encourage engagement with older adults. As identified in Stage A, there are service difficulties with person-centred engagement in older adult fall prevention. The following quotation from Participant I (occupational therapist) spoke about the problem and how the AREVT may combat it in the field:

“By engaging the client and involving them in what the outcomes are going to be and the process. For example, people often say, ‘You know where to put the rail—you’re the expert,’ and I would say back to them: ‘No, you’re the expert. I need to know how you operate physically—that will help me determine where to put the rail. I need to know your preferences for it to work most effectively for you.’ So, there is always that collaboration and you are trying to encourage them. [The AREVT] certainly does that.”

The engagement of older adults directly correlates with person-centred ideology. As reflected by Participant I (occupational therapist) in the above quotation, the AREVT offers a bridging mechanism to curb issues related to self-worth by providing older adults with a valued role in the service hierarchy. The AREVT does this through a supporting service structure that invites client collaboration in the fall prevention design process.

All participants in this study maintained that the delivery of highly-individualised fall prevention is fundamental to their service. Augmented reality was observed as an experiential design medium through which clinicians could enable older clients to retain personal control and see how their goals could be reflected in fall prevention.
recommendations. For example, Participant H (occupational therapist – management – domiciliary care) stated:

“If [the occupational therapists] can personalise [the home modifications] so that the [older clients] can see that, they can feel that they are being engaged in the process and that they have got some decision-making capacity in the process. Therefore, you get enhanced uptake of recommendation. Then that should have a follow-on positive effect on the reduction in falls risk.”

As established by the literature, person-centred care is based on goals and the engagement of those goals in health services. Insights from the analysis show that the AREVT provides a mechanism to engage with client goals. Furthermore, the level of engagement is foreseen as extending beyond older adults; clinicians can use the AREVT to discuss their own safety design requirements in an easily communicable manner, and invite feedback from the client. Participant D (physiotherapist) stated that the AREVT can assist with the identification of goals, and their reflection in fall prevention services:

“[The AREVT] can help with redirecting goals; we can meet what that person’s concerns are, what their goals are, where we are starting, what the issues are, where we are wanting to head, and there might be other goals that the clinician has as well. So, helping to get those on the same page.”

The following quotation from Participant H (occupational therapist – management – domiciliary care) provides further insight:

“Part of person-centred care is about always having the person’s goals at the centre of what you are doing. So rather than them feeling like they are just passively being taken along with the process, it is being targeted specifically to meet their needs … I think that being able to actively see things does help people to understand how it will work for them.”

The AREVT is a method of visual communication that actively engages older adults in the care recommendation process in a manner that is based on their needs.
All participants expressed that by engaging with older adults via the use of the AREVT, they would generate improved communication concerning their goals. Creating a process that encourages and nurtures the engagement of older clientele increases the possibility of informed client choice, leading to greater transparency and understanding in care solutions. In the quotation below, Participant B (regional manager – community services) refers to some issues in current services:

“Transparency is about showing people what can actually work for them ... And I don’t know if that’s the case with fall prevention—you know, we’ll put in a ramp and we will fix it. I have not seen a lot of evidence that people are engaged in the process of putting ramps in, and ramps are a significant issue.”

An informative and transparent home modification visualisation is advantageous, as it demonstrates the use of goals and the clinician’s desire to engage the older adult. The AREVT was predicted to solve issues regarding transparency. Participant D (physiotherapist) supports this finding:

“Because [older adults] can visualise [with augmented reality], they can say: ‘Yes, I like this, and no, that is not going to work for me’ ... They can see how it relates to them. So, it seems like a reliable tool to help them visualise their goals and how they can achieve them.”

As established from the fall prevention industry participants, augmented reality is expected to improve communication between clinicians and clients, and encourage older adults to be active in fall prevention.

**6.8.1.2 Informed choice**

According to all industry participants, the ability to visualise home modifications allows greater choice in home modification solutions. Informed choice can be as simple as product range, colour, texture and materials. This includes the ability for an informed older adult to decide against something. Ten of the participants predicted that a fall prevention service using the AREVT would be beneficial in returning control to older adults through informed decision-making. Other participants identified more significant issues in the conduct of fall
prevention services that required further attention. These issues are extrapolated and investigated in the Second Conceptualisation Phase, which is presented in Chapter 8. In the quotation below, Participant H (occupational therapist – management – domiciliary care) gives an overview of the consensus about choice and decision-making in current services, and how the AREVT may help solve these issues:

“They have had so many options and choices taken away from them by the aging experience ... Often people make decisions on their behalf, whereas something like this [the AREVT] gives them back some of the decision-making process, which is very important."

The ability to make informed decisions was identified as a component of the AREVT. For example, Participant E (occupational therapist – domiciliary care) said:

“[The AREVT gives [older adults] ... the choice to see it for themselves and to decide whether they want it, or whether they want to change it as well.”

Participant B (regional manager – community services): suggests the advantages of having the opportunity to make an informed choice:

“It is all about the choice. People will always make a choice or a decision if they have all of the information. I think sometimes whilst not making a choice is a choice, sometimes people don’t make a choice because it is not working for them.”

Enabling older adults to make better-informed choices regarding their own design selections extends beyond their preferences, and can expose other unanticipated design implications. This was indicated by seven participants. The following anecdote from Participant K (disability specialist architect) highlights this:

“We had a client who had a blue bathroom, and no way would he have any rails until he saw that you could get it in blue. The unfortunate part was that there was no visual contrast. Sure the rail was there, but you need to have visual contrast. But the important thing is that he got a rail once he knew that he could get the colour that he wanted.”
The above quotation shows that the AREVT can assist with unanticipated communication about design choices. For example, colour contrast was an unforeseen issue that was difficult to communicate until the specialised handrail was available.

6.8.1.3 Design comprehension

All industry participants felt that home modification design comprehension among older clients is a problematic area. Participant E (occupational therapist – domiciliary care) acknowledged that home modifications are often complex, and that communicating the environmental, structural, functional, aesthetic and financial factors is challenging for service providers:

“It is hard for us to get out the concept to them [older adults], and to help them to understand it when it is such a big thing and you can’t trial it or anything. It is yes or no, without ever seeing it, but putting their money towards it. I think a lot of clients have never really seen these things before, and don’t have the ability to build the concept in their mind.”

As already discussed in relation to Stage A, clinicians abide by the Australian Standard AS1428.3 as a guideline for the safest ways to design home modifications. Participant G (occupational therapist – management – domiciliary care) reflects on the applicability of the AREVT when working with the Australian Standard:

“It is so hard for them [older adults] to imagine what a 14-meter ramp is going to look like. I think it would show them right then and there. They would have a clear idea of what it is going to look like and if it is something that they want.”

According to AS1428.3, ramps should be constructed at a 1:14 length-to-height ratio to create the appropriate steepness grade for those with gait and other movement issues. In the following quotation from Participant E (occupational therapist – domiciliary care) highlights how design communication problems can affect older clientele:

“It is definitely something that would make our lives easier, because we struggle to get the concepts over to people from sketch to what it is actually going to look like in real life, and
because of that [older adults] are either shocked at the end of it, or think that ‘This is what I need when I need it’.”

Reflecting on the findings from Studies One and Two A, communication concerning proposed home modification design remains predominantly verbal, with supporting sketch work, pamphlet-based photographs and technical architectural input (see Chapter 4 for examples). During the analysis, it became apparent that all industry participants recognised issues with these current methods of design and their impact on client understanding. In the following quotation, Participant F (physiotherapist – management) comments on the language and methods of design communication at present:

“The information that we are giving is very verbal; we use a lot of language, but the visual representation could definitely be better. Particularly when it comes to something like home mods, if they [older adults] can visualise it, it would be great.”

The following excerpt from Participant J (occupational therapist) provides further insights:

“We already try to give [older adults] the chance [to visualise outcomes] just with some photos of bathrooms, but they’re usually photos of someone else’s bathroom or a model bathroom, so it doesn’t look enough like theirs, so sometimes they still can’t really visualise what theirs will look like.”

As stated above, limited methods of design restrict client comprehension of home modifications. However, a promising insight from the analysis was that fall prevention service providers are ready and willing to investigate and explore alternative methods of communication. Each fall prevention service involved in Study Two expressed interest in continually reforming their practices and services to become more person-centred. For example, Participant A aims to pursue service developments in aged care and allied health to advance innovation and strengthen the person-centredness of the services provided by the organisation. In the following quotation, Participant A comments on the restriction of current service processes in fall prevention, and points out the potential benefits of new technologies such as the AREVT for use in home modification design procedures:
“As soon as you’re drawing up sketches, you’re relying on the person drawing the sketch. Is that an accurate representation? A photo or an image is what it is, but [augmented reality] is exactly there. It gives it a platform to really develop and take things forward. The reality is that this is happening in every other sector. It would be naive not to ... All of this virtual stuff which is giving people the ability to look and see exactly what they will see at the end – it’s not a 2Dimensional piece of paper.”

Current fall prevention design methods cause difficulties in client understanding. However, all industry participants identified that design communication is a critical issue that restricts their own service procedures, which negatively impacts on the uptake and compliance with fall prevention recommendations. This is explored in the following section.

6.8.1.4 Foreseeable uptake and compliance

All industry participants predicted that the use of augmented reality would lead to greater acceptance rates of fall prevention interventions through increased client engagement, contribution and design comprehension. This is demonstrated in the following series of quotes.

Participant H (occupational therapist – management – domiciliary care):
“Older people can sometimes be very rigid in their thinking about things and have very fixed ideas, and I think you have to use a variety of strategies to help get them to understand why you are suggesting certain things, and I think if you have the visual representation to assist you in communication why you think a recommendation will benefit them, then they are more likely to have uptake of it.”

Participant G (Occupational therapist – management – domiciliary care):
“I think that [augmented reality] definitely could [enhance person-centred fall prevention] in terms of the uptake of the home modifications, because [older adults] can see what it is going to look like. This would ultimately reduce falls, as our recommendations are based on safety and independence. I think it would definitely help.”
Participant H (occupational therapist – management – domiciliary care):
“I think if you have that technology to help people to understand what it is going to look like, and because of that, increase the uptake of fall prevention interventions, then ultimately there will be enhanced safety.”

Participant I (occupational therapist) commonly uses Google Sketch Up to communicate complex home modification design ideas. The following is the Participant I’s evaluation of the AREVT:

“On the iPad I aspire to something like this: rather than representing it with a line, actually have a rail. It gives them a great representation. It is a powerful tool to be able to visually represent something to someone, especially when it is their home … If that means that they accept it or not, it is really important. It is not good when you get someone who is really unhappy with how something looks. You have altered their home, the place where they live, and it is such a sensitive area.”

Whilst use of the AREVT is foreseen to carry many benefits for fall prevention service providers, the review of the technology did highlight some barriers that would need to be considered.

6.8.2 Barriers

6.8.2.1 Technological limitations

For the AREVT to be used by clinicians, it would need to be simplified and modified to suit their exact requirements in the field. I do not think the Augment application is ready for immediate deployment as it is currently set up. While it is the perfect platform to quickly test and assess augmented reality as a portable design communication prototype, there are several additions and technological refinements that are necessary to create a robust application for deployment. Unfortunately, due to the limitations of Augment, many of the recommendations suggested by the clinicians were unable to be implemented in the application prototype. However, they are important to note, as these requirements should
be included in a future AR application specific to occupational therapy. These requirements include:

- Greater stability with larger interventions

When a visualisation of a larger ramp was placed in the environment it would often appear unstable. However, for smaller objects such as handrails the AREVT works well. To visualise larger interventions including ramps, a larger field of view is required to keep the object stable and in frame. Therefore, greater stability with larger visualisations is required to avoid user frustration.

- Measuring system

A simple measuring system that could document the dimensions of the environment would be highly beneficial. Participant I (occupational therapist) expresses this:

“Measuring system, that is important ... Possibly having the ability to scale models in the app, because you are dealing with bathrooms of all different sizes, or cut off parts of the component.”

Several participants spoke of their experience with another application: My Measures.11 This application is used to photograph and save environmental dimensions. Occupational therapists would use it to communicate with older clients about railings, using basic lines and arrows, though this application is beyond its original intentions and capacity. This further demonstrates the need for proper visual communication tools in home modification design services. Several participants expressed their frustration with the My Measures platform. For example, Participant E (occupational therapist – domiciliary care) compared the augmented reality application prototype with My Measures:

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11 www.mymeasuresapp.com
“With My Measures, they’re so limited—they’re not rails, they're just line. This [the AREVT] actually looks lifelike.”

- Case logging system

Clinicians felt that it would be beneficial for the application to connect with the client’s digital record; then modification designs could be logged easily, referred to, and forwarded on to builders and others as necessary.

The texture of assistive surfaces is an element that is beyond the scope of the AREVT. While colour and observable texture can easily be communicated, traditional swatches are required to assess the grip factor of a surface. As Participant K (disability specialist architect) says:

“Textures are important, especially with flooring.”

One participant predicted that older adults might hesitate to use digital tools. For example, Participant F (physiotherapist – management) said:

“The minute you take an iPad out, someone is going to say: ‘Oh, I’m not interested in that kind of stuff.’ I don’t know whether there will be barriers from that end.”

6.8.2.2 Clinical competency with technology

Some industry participants acknowledged that the AREVT would need to be easy for them to use:

Participant D (physiotherapist):

“Ease of use for the clinician—it needs to be very intuitive to use, because then hopefully the client can also have a play with it.”

Participant E (occupational therapist – domiciliary care):

“If it was easy to use, that’s an important part—quick and easy. Tap it all up and show them. Then I would be using that a lot.”
It is important to note that the use of technology in the occupational therapy industry is becoming more common, but the limited applications currently being used in this space are ill-suited to the workflow of an occupational therapist. This causes hesitation to use new applications made for them.

Participant I (occupational therapist):

“I think momentum is gathering. One of the other occupational therapists (in an online occupation therapy forum) was looking at how technology can assist occupational therapists. People are starting to become aware of it and play around with new technology and wanting more from current technology. I have been waiting for a while for someone to develop some more occupational therapy-specific apps. There is a big hole in the technology that we use, and it could be a lot better.”

The review of the AREVT has highlighted a number of foreseen benefits and barriers in older adult fall prevention. In the following section, these are discussed against the theoretical foundation of control and person-centredness.

6.9 Discussion (Stage B)

6.9.1 Addressing uptake

The empowerment of older adults is directly linked to their engagement and experience in the home modification design process. This must be taken into account when considering the benefits of the AREVT as a clinical tool, and how it can avoid the person-centred service barriers identified in Stage A.

Although fall prevention service providers aim to deliver person-centred services and outcomes, clinicians can revert to hierarchical structures, and allow their experience in the field—rather than the goals of older clients—to drive the fall prevention process. As detailed, this can often be bought about by extensive experience and an inability to engage with older adults in a manner that is reflective of their own personal goals; this dynamic has been referred to as sugar thinking (Rogers and Marsden (2013). While this behaviour is
not ill-intentioned, the problem is exacerbated by a lack of fall prevention design tools that aid in the communication of complex home modifications, and assist in engaging with older adults in accordance with their goals. This dissonance is commonly caused by divergent thinking between clinicians and clients in the home modification design process. For example, clinicians are motivated to provide the highest-quality safety solutions, whereas older adults may be driven to retain the ability to maintain an abstract goal. Alleviating this divergent thinking is possible through proper, transparent, goal-driven communication between these stakeholder groups.

Uptake and adherence of home modifications remains a critical problem within the fall prevention domain, this was reflected in the literature (see Section 2.4.9) and in the results of this study. To address this, it is important first to deconstruct it and investigate its individual components, and identify how these can be mitigated. In Stage A, the barriers to uptake and compliance with recommendations by fall prevention clinicians were highlighted (see section 6.4.2.4). The capacity of the AREVT to address issues of compliance and uptake of fall prevention interventions can be divided into two areas of inquiry: relevance and ownership.

**6.9.1.1 Relevance**

In Study Two, the theme of relevance emerged consistently as a problem. In the Stage A and B interviews, fall prevention industry professionals often expressed frustration with communicating the reasons for recommendations to their older clientele. For example, risks and hazards are identified by clinicians throughout the fall risk assessment process. These require rectification to increase the safety of the older adult in their home environment; clinical recommendations are then made. However, if the older adult’s goals are not in line with the recommendations made by the clinician, the client may interpret the recommendation as irrelevant or not important enough to them. Interestingly, this might occur because the clinician’s service goals are perceived as abstract by the older adult client, who does not associate the recommendations with their own non-medically-oriented goals.
Successful fall prevention requires consideration and mitigation of risks and hazards in accordance with the goals of both occupational therapists and older adults. From these insights, it can be inferred that goal communication remains a consistent barrier between clinicians and their clients. With the emerging influence of person-centred care, clinicians are mindful of the importance of goals, but currently lack proper mechanisms to link the abstract with the functional. Considering the benefits of the AREVT perceived by the industry participants, it is contended that the tool could provide a mechanism for clinicians to communicate across these divides, and satisfy goals sought by other parties.

Based on the results, the ability to provide a home modification design discourse that invites and encourages active participation from older adults will assist in avoiding problems of relevance. For example, an occupational therapist may identify that an older adult has decreased lower limb strength, making it difficult for them to traverse steps. In contrast, the older adult is more worried about finding it difficult to rise from the toilet; however, they still want to be able to access their workshop in the backyard every day. The occupational therapist is aware that there are several steps from the back access leading to the flat level yard, and that railings for the steps and the toilet would be an appropriate recommendation. Rather than simply suggesting the back-access railing, the occupational therapist could accurately visualise how this recommendation would work for the older adult, and provide them with the opportunity for their greater goals to be addressed, while simultaneously meeting their more functional goals.

6.9.1.2 Ownership

As retention of control by older adults in times of duress is dependent on their primary and secondary mechanisms (Schulz & Heckhausen, 1999), it is also possible to link the power of ownership to this ideology. For example, an external effort to modify the immediate environment, so that the older adult could continue to live safely and at home, would constitute a primary control mechanism. The corresponding secondary mechanism could be the assurance that this modification would not alter their self-identity, or their emotional connection with and sense of ownership of the environment. Therefore, ownership of the decision-making process that leads to recommendations and final
outcomes is imperative. The AREVT could provide a means to achieve this through empowerment, active participation, transparent communication and comprehension of design outcomes (see section 6.8.1).

Ownership can be outwardly expressed through simple decision-making throughout the design process. In Stage A, Participant J (occupational therapist) succinctly summarised the desire for ownership:

“Sometimes people just want to invent their own thing. It doesn’t matter what you give them, they must change it just a little bit and then it becomes their own.”

The above quote is connected to the notion of control, the perception of which directly correlates with uptake in fall prevention recommendations made by occupational therapists (Clemson et al., 1999).

Based on the findings, fall prevention industry professionals predict that the AREVT is a visual communication mechanism that would encourage client engagement. The AREVT promotes a design process through which older adults can actively participate and feel a sense of ownership through the reflection of their goals. Design comprehension would be increased, and older adults would maintain control through an acknowledged co-creative process in which they are aware of the value of their own input.

6.10 Conclusions

Study Two investigated community-based older adult fall prevention in two research stages. Stage A explored fall prevention from multiple industry perspectives to generate better, up-to-date understanding of the strengths and weaknesses of person-centred fall prevention. Stage B investigated the AREVT from an industry perspective to evaluate its proposed effectiveness as a person-centred home modification design communication tool.

Stage A identified that clinical approaches to delivering person-centred care are perceived among fall prevention industry professionals as both emerging and valuable. However, there are disconnections between the application of person-centredness and the
reformulation of existing service structures. These barriers negatively influence the ability of older adults to retain control in fall prevention, fostering outcomes that may not fully account for their goals. The above-mentioned problems are exacerbated by current analogue communication tools that fail to provide transparency and opportunities for informed choice in home modification solution.

Following the identification of fall prevention service barriers and problems in Stage A, the AREVT was evaluated with the same sample of industry participants in Stage B. The evaluation investigated the possible utility of augmented reality as a clinical home modification design mechanism. The findings from Stage B highlight that the AREVT constitutes a tool in the design process that supports clinicians to incorporate the goals of older adults as design drivers in the service provided. Clinicians were positive about the use of the AREVT. The AREVT design process was foreseen as delivering a person-centred process that enables clinicians to tailor a service experience that invites active participation and engagement. This is possible through informed decision-making and an enhanced visual communication experience driven by the goals of older adults. In turn, it would adhere both to their clinical service goals of high-quality safety solutions, and to the potentially more abstract goals of their clientele. The method would promote ownership and trust in older adults, and their perceptions of control would be bolstered.

The results from Study Three require substantiation by older adults to determine the appropriateness of using the AREVT as a person-centred home modification design tool. This is investigated in Chapter 7.
Chapter 7. Study 3: Evaluating the needs of older adults in fall prevention

“Needs arise from the ways in which people perceive their everyday world and how they decide to act upon their own self-determined priorities. The ways in which needs arise thus depend upon the individual, but are also driven by the norms shared with other people within their social group ... technological solutions must adequately account for the full complexity of human experience if they are to be useful.”

(Sixsmith & Sixsmith, 2000, p. 192).
7.1 Status of the Augmented Reality Environmental Visualisation Tool (AREVT)

The results from Study Two provided insights into the current state of person-centred fall prevention, and how the goals of older adults are perceived by industry professionals and reflected in practice. Greater knowledge regarding the barriers and challenges from an industry perspective have been obtained. Based on the perceived need for visualisation technology—augmented reality—Study Two provided a means to further contextualise and refine the use of the Augmented Reality Environmental Visualisation Tool (AREVT).

Study Two demonstrated the advantages of the AREVT as a design tool in person-centred fall prevention. The design process facilitated by the AREVT was judged by fall prevention industry professionals as being in line with person-centredness, and as able to provide a two-way, informative discourse between clinicians and their older clients. The AREVT highlighted that goal-oriented and digital design processes are valid mechanisms at the forefront of person-centred occupational therapy. The AREVT was perceived as increasing the person-centredness of the services provided, by allowing older adults to retain control in fall prevention through informed health care design decision-making. It was concluded that a technological platform where goals could be communicated would assist in providing client control. This would lead to higher rates of uptake of and compliance with home modifications, producing safer and more empowering living environments.

The results of Study Two have implications for the ensuing Study Three presented in this chapter. It is important to investigate whether the perceptions of the fall prevention industry participants are shared among older adults, as co-design and communication require equal and shared input.

7.2 Overview

Study Three comprises semi-structured interviews with older adults conducted in their homes. The interviews include documentation and cataloguing of the participants’ home environments via photographs, as well as an evaluation of the AREVT.
By conducting in-depth interviews with older adults in their home environments, Study Three produces greater insights and knowledge regarding the goals of older adults living in their own homes, and addresses how these goals have been reflected in the participants’ own fall prevention experiences. These insights provide a platform upon which the AREVT will be further evaluated to assess the perceived usefulness of the tool and the design processes that accompany it.

In the literature review in Chapter 2, I presented the argument that a greater use of engaging design methods and new technologies may assist with person-centred fall prevention and home modifications to achieve higher uptake and user satisfaction. Accordingly, fall prevention design methods must provide a means to communicate the goals of older adults, and use them as design drivers to achieve a greater sense of control over home modification design and decisions.

Current analogue fall prevention design methods do not allow older adults to visualise their goals in context, and many industry professionals struggle to communicate environmental changes effectively (see Chapters 4 and 6). The AREVT was conceptualised and produced as a design communication platform for fall prevention service providers to better engage older adults in the home modification design process (see Chapter 5). The expectation is that the design process enabled by the AREVT will increase the person-centredness of the fall prevention services provided. While this has been confirmed from a fall prevention industry standpoint (see Chapter 6), it is necessary to ascertain whether this is also the case with older adults, as they are the primary stakeholders and end-users of home modifications.

Study Three is formulated as a final research phase in this thesis, and is separated into two Stages: A and B. Both stages are conducted during the same interview session, but differ in their aims, objectives and methodology (see Chapter 3).

The results from Study Three have been published as a double-blind peer-reviewed long paper in the proceedings of OzCHI 2016 – Connected Futures (Lo Bianco, Pedell, & Renda,
2016a), and presented at *The 7th Biennial Australian and New Zealand Fall Prevention Conference* (Lo Bianco, Pedell, et al., 2016c).

### 7.2.1 Study Three aims

#### 7.2.1.1 Stage A

Study Three investigates the goals, life experiences and lifestyles of older individuals, as well as the interplay between these factors and the relationships they have with their own home environments. More specifically, Stage A aims to investigate the participants’ perceptions of the representation of their own goals in their fall prevention recommendations to assess the impact of this on their sense of control. Consequently, Stage A generates understandings of the relationships between the goals of older clients and the control mechanisms at play. In this way, the person-centredness underpinning the recommendations can be appraised. The design of the guiding questions in the semi-structured interviews aimed at examining whether older fall prevention clients could identify the influence of their own goals and lifestyles on the fall prevention recommendations made to them.

#### 7.2.1.2 Stage B

Study Three B aims to evaluate the AREVT as a design communication tool to be used in fall prevention, and specifically to communicate and visualise home modifications with older adults in accordance with their goals and lifestyles. The information gathered during Stage A was harnessed and used as a guiding stimulus throughout the evaluation of the AREVT in Stage B.

The overall aims of Study Two are summarised and presented in Figure 7.1.
Aims of Study Three A: Understanding older adults and their fall prevention

(A) To investigate older adults’ perceptions of their own goals in their fall prevention recommendations
(B) To gather in-depth understandings pertaining to the relationship between older individuals and their home environments
(C) To evaluate and understand older adults’ journey through the fall prevention service, and to examine its strengths and weaknesses

Aims of Study Three B: AREVT evaluation

(D) To draw on the knowledge gathered about older individuals, and define a fall prevention design process that would be beneficial to them
(E) To assess the augmented reality tool as a supplementary fall prevention design communication aid, and to investigate its strengths and weaknesses

7.2.2 Research questions

7.2.2.1 Stage A

Study Three A addresses the following research question:

- How are the goals of older adults reflected in their fall preventative home modifications?

A supporting research question underpins this:

- What is the fall prevention experience of the older participants?

7.2.2.2 Stage B

Study Three B considers the following research question:
• How suitable is augmented reality as a platform to communicate goals for older adults in fall prevention?

The research questions underpinning this evaluation include:

• How does the use of such a tool differ from traditional methods?
• What refinements could be made to the AREVT?

7.2.3 Participants

Ten older participants were recruited via a fall prevention health service provider. Each older participant had experience with fall prevention services, which typically included connections with occupational therapy, domiciliary care and/or physiotherapy. All but one participant had suffered at least one fall in their home environment. The participants were at different stages of the fall prevention process. Some participants had home modifications installed six months prior to the interview taking place; others were on a waiting list, and others were at a point where these stages were combined in various ways. There was a reasonable gender balance, with four males and six females taking part in the study. Participants’ ages ranged from 69 to 92 years. All participants were de-identified, and have been provided with gender-appropriate pseudonyms to mask their identities. Table 7.1 provides an overall summary of the participants.

Table 7.1 Study Three participant summary

<table>
<thead>
<tr>
<th>#</th>
<th>Gender</th>
<th>Age</th>
<th>Pseudonym</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>88</td>
<td>John</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>87</td>
<td>Patricia</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>72</td>
<td>Henry</td>
</tr>
<tr>
<td>4</td>
<td>Female</td>
<td>72</td>
<td>Mary</td>
</tr>
<tr>
<td>5</td>
<td>Female</td>
<td>80</td>
<td>Cathy</td>
</tr>
<tr>
<td>6</td>
<td>Male</td>
<td>73</td>
<td>Peter</td>
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<td>Male</td>
<td>80</td>
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<td>Female</td>
<td>78</td>
<td>Susan</td>
</tr>
<tr>
<td>9</td>
<td>Female</td>
<td>69</td>
<td>Sarah</td>
</tr>
<tr>
<td>10</td>
<td>Female</td>
<td>92</td>
<td>Ruth</td>
</tr>
</tbody>
</table>
7.3 Study Three A: Understanding older adults and their fall prevention

Study Three A reports on the results of a series of semi-structured interviews to explore the individuality, goals and lifestyles of older adults living in the community who have had various experiences in fall prevention services.

7.4 Method (Stage A)

7.4.1 Data collection

The interviews were recorded on two separate audio devices to ensure that a backup was available during the analysis if required. Digital photographs were taken in the homes of the participants. Each interview was approximately 90 minutes in duration; this included Stage A (about one hour) and B (about 30 minutes).

Between the Stages, the participants were asked to give the researcher a tour around their home environment to discuss their modifications, and to share their ideas and personal connections to areas in the home. Stage A was structured around three areas of inquiry: (i) the goals of older adults and how these contribute to their daily lives and lifestyles; (ii) troublesome areas of the home, and the impact that home modifications have made on their lives; (iii) design input and the role of the older individual in the decision process. A sample of the semi-structured interview guideline for Stage A is presented in Figure 7.2. A more detailed guideline is available in Appendix D.1.
Sample interview questions from Study Three A

What are your interests? What do you enjoy doing?
Tell me about your daily routines and what makes a good day for you?
Is there anything that is not working well, and what needs to happen to change?
Can you please tell me a little bit about your home?
Do you have difficulties managing any areas of your home?
Have any modifications been made to your home to help you manage the environment?
Please describe for me the modifications/equipment in your home.

Figure 7.2 Summary of Stage A interview guideline

7.4.2 Data analysis

The data collected consisted of the 10 semi-structured interviews and accompanying photographs (n=278) taken in the homes of the participants. The interviews were transcribed verbatim by me.

Thematic analysis was undertaken to investigate the data from Study Three (Patton, 2002; Saldaña, 2009). The analysis procedure undertaken was similar to that of Study Two; however, it differed in terms of its aims and objectives. All older adult interview transcripts and accompanying photographs underwent the same analysis procedure, detailed below:

- Transcripts were open-coded (Saldaña, 2009) into a sequence spreadsheet in Microsoft Excel. Doing so distributed and simplified the data into appropriate portions. The accompanying photographs were then catalogued corresponding to the relevant open codes (see Appendix D.4.1)
  - Starting with an open coding process is advantageous when working with large data sets. Each interview transcript was approximately eight pages in length, with the number of photographs varying between participants.
- The data then underwent an axial coding process, when it was cross-referenced against itself to identify relevant sub-themes and relationships (Saldaña, 2009). This
was undertaken through a series of spreadsheet printouts and a supplementary software program, Annotations (see Appendix D.4.2).

Significant themes were then taken from the data and substantiated with central quotes from the industry participants via a content analysis (Patton, 2002).

**Study Three A analysis guideline: Understanding older adults and their fall prevention**

How are the goals of older adults reflected in their fall preventative home modifications?

*Aim A:* To investigate older adults’ perceptions of their own goals in their fall prevention recommendations

What is the fall prevention experience of the older participants?

*Aim B:* To gather in-depth understandings pertaining to the relationship between older individuals and their home environments

*Aim C:* To evaluate and understand older adults’ journey through the fall prevention service and to examine its strengths and weaknesses

What is working? What is not working? What could be improved? What was initially expected, and what is the outcome?

![Figure 7.3 Study Three A analysis guideline](image)

### 7.4.3 Evaluation criteria

To prepare the research space for an appropriate appraisal of the AREVT and its intended fall prevention design processes, it was necessary first to examine and consider the service eco-system in which it will be positioned and evaluated.

There are various factors and relationships influencing the research setting that make this initial evaluation and planning phase especially important (Gitlin, 2003). To evaluate the setting in which fall prevention takes place, I considered the service design implications of
the research and its findings. A consideration of the supporting service design enabled the construction of appropriate evaluation criteria for Study Three B.

### 7.4.3.1 Service design

Service design has the potential to include various research disciplines. Its scope surpasses design, carrying into other paradigms including strategy and interaction design. In the context of this research, the interactive design element is especially important, as services produce interactions. This leads to engagement and empowerment of the individual in the fall prevention service.

Stickdorn and Schneider (2010) argue that service design can be broken down into five basic principles, which are summarised and presented in Figure 7.4 below (see Chapter 2, Section 6 for a detailed review). There is significant overlap between these principles concerning the theoretical considerations underpinning this research. This provides an appropriate platform upon which fall prevention services can be assessed and discussed.

**Principles of service design**

<table>
<thead>
<tr>
<th>Principle</th>
</tr>
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<tbody>
<tr>
<td>User-centred – services should be experienced through the customer’s eyes</td>
</tr>
<tr>
<td>Co-creative – All stakeholders should be included in the service design process</td>
</tr>
<tr>
<td>Sequenced – The service should be visualised as a sequence of interrelated actions</td>
</tr>
<tr>
<td>Evidenced – Intangible services should be visualised in terms of physical artefacts</td>
</tr>
<tr>
<td>Holistic – The entire environment of a service should be considered</td>
</tr>
</tbody>
</table>

*Figure 7.4 Principles of service design. Source: (Stickdorn & Schneider, 2010)*

### 7.5 Results (Stage A)

#### 7.5.1 Biographies

A biography was created of each participant who took part in Study Three. The information contained in these biographies is based on their responses during the qualitative investigation undertaken in Stage A. These personal stories are interspersed with
photographs taken in the homes of the older participants to generate richer understandings of each individual person and their home-related goals.

These biographies contribute to a better understanding of the results and themes from Stages A and B. Moreover, as this investigation focuses on person-centredness and goals, personal background information is important.

7.5.1.1 John

John is 88, and lives at home with his wife, who is also his carer. John is a retired maker of clocks and watches. His son and daughter have carried on the family business, and his son lives next door.

John is quite frail, has a stooped posture, shuffling gait, dizziness, balance problems and lack of strength throughout his body. Over the past 12 months, he has experienced three falls in his home, two of which have resulted in significant injury. He lost his balance and fell backwards in his workshop, and hit his head and bruised his ribs. John also fell in the lounge room while reaching for a power point.

John uses a single-point walking stick and a four-wheeled walker to move around the house and get to his workshop in the backyard. Walking towards the house there is a gravel driveway, and three steps at the front entrance. The floor is a combination of carpet and floorboards. There are five steps at the rear entrance, and pavers to get to the workshop in the backyard. John has several hand-rails throughout the house, which were created and installed by his son under the guidance and recommendation of an occupational therapist.

John and his wife purchased their house in the 1950s as a holiday home. It was an old shack back then, in a very green and secluded area. As the years passed, the local area became further developed and urbanised. Being an environmentally-conscious person, John noticed a decline in the number of birds in his area. Therefore, he decided to take it upon himself to begin wood carving birds to document the local birdbife in the area that he loves. Over the years, John developed a passion for wood carving, and joined a local wood-turning club; his handiwork has been regularly displayed at local exhibitions.
John loves to get into his workshop every day to continue his bird carving, pyrography, and to “dabble” in clock repair when his son brings them to him to work on at home. To get to the workshop, he follows a path through the house that has been fitted with assistive handrails that were installed, and in some cases created, by his son under the recommendation of an occupational therapist. John says: “My son is very good; he makes all sorts of handrails and supports for me to get around and get out to the shed without any bother.”

7.5.1.2 Patricia

Patricia is an 87-year-old widow who has suffered three falls in the past 12 months. She lives alone in a small one-bedroom unit in a retirement village. Patricia suffers from dizziness and feels very anxious about falling in her home.

In her working life, Patricia was head nurse at a major hospital, and managed several wards, so she is familiar with health care on a professional basis. Each day Patricia enjoys
getting into her garden to tend to her flowers and vegetables. She also enjoys playing the organ, and would still love to play frequently at her local church.

Patricia has a four-wheeled walker, four different walking sticks that she has collected over the years, a shower chair and rails in the shower. She forgets to use the walking sticks, and tries her best not to depend on her other assistive devices. She wants to remain independent for as long as possible.

“Well I thought that this one [handrail] would have been better here, but just a bit higher, because you’re standing here and you would tend to put your hand over there. I probably was asked, and thought that that would probably be all right, but in actual practice it is a different story.”

Figure 7.6 Patricia’s flower and vegetable garden
7.5.1.3 Henry

Henry is 72 years of age and lives at home with his wife. He has a history of double vision, and has recently been diagnosed with Parkinson’s Disease. In the past 12 months Henry has suffered three falls.

For approximately 50 years, Henry was a remote-area nurse with extensive experience in Australia and overseas. He is currently transitioning into retirement, and is looking forward to spending more time with his two grandchildren, and possibly venturing into some health-oriented volunteer work. Henry is doing well currently, as he has been receiving treatment for his Parkinson’s Disease. For a while his health restricted his abilities to manage his goals, but now he can look after his grandchildren—a primary goal in his new retirement lifestyle.

Before starting the Parkinson’s treatment, Henry was having all sorts of problems with movement and tremors. The fall prevention service has supplied him with a bed pole, various handrails, and other smaller assistive devices to use in and around the home. Henry finds these are helpful, and was quite accepting of them.
“You have to look at the whole family use of it all; the young don’t use it because they don’t need to. They just go burning over the steps, but occasionally they do hang off it and go up and down as a plaything. But it is helpful.”

Figure 7.8 Henry’s handrails

7.5.1.4 Mary

Mary is 72 years old and lives at home on a farm with her husband and her two adult sons. She has experienced three falls in the past 12 months in and around her home, and she is fearful of experiencing more. Mary has bad back and leg pain; this restricts her mobility a lot.

Mary was a nurse for 40 years in her working life. These days she enjoys cooking, gardening, knitting, cleaning and collecting vintage dolls, and she is looking forward to starting a colouring book that her sister gave her.

Mary has a walking stick that she uses outside the house. She doesn’t use it inside, preferring to feel her way around the house while holding onto furniture, doorways and windows. Mary has difficulties managing the front doorstep; she recently had a fall there.
and sustained a severe bruise. Following this incident, she had rails installed in the shower and beside the toilet; these do help her a lot.

“I didn’t mention anything, I didn’t say anything, but you know I wondered ... She didn’t suggest anything further than the bathroom, and I wondered why she didn’t suggest something further like a ramp.”

![Figure 7.9 Mary’s doll collection](image)

### 7.5.1.5 Cathy

Cathy is an 80-year-old widow who lives on her own. She suffers from decreased ability to balance, and has experienced six falls in the past year, most of which occurred outdoors. Cathy was terrified and embarrassed when people helped her after a fall—she would have preferred that no-one was around.

Cathy enjoys her craft work and making things to put around the house, getting out to play bingo at the local seniors’ club, and tending to her garden, although she cannot do as much as she used to. She is frustrated that she has begun falling, and would love to be able to get out and take her dog for regular walks again. She has purchased a four-wheeled walker, which she plans to use to take the dog around the neighbourhood.
Cathy is awaiting several modifications to be made to her home. These include handrails and ramps at the front and side access, and a bathroom modification.

“Well, I understand from them telling me more than I understand the drawings. I can see what they mean, but I can’t picture it from here, but when they tell me I can work it out.”

![Cathy's side access](image)

**Figure 7.10 Cathy’s side access**

### 7.5.1.6 Peter

Peter is 83 years of age, and recently suffered a fall while getting dressed. He currently lives alone in his house. He had been the primary carer for his wife after her Parkinson’s Disease diagnosis, but she now lives in residential care.

Peter is still adjusting to his new lifestyle, and has found that he has more time to work in his church community again, and for bowls and other social activities with his friends.

Peter was an engineer in his working life. Using his life experience, he researched, designed and had a series of home modifications built and installed to accommodate his wife’s decreasing physical abilities. Peter uses most of the equipment himself now when he feels
he needs it, and finds it very handy, although there are a few minor alterations that he would like to have done to suit his own needs.

“I am prepared to listen, like to tell you that at work, I could listen, but I will make the decision. You’re going to tell me and I make the decision. If it is a good decision you will have it and if not I will tell you why it is not.”

![Image](image-url)

Figure 7.11 Peter’s self-designed disability bathroom

### 7.5.1.7 George

George is 80 years old. He and his wife moved house four months ago to be closer to their daughter. This has been a very stressful move for them, and during this period George has suffered three falls, and a total of five in the past 12 months.

George was a cabinetmaker by trade, and he still enjoys getting into the shed and practising his craft, though he is currently finding it difficult to get into his normal routine in this new environment.
George has had several modifications installed around his home. These include rails at the front and rear entrances, rails in the toilet, bathroom and shower, and a series of steps leading to the shed. He is happy with the work that has been done, and finds it all very helpful, as he claims that he could “trip over a matchstick”. The steps leading to the shed help George to get to the shed each day to continue working towards his cabinetry goals.

“I will always be making cabinets. I have so much timber it is not even funny. That is my main and only interest, but then again sometimes it gets to the stage where there is nothing to do.”

7.5.1.8 Susan

Susan is 79 years of age, widowed and lives in a big one-level house with her daughter. The house is on a slope and has a large staircase leading to the backyard. Susan has not had a fall; however, she is fearful of falling due to her age and declining physical abilities.

Susan enjoys reading, watching television, going to the pokies and spending time with her dog, Ruby. She ambulates well around the house; however, there are a few areas that are difficult for her to navigate, such as the back steps. A shower railing has recently been installed, and Susan does find it helpful.
“I just wake up in the morning and be glad that I am healthy and mobile.”

7.5.1.9 Sarah

Sarah is 69 years of age and lives alone in a small unit. Over 15 years ago she was in a bicycle accident and sustained a severe head injury, which has affected her physical abilities tremendously. Recently, Sarah has been diagnosed with Parkinson's Disease. She has been having falls daily.
In her working life, Sarah was a carer and worked in a nursing home. When she went back to work after her accident, she found that she was unable to do many of the things that she used to be able to do. She started to have falls at work, and ended up having to stop working. Sarah used to be a very fit and active person; she enjoyed sports, especially golf. These days she spends a lot of time reading and going out to social gatherings at some of the local clubs in town.

Sarah is aware of her limitations, and has done what she can to prepare for and manage her deteriorating abilities. She bought her house prior to her accident. It is a flat dwelling—the insight she gained from working in the nursing home made her think this would a good forward-thinking decision. Extensive remodelling works have been done to her house, including the removal of walls to make it easier for Sarah to navigate through with her assistive devices. She also uses a variety of walking devices, handrails throughout the house, ramps and other non-traditional assistive equipment. Sarah is looking forward to purchasing a pocket metronome, a time-keeping device that she will use to keep her steps in rhythm.

“I just felt that I was getting worse. It was sad that I was starting to rely on these aids. It doesn’t bother me anymore; my house is what my house is.”

Figure 7.15 There are rails throughout Sarah’s home
7.5.1.10 Ruth

Ruth is 92 years of age and lives alone in a small unit. She enjoys cooking and shopping for herself, and takes pride in her independent abilities.

Ruth suffered a fever that affected her mobility, and caused her to have several falls in her home. Ruth has since recovered, and several home modification measures have been taken to ensure that her home is safe. She also uses a four-wheeled walker to move around the house.

In Ruth’s home, she has had the shower modified with a pull-down handrail, and has had other handrails installed on the walls. She finds the modifications “great”—they help her daily. However, she was unaware of what some of these things would look like, and how they would affect the way she used her bathroom.

“I am staying here as long as I can. I am comfortable and I can manage it.”

Figure 7.16 Ruth’s living room
The participant biographies have demonstrated how the lifestyles and goals of older adults are relevant to home modifications. The attitudes, beliefs and former professional and life experiences were included to highlight the fact that various combinations of these elements will play a role in the level of acceptance of fall prevention recommendations.

7.5.2 Poor visualisation

During the interviews, six of the participants expressed frustration at design misunderstandings pertaining to their own fall prevention experiences. The limiting nature of current design communication methods was a common topic of discussion. This is the focus of the following participant stories.

7.5.2.1 Cathy’s upcoming modifications

Cathy stated that she was very active in her fall prevention planning, affirming that she spoke with the specialist architect about her own ideas. However, the modification planning documentation confused her, and she remains uncertain about how these home modifications are going to look.

“Well, I understand from them telling me more than I understand the drawings. I can see what they mean, but I can’t picture it from here, but when they tell me I can work it out.”

Figure 7.17 shows a bathroom modification to be undertaken in Cathy’s house. The image is like many diagram drawings presented in Study One, Chapter 4. The following quote captures her confusion about her upcoming home modifications:

“This completely confuses me (Figure 7.17) ... there’s the shower; they’re going to bring it a bit further out here, and they’re going to put the rail around there because that is the toilet, and I don’t mind making it a little bit smaller because it is only me. No, is that the shower or the toilet, oh that’s the basin! ... This is what confuses me, all of these lines and things!”
The following is an account of Cathy's experiences and choices regarding her upcoming home modifications, and her understandings of the designs supplied to her:

“I could tell them if I didn’t like what they were telling me because he (disability specialist architect) was doing little drawings as well. They said: ‘If you don’t like what you see when we are going to do it, you can say what you want.’”

If changes are made later or during construction, this makes the process more time-consuming and costly. Furthermore, Cathy was provided with sketches and drawings as a visual representation of something that she did not quite understand, leading to guesswork and the opportunity for misrepresentation and confusion concerning the design outcome.

7.5.2.2 Ruth’s shower rail

Ruth has had several modifications applied to her bathroom, including several handrails. She was unaware of how the rails would affect the placement of her existing towel rails, as these had to be removed and placed elsewhere.
The pull-down handrail in the shower extends beyond the space of the shower; this means the door must stay slightly ajar while Ruth is showering, which causes the floor to get wet and slippery (Figure 7.18). Ruth was unsure of this drawback prior to the installation.

![Figure 7.18 Ruth’s pull-down shower rail](image)

7.5.3 Hierarchical disengagement

The hierarchical relationships between clinicians and clients was a point of contention for several participants. Two were distinctly unaware of their role or value in driving the fall prevention process, and several others thought that their input was not valid, as they themselves did not have professional expertise.

7.5.3.1 Mary’s experience

As stated in Mary’s biography, she had recently suffered a fall at the front access, and had sustained an injury. She wished to modify the front access to make it safer to avoid further falls. Throughout the fall risk assessment, the issue of the front access was not raised, and Mary is still unsure why it was never discussed or modified:
“I thought that it was strange that they didn’t do the step ... I didn’t mention anything—I didn’t say anything—but you know I wondered ... She didn’t suggest anything further than the bathroom, and I wondered why she didn’t suggest something further like a ramp ... you might have seen it as you came in. There is a little stool thing; it will go by the door. I can step onto that and step in.”

Mary bought the small stepping stool pictured in Figure 7.19 after seeing it in a television advertisement, when she realised that she would not be getting a ramp or rail at the front access.

![Figure 7.19 Mary’s front access](image)

Mary expressed that she felt passive throughout the fall prevention process. The following quote captures this sentiment:

“It would be really nice to have a say in what you want ... they (the occupational therapist) more or less said ‘you need one (railing) in the bathroom and one in the toilet’, so I just went along with it. I didn’t add and say that I really feel that I need one here (the front access).”
Mary said the following in response to the question: Do you think you had some valid design points and critiques to add?

“I think I could have designed it better… I did, but I didn’t think that it was my place. You know, when people are doing things for you, you go along with what they say.”

This quote encapsulates the shortcomings of the current state of the fall prevention process in relation to person-centredness. It shows that older adults feel they are passive receivers of care, and that they don’t really have a voice. Mary also stated:

“It is nice to have people who listen to you, and it is nice to have people who give you feedback when you’re talking to them.”

7.5.3.2 Patricia’s shower rail

Patricia has several handrails and assistive equipment placed in her home. When discussing the handrails in her shower earlier in the interview, Patricia stated the following:
“I only use them in the shower when I am washing my hair; I try to not depend on it. I have got a chair in there as well ... I want to be independent for as long as possible.”

During the tour of Patricia’s home, she gave the following answer to the question: Where would you have liked them?

“I didn’t have much choice. I would have preferred them to be in a different position ... On the other wall, where it is sort of more automatic, where you would go to if you had to save yourself ... the occupational therapist—they recommended where to put the rails ... I just went along with it. They know what they’re doing—that’s their job.”

Patricia knew what the rails would be like before installation, because her husband had needed them in their previous house before he passed away. However, she feels as though the rails could be better placed to suit her needs. For example, she said that placing the rail on the other shower wall seems more automatic for her needs.

“Well, I thought that this one would have been better here. But just a bit higher, because you’re standing here and you would tend to put your hand over there. I probably was asked,
and thought that that would probably be all right, but in actual practice it is a different story.”

In this case, the problem relates more to functionality than aesthetics.

### 7.5.4 Working backgrounds

The working backgrounds and life experience of the older participants also affected their acceptance of recommendations. For example, among the 10 participants, four had health and/or care-oriented working experience. Therefore, it is important to acknowledge that the participant sampling may be weighted towards assistive home modification. This implies that many of the problems identified may exist in an intensified form in the general older adult population. Henry is a retired nurse. In the following quote, he discusses his and his wife’s experience in the fall prevention process:

“We didn’t really have much choice when these were being put up. The fall prevention lady came around and said that this is where they should go, and that’s where we accepted them.”

However, not all older adults with non-health-oriented working experience are as accepting of home modification recommendations. While different levels of acceptability are to be expected, the positive impact of engagement and involvement in creating individualised solutions remains an important factor for all older adults.

### 7.5.5 Individualised solutions

Individualised solutions or ‘home-made’ approaches to fall prevention were also evident in the findings. While these approaches may differ from standardised clinical outcomes, the value of clinical knowledge and input, and of the freedom to design individualised solutions, was evident.

#### 7.5.5.1 John’s walk-through

In the following section, John’s home environment is depicted and explored through a series of photographs. It is a particularly poignant example of what was also found in other
participants’ homes. John occupies himself each day by going into his workshop and *pottering about*. Whether it be bird carving or clock repair, these activities sustain him daily. Throughout John’s house there are handrails and other assistive devices that his son created for him on the advice of an occupational therapist. In John’s case, the home-made handles convey a sense that he is being cared for; they have positive connotations and sentimental meaning. Furthermore, a walk-through of John’s house is a good example of how goals can be manifest in assistive devices and home modifications in a physical house.

The following is an overview of the way John typically moves from his lounge room though the house to get to his workshop—two areas where he spends most of his time:

Figure 7.22 shows John’s four-wheeled walker, which he usually uses to move around the house. From the lounge room, John must raise himself and walk approximately eight metres towards the back of the house.
When John arrives at the single step down that leads to the back of the house (Figure 7.23), he leaves his walker on the carpet area, and then reaches around the door frame and grabs onto a wooden handrail that his son created and installed for him. John proudly stated: “That’s the handle that my son made.” John then reaches across to grab his walking stick and does not use the opposing steel handrail for support. When questioned why he abandoned using the steel rail, he said: “It’s because I like wood; that’s cold (the steel rail), and the wood is warm.” John then uses the walking stick to continue to the back of the house.

The back door leads to five stairs that go down to the paved and grassy area (Figure 7.24). Under the recommendation of an occupational therapist, John’s son installed another handrail to help his father go down the back stairs; it is an old mop handle. John said: “Since my son put that old mop handle up—it doesn’t look like much but it is amazing how it helps. It makes you feel more secure. I like the mop handle.” This exemplifies how occupational therapy recommendations and positive individually-tailored solutions can complement each other.
A left turn at the bottom of the stairs leads to a pathway made of pavers (Figure 7.25). The pathway is accompanied by a railing that is approximately three metres in length. The railing is a light pole that had fallen down, and was salvaged by John’s son from the local supermarket car park. His son then installed it in the backyard for his father. John proudly stated: “My son picked it up and thought it would come in handy for something... He’s a real scrounger.” When John comes to the end of the pathway, he lets go of the steel handrail, and supports himself on the door handle as he enters the workshop.
In the workshop, John moves around with the assistance of his walking stick, and with the support of the nearby benches and equipment (Figure 7.26).
The workshop is full of past and present projects that John is working on (Figure 7.27). Continuing these activities in his workshop is important and meaningful for him; he makes this challenging walk to the workshop every day to continue doing what sustains him. This is the goal that motivates him.

Throughout the course of the interviews, it became apparent that similar goal-oriented pathways could be found in the homes of the other older adult participants.

### 7.5.5.2 George’s steps

Like John, George enjoys getting out into his workshop as often as he can. In his working life, George was a carpenter, and a new series of wooden steps was required for him to access his workshop. However, while George is happy that he can now reach the workshop, he was frustrated by his inability to build the stairs himself.

“Like those steps (Figure 7.28). I’m a chippy, I have got all that timber in my shed. Why couldn’t I do that? But I couldn’t. The thing is, why couldn’t I do them? I’ve been doing them all my life. I used to use those stone steps, the green bin to lean on, and the water tank, until I had them done. But why couldn’t I do them?”
While George's physical abilities may be declining, there is a still a role he could play in decision-making and in the design process, even if he does not build the steps himself. This demonstrates the relevance of having discussions that work towards solutions that provide a sense of ownership.

### 7.5.6 Non-stigmatising universal solutions

#### 7.5.6.1 Henry’s family rails

Having been a nurse himself, Henry sees great value in fall prevention, and in the input of health care professionals. Henry does well in managing his risk of falling, and enjoys watching his grandchildren play with and hang off the rails in his house (see Section 7.5.1.3).

"You have to look at the whole family use of it all; the young don't use it because they don't need to. They just go burning over the steps, but occasionally they do hang off it and go up and down as a plaything. But it is helpful."

Home modifications such as ramps and rails can become meaningful to other members of the family. As indicated in Henry’s quote above, his handrails have become a novelty for his
grandchildren, and spending time with his them is one of Henry's goals (7.5.1.3). This suggests there is a more universal use for these devices, and a consequential de-stigmatisation of home modifications when used in such a way that they support primary goals.

### 7.5.7 Proactive planning

Susan and Sarah were the two participants who took to fall prevention in a proactive manner. Sarah has dealt with mobility issues since her accident. The physical limitations were obvious, and she understood what she needed to look after herself because of her past working experience as a carer:

“I just felt that I was getting worse. It was sad that I started to rely on these aids. It doesn’t bother me anymore; my house is what my house is.”

Susan is dealing with mounting physical barriers and problems. She had a shower rail installed because she wanted to continue washing the bottoms of her feet. The desire to do this demonstrates initiative and an understanding of her own abilities. Rather than waiting until a fall occurs, Susan addressed this goal proactively. This has ensured that Susan ‘owns’ the process, and is safer as she continues to follow her daily routine.

### 7.6 Discussion (Stage A)

This section focuses on the evaluation criteria for service design and their theoretical overlap with person-centred care.

#### 7.6.1 Person-centred fall prevention services

The five key principles of the service design process as presented by Stickdorn and Schneider (2010) provide a foundation upon which to structure, address and evaluate the fall prevention service experiences of the older adults in Study Three A. A detailed breakdown of the five service design principles was presented in the literature review (see Chapter 2, Section 2.6).
Services are intangible, and rely on human relationships to structure and drive them. Stickdorn and Schneider (2010) reinforce this by stating that “services are created through interaction between a service provider and a customer” (p. 36). However, the findings from Study Three A suggest that there is a need to substantially improve fall prevention services to address these five principles more thoroughly.

7.6.1.1 **User-centred**

As the findings showed, six of the 10 older adults interviewed were unsure and disengaged regarding the design communication methods they experienced in the fall prevention service. The failure to deliver transparent recommendations goes against person-centred ideology. While person-centredness has been identified as an emerging area in fall prevention services, it is crucial that clinicians not only are mindful of the goals of older adults, but can relate to them and communicate them visually in practice. For example, if a recommendation is to be person-centred, older adults must be reminded of the value of their goals, and of the role they will play in the design process. This user-centred mindfulness must be generated and reinforced through the service experiences driven by clinicians. Without user-centredness being embedded in design solutions, uncertainty, apprehension and rejection of modifications are possible.

User-centredness is a necessary objective for fall prevention providers if they are trying to achieve greater person-centredness in their services. The barriers that cause poor visualisation and hierarchical disengagement stem from a lack of appropriate communication tools to drive the design process according to the older adult’s goals.

7.6.1.2 **Co-creative**

For fall prevention services to be co-creative, the older adult must be at the centre of them. By utilising the goals, rich knowledge and personal experience of older adults, clinicians can tailor service outcomes with greater input from the older client. However, from the findings it is evident that there were significant influences that inhibited older adults from discussing their needs. Like the issues that limit user-centredness, communication is
constrained by similar problems, including an underestimation of the value of their role. Without an open dialogue, co-creative service measures are restricted from the onset. To address co-creativeness, older adults must be encouraged to engage in prevention processes.

7.6.1.3 Sequencing

The timing of fall prevention services is very much dependent on case load and funding. While older adults are typically subjected to waiting periods, there is good communication from the service providers about the sequencing of fall prevention events.

It is important to note that fall prevention processes are dynamic, and each case is different. However, it is critical to consider the person-centred service timeline, since the rhythm and timing of a service has the potential to greatly influence the disposition of the consumers. As fall prevention is typically conducted reactively rather than proactively, the timeliness of interventions is critical to bolster an older adult’s ability to remain living at home.

7.6.1.4 Evidencing

As highlighted in the results, the intangibility of fall prevention recommendations remains an issue for older adults. The lack of design mechanisms currently available to clinicians—and thus to their older clientele—limits the perceptibility of service outcomes. This can lead to uncertainty and the inability to visualise one’s own goals in fall prevention recommendations, which lessens the person-centredness of the fall prevention service and its resulting outcomes.

Based on these insights, it can be deduced that fall prevention service providers require a tangible and accessible mechanism that communicates fall prevention recommendations in an easily-comprehensible manner. By utilising the goals of older adults and their own environments, the fear of the unknown in fall prevention can be confronted and mitigated.
7.6.1.5 Holistic

As services involve human relationships, it is important to consider the wider context of fall prevention services, including hierarchy, the environment, individual experience and goals.

During the interviews, it became evident that the clinician-to-client hierarchical structure was perceived by older adults as being heavily weighted towards the professional. This unbalanced service structure would negatively influence the person-centredness of the services provided. For example, it would create a sense of disengagement among the older adults, and generate service experiences where clients were unaware of the value of their role in their fall prevention. This would limit their input to the service, and restrict its ability to account for the wider circumstances surrounding falls and their prevention. As expected, this theme was identified in Study Two A, and was acknowledged among service clinicians. It is now evident that these negative qualities affect older adults.

The five service design principles have provided a means to explore and investigate fall prevention services to provide contextual knowledge in preparation for an assessment of the AREVT in Stage B.

7.7 Study Three B: AREVT evaluation

Study Three B reports on an evaluation of the AREVT conducted among the same group of participants as Stage A. The AREVT is evaluated regarding its usefulness, ability to communicate complex health interventions, and its possible utility in fall prevention and home modification design practice. The aim is to create a person-centred service structure in which older adults have some control.
7.8 Method (Stage B)

7.8.1 Data collection

The design of the supporting interview questions focuses on examination of the AREVT. The questions provide a structure within which the evaluation can take place, and are summarised in Figure 7.28.

The interviews conducted as part of Stage B directly followed those in Stage A. Therefore, individual insights had already been gathered about each participant and their fall prevention journey prior to the initiation of Stage B. From the onset of Stage B, it was made clear to the participants that the AREVT is intended as a supplementary tool for an occupational therapist or other appropriate health care professional to use. Therefore, Stage B commenced with a demonstration of the AREVT. The AREVT was introduced by the researcher as a home modification design tool. An overview of the AREVT’s capabilities was provided to each of the older adults and demonstrated by the researcher displaying a handrail at one of the walls in the participant’s home (see Figure 7.30). The participants could pilot the tool if they wanted to. Participants were then invited to comment on, use and experience the AREVT themselves.

Stage B is driven by its own aims and research questions (see section 7.2.1.2 and 7.2.2.2). The objectives in this study are reflected in the interview questions presented below in Figure 7.28. A more detailed guideline is available in Appendix D.2.

Sample interview questions from Study Three B

Do you have any comments on the application?

If you could change something about it, what would it be?

How would you feel about home modifications if you could see what they looked like in your house beforehand?

Figure 7.28 Summary of Stage B interview guideline
7.8.2 Data analysis

The data sample collected as part of Stage B included semi-structured interview transcripts and accompanying photographs taken in the participants’ homes.

The data underwent the same thematic analysis process as that for Stage B, which is discussed in section 7.4.2.

<table>
<thead>
<tr>
<th>Study Three B analysis guideline: AREVT evaluation</th>
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<tbody>
<tr>
<td>How suitable is augmented reality as a platform to communicate goals for older adults in fall prevention?</td>
</tr>
<tr>
<td><strong>Aim D:</strong> To draw upon the knowledge gathered about the older individuals and define a fall prevention design process that would benefit them</td>
</tr>
<tr>
<td><strong>Aim E:</strong> To assess the augmented reality tool as a supplementary fall prevention design communication aid and to investigate its strengths and weaknesses</td>
</tr>
<tr>
<td>How does the use of such a tool differ from traditional methods?</td>
</tr>
<tr>
<td>What refinements could be made to the tool?</td>
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Figure 7.29 Study Three B analysis guideline

7.9 Results (Stage B)

7.9.1 First impressions of augmented fall prevention scenarios

Eight of the 10 older participants viewed the AREVT positively, claiming that they felt it would be a more helpful tool in discussing design ideas related to home modifications than the traditional design methods they had experienced in the past. One of the participants viewed the tool as negative, and another was apprehensive and generally undecided about the AREVT.

When older participants spoke about their fall prevention experiences and ideas during Stage A, I took note of these insights for further investigation in Stage B. Throughout the
course of Stage B, I would reflect these fall prevention ideas back to the older participants as scenarios in their home environments, and explain the role the AVRET could play in addressing their ideas and goals. The following is a collection of first impressions:

**7.9.1.1 Sarah**

Sarah continues to seek ways to improve her living spaces so she can remain living independently (see section 7.5.1.9).

The following are Sarah’s first impressions of the AREVT:

“Oh that’s clever, isn’t it? I needed a rail there because you see on the wall where my hands have been. That’s excellent! It gives you a vision of what it is going to be like. I don’t have to rely on you telling me what it is going to be like. I can see what it is going to be like anyway.”

![Figure 7.30 Screenshot from the AREVT in use in Sarah’s home](image)
Sarah’s response was positive. She was intrigued by the application, and wanted to explore other modifications to her home. She immediately understood the purpose of the tool, and why something like this would be beneficial in the fall prevention field. She continued:

“I think that it is a good device for people who need it, especially for people that can’t comprehend things so quickly. They can see visually, and see what it is like. Sometimes, if you see something (diagram or a sketch) you may not be able to picture it.”

7.9.1.2 Cathy

An account of Cathy’s fall prevention story told in Stage A was presented in Section 7.5.1.5. Cathy expressed her frustration at being unable to understand home modification design diagrams that were left with her, and she was unsure what her modified bathroom was going to look like (see Section 7.5.2.1). The following quotation is taken from Cathy’s first experiences of the AREVT:

“I think that it is a good idea, to see it like that is a lot easier than trying to imagine it. It is a good idea!”

This was Cathy’s reaction after a simple handrail was placed on her lounge room wall. After seeing the railing, Cathy shared her own ideas about a possible railing at the step leading down into her garage. A possible solution was visualised for her on the AREVT, which received a positive response.

7.9.1.3 Mary

As a result of her experience, Mary felt uncomfortable and was reluctant to share her opinions and preferences throughout the fall risk and home modification assessment (See section 7.5.3.1). Mary stated that she was unsure of her role in the clinical and client relationship, and this led to her doubting the weight and relevance of her own opinions in the fall prevention process.

This was Mary's first impression of the AREVT:
“Isn’t that wonderful that they can do that! I am looking at the rail and that’s a good idea. It is confusing out there (the front access). I don’t think that there is anywhere that they (occupational therapists) could put it (a railing), but I would love it if they could.”

Mary was confused about the front access, and indicated that she was unsure how a fall prevention service could assist her. After seeing the AREVT, she said that a tool like this would greatly assist her, and other people like her, in informing her about her choices and options.

7.9.1.4 John

John is a creative person and a handyman; this became obvious during his detailed home walk-through (7.5.4.1), and is clear in his biography (7.5.1.1). John did not view the AREVT positively, but spoke about how he was still able to imagine things for himself.

“Not all of these fancy ideas are good. Maybe it’s because the people who suggest them aren’t practical and they don’t use them, but if it ain’t broke don’t fix it.”

As a creative person who enjoys fixing things, John would rather be in control, and do things by hand, whether that means he does it himself, or his son assists him in completing the task.

7.9.1.4 Susan

Susan was apprehensive throughout the evaluation of the tool. She did not identify with it, as she prefers an old-fashioned method of communication.

“I am used to the old-fashioned way … I am not up to modern technology. Sometimes I wish I were.”

It is important to note that in this case, Susan showed signs of apprehension when she first saw the iPad, and disengaged prior to the AREVT demonstration. This is directly in line with one of the earlier predictions made by an industry participant in Study 2B.
7.9.2 Professional background

It was discovered that the past life experiences of many of the older participants contributed significantly to their understanding of home modifications, and ultimately to their opinions of the AREVT.

For example, Henry has Parkinson’s Disease and lives at home with his wife. He is a retired nurse with approximately 50 years’ experience in various nursing fields. Escalating intrinsic risk factors related to his condition limit his ability to perform various tasks in his home safely. While Henry has gained extensive health care knowledge in his life, he still values the input of health care professionals in his fall prevention:

“I would consult with someone first to make sure we were getting it (the handrail) put into the right place. That’s why we are having it done now. My condition will change—I don’t know which way it is going to go.”

While he and his wife believed they had limited choices, Henry understood the importance of having a health professional explain why something was being recommended:

“I don’t think you should do it without that input, because otherwise you could just be doing something totally wrong. It depends on your condition.”

The past life experiences and capabilities of adults are underestimated when it comes to comprehending technology. For example, Peter is a retired engineer, and designed a disability-specialised bathroom in their home for his frail wife. His wife now resides in care, and Peter remains living at home. When Peter experienced the AREVT, he stated:

“I found this out during my engineering life—a lot of people couldn’t see the end picture ... It (AREVT) would help others, and it would also help me. It is nice to play with things; it is nice to play with things and have a look and what is going on, and then working in your own mind what you could do with it ... I can see its benefits.”
Some participants wanted to care for themselves and expressed their deep frustrations regarding their home modifications. The following is George’s account of his fall prevention experience, and its relationship with his self-identity:

“Denial was number one for me: ‘I don’t need a stick. I don’t need a wheeler’. It takes a lot even now. I know that I need things ... I would rather make it hard to do, than admit that I can’t do it—like those steps (backyard modification to access his shed). I’m a chippy (carpenter). I have got all of that timber in my shed. Why couldn’t I do that? But I couldn’t. The thing is, why couldn’t I do them? I’ve been doing them all of my life.”

When George was shown the AREVT, he began to discuss his practical mind, and how he would typically work through problems. He has been a carpenter for most of his life, and talks about the traditional pen-and-paper methods he employed himself when designing. He saw value in the AREVT, as it would allow other older adults to visualise what he himself could imagine in his mind. The AREVT can assist with self-identity and denial issues as well, as older adults can see how something will work for them, and how it will fit into their lifestyles. George spoke of his initial hesitation and stubbornness in accepting modifications and assistive equipment, but once exposed to these assistances, they became quite natural.

7.9.3 Barriers and limitations

During the interviews, many older participants expressed their own ideas, preferences and goals regarding the AREVT. This was expected, as the AREVT is a proof-of-concept device. The following list outlines future considerations if the AREVT were to be further developed:

- Some apprehension surrounding the AREVT was apparent at first sighting of the technology. While this may not be reflected in the transcript data, the body language of several participants revealed hesitation and uncertainty at the sight of the iPad. Once I had communicated that I would pilot the AREVT, and provided a demonstration, all apprehension faded.
• Printability: All participants said that they would appreciate the ability to retain a printed version of the design for their own record, and to remember the proposed installation. This is understandable, as there can often be significant waiting times before a modification is installed.

• Hands on: Two of the participants expressed that they would like to be able to feel and experience the texture of some home modifications—in this case, handrails.

7.10 Discussion (Stage B)

7.10.1 A person-centred communication process

During the interviews, it became apparent that there were numerous issues among participants relating to design communication and their own sense of control throughout their fall prevention experience. It is evident in many of the quotations that older adults fail to fully comprehend home modifications. Older adults are not to blame for these misunderstandings, and neither are fall prevention service providers—both parties have struggled to communicate without the proper design tools to bridge these gaps.

The design disparities are related to the non-reflection of client goals, as well as limited opportunities for informed discussion and input. Based on the findings from this study, and building upon the results of the earlier studies, I have concluded that a tool such as the AREVT will allow occupational therapists to cut through some of these home modification design disparities by utilising a co-creative design process that is supported by and facilitates the use of augmented reality as a design medium. It is foreseen that this will ultimately reduce the amount of clinical guesswork required, and limit the possibilities for design comprehension error.

The aim was to create a platform that facilitates and strengthens the role of older adults in their own fall prevention journey. The AREVT supports this. It allows older adults to preview environmental changes to their home, and gives them the grounding to have an informed two-way discourse with their fall prevention service provider. Allowing older
adults to visualise the modification and see their goal being reflected in practice empowers them, and motivates them to accept safety modifications.

7.10.1.1 Goal communication

Railings and other assistive equipment almost always carry connotations of frailty and impending functional decline, especially when these objects are permanently embedded in an older adult’s home environment. This is almost unavoidable. To make these outcomes more palatable for older adults, the methods and service delivery processes leading to their implementation need to encapsulate and exemplify the goals and input of older adults, and enable choice.

Conducting the assessment of the AREVT in Stage B rather than Stage A was highly beneficial. Separating the two investigation phases allowed me to get to know the older adults individually, and to build a rapport with them, and learn about their goals in life. Through showing genuine interest in the goals of my older participants, and working through their ideas to construct and communicate their goals in practice, a comfortable working environment was established. Having been through the Stage A process greatly assisted the technology assessment. The procedure I followed included many elements that an occupational therapist would cover when conducting an assessment. The risks and hazards were discussed, and the goals were identified. Working through goal-oriented, everyday scenarios with the older adults via the AREVT demonstrated to them that I was willing to incorporate their ideas and goals, and emphasised their role in the service relationship. Rather than focusing on issues of disability when discussing the AREVT, conversations were formulated around the goals and individuality of the participant, and how to retain the ability to perform tasks they perceived as important.

7.10.2 AREVT deployment in a fall prevention service

It was anticipated that there would be some hesitation about the AREVT among the older participants. These insights strengthen our initial claim that the AREVT should be a supplementary design aid. I do not suggest that the AREVT tool is the final solution in
creating the most optimal outcomes for older adults. Nor do I assert that this AREVT is applicable for all older adults—such an argument would be counter intuitive to person-centredness. However, new technologies and empowering methods of use is imperative if we are to encourage older adults to remain in control of their own fall prevention processes.

As demonstrated in the results, older adults are capable of expressing their opinions and articulating their goals and needs in the home modification design process, but this is dependent on both parties in the health care process being aware of their options. The AREVT provides an informed communication platform for both stakeholder groups. The AREVT will only demonstrate its full potential at enhancing fall prevention person-centredness when proper goal scenarios are walked through in the home and contribution is encouraged. The AREVT is a supplementary service tool to encourage older adults to take on their roles and contribute in a reflexive and empowering manner. The capabilities, goals and preferences of older adults are harnessed, along with their desired level of choice and input they wish to have into their person-centred fall prevention. Furthermore, the notion of sugar thinking and the stereotypes associated with older adults and technology are overturned. The positive impact that better client engagement has on care outcomes is reflected in the findings of this research and in the literature.

7.10.3 Inviting engagement and control

Stages A and B show that older adults are driven to maintain control through both intrinsic and extrinsic functional decline. To retain control in difficult life circumstances, older adults adopt primary and secondary mechanisms to counter many of the hazards presented by the environment and their own functional/medical limitations. These reflexive mechanisms are dependent upon each other for cohesion and control.

The AREVT was a conversation enabler, which was anticipated prior to this study. However, this effect was far greater than anticipated. During the interviews conducted in Stage A, the participants and I became familiar with each other. When they saw the AREVT and learned about its capabilities, many of the participants took the opportunity to discuss
their design preferences, lifestyles and goals beyond the scope of the questions prepared for this purpose in Stage A. In the interviews, an almost instantaneous understanding of the capabilities of the AREVT was apparent among the older participants. Once a simple handrail had been placed on a participant’s wall, many of them promptly began discussing their own needs, how they perceived their own abilities and how additional modifications might benefit them. However, enhanced person-centredness is not simply a by-product of the AREVT; the way it is used by an occupational therapist is critical. To incorporate a new technology such as the AREVT into person-centred fall prevention, it is essential to consider the health service in which it will be embedded. To position the AREVT in a person-centred service structure, service design must be considered.

In assessing the AREVT in relation to the five service design principles (Stickdorn & Schneider, 2010) several points must be considered. The AREVT must be embedded in a framework that advocates proper use in accordance with the five principles. For example, as stated above, the AREVT is envisioned as a supplementary service platform that is anticipated to benefit both service providers and consumers through the five service design principles.

7.11 Conclusions

Study Three evaluated fall prevention according to two considerations. Stage A investigated the self-perceived role older adults play in their own fall prevention journeys to understand their goals, and how these were reflected in the fall prevention service. Stage B evaluated the AREVT from the perspective of the older adults to assess its utility in providing an appropriate design medium through augmented reality.

Stage A of this study confirmed that many older adults feel disconnected from the fall preventative home modification process, and that person-centredness is strongly linked to one’s sense of control. Primary and secondary mechanisms of control adopted by the participants to offset their fall prevention experiences were discussed. Stage A demonstrated that the creation of the AREVT, the rationale supporting its use, and the prior Studies One and Two are useful and valid. Many of the issues related to an older adult’s
inability to continue pursuing their goals are not reflected in the literature, or in the earlier interviews with industry professionals. For example, without speaking directly with older people within their own homes it is difficult uncover this problems and to explore them. Stage A also demonstrated that older adult home modifications and fall prevention remains a troublesome space—one that industry practices cannot currently keep up with.

To bridge barriers and alleviate problems, the AREVT was evaluated in Stage B. This secondary stage of Study Three investigated the usefulness of an augmented reality environmental design tool in older adult fall prevention—specifically home modifications. It is simply not sufficient to represent complex design ideas verbally, accompanied by basic visual representations. These best efforts made by industry are limiting for older clientele, and could be represented in a manner that is more person-centred.

It is concluded that the quality of the AREVT representation of home modifications aids person-centredness. Only when the older individual can actively engage in their environment can they retain a proper sense on control, and have the ability to make completely informed choices in their health care decision-making. This close connection between fall prevention recommendation compliance and instilling a sense of control among older adults is pointed out by Clemson et al. (1999).

It is important to integrate these insights into an appropriate fall prevention guideline for occupational therapists. As stated earlier in this thesis, falls are multifactorial, and multi-view approaches are required to provide greater person-centredness. In the next chapter, a detailed fall prevention service model that integrates the knowledge gathered in this thesis is presented. It encapsulates the AREVT, and uses it in a manner that is empowering and does not perpetuate stigma.
Chapter 8. A service model for person-centredness in fall prevention

“During a service design process, we need to involve customers as well as all other stakeholders involved in exploring and defining the service proposition.”

(Stickdorn & Schneider, 2010, p. 38)
8.1 Overview

Chapter 8 presents a theoretical service framework to enable greater person-centredness in fall prevention. This outcome is referred to as Conceptualisation Phase Two. The framework is offered as a service model in this chapter, and the rationale behind its utility is based on current knowledge established from the literature review (Chapter 2), the findings from Study One (Chapter 4), the insights generated from the fall prevention industry study (Chapter 6), and the results obtained from Study Three involving older adults (Chapter 7).

A detailed rationale of the model and its distinct phases are presented and discussed in this chapter. Section 8.2.1 re-introduces service design and its relationship with new embedded technologies. The following Section 8.2.2 details the relationship between services and the people within them. Section 8.2.3 establishes fall prevention stakeholders as designers in the home modification process. Section 8.2.4 re-introduces the concept of sugar thinking and its interplay with services. Section 8.2.5 introduces the reader to the proposed double-diamond model of service design. Section 8.3 presents the service design model, and provides a detailed breakdown of its phases.

This service model was presented at the 10th World Conference of Gerotechnology and published as a double-blind peer-reviewed article in the Gerontechnology Journal (Lo Bianco, Pedell, Renda, & Kapoor, 2016).

8.2 Rationale

Based on the findings from Studies Two and Three, it is critical that occupational therapists and other health professionals on the front line are given tools to facilitate co-design with their older clients. Furthermore, older adults have the ability and desire to remain in control, and to contribute to their own health care. However, as demonstrated in the preceding studies, both groups lack appropriate design communication media to converge their divergent thinking regarding their goals, home modification design ideas, and health
and safety requirements. To support successful interplay between these groups, it is important to design a service structure that enables practitioner and client co-creation.

Technological developments, their role in established services and their effect on people motivate the proposed person-centred fall prevention service model offered in this chapter. The Augmented Reality Environmental Visualisation Tool (AREVT) is an example of a promising technology for use in fall prevention. However, the service model presented in this chapter does not depend on it. Rather, the value of the model is based on the findings from the studies, and on the foundational guidelines and values linked to stakeholder engagement and communication, with the aim of achieving person-centredness. Other service tools and technologies could be integrated in the future. The model presented provides a theoretical framework development and evaluation of new, person-centred technologies.

The service design model presented in this chapter is based on a foundation of insights into the everyday lives of older adults and fall prevention service providers, as investigated and established in the preceding chapters. The new model aims to benefit both clinicians and older clients through its distinct phases and consumer-directed stages.

### 8.2.1 Technology integration in existing services

Service design has arisen as a specific design practice in the last ten years or so. Polaine et al. (2013) claim that “twenty-years ago, the design of services tended to be about hotels and hamburgers. Today, digital platforms are critical ... The digital landscape of the information age has created radical enablers for new types of service delivery” (p. 24). Digital enhancements of services in health and beyond have become grounded with technological touchpoints to the point of normality among service users.

The addition of new digital elements in an existing service adds to the complexity of the service provided, creating both opportunities and barriers. This complex combination accounts for the fact that service design has developed as an explicit design practice that aims to curb service barriers and ensure positive outcomes. Consequently, there are two
factors underpinning the need for an appropriate service model: (i) a suitable service
model is an integral element to the successful introduction and evaluation of new
technologies; (ii) it is necessary for the successful integration of all stakeholders who have
active roles as co-designers. These elements have been considered carefully throughout the
research so far, and are presented in this chapter.

8.2.2 The relationship between services and people

Services delivery is reliant on the people who use them and drive them. A service is not a
physical object, it is a relationship between users and service providers. While new
technologies can automate, simplify and improve many types of health-related service
offerings, the fundamental component of a service is the intrinsic relationship between its
stakeholders.

Correctly designed person-centred health services create a situation in which an individual
who enters into a relationship with a healthcare provider is invited to co-design and
produce the service experience and outcomes. Consideration of the connection between
these stakeholder groups, including their interactions, goals and experiences, must venture
beyond one-sided medical models of consumption and performance. This ideal drives this
research.

Service delivery is about people, and this is especially the case in fall prevention. For new
technologies to provide a person-centred design method in fall prevention, consideration of
the service in which it will be embedded is essential. A fall prevention service design model
is required to offer guidelines to practitioners about the use of technologies. This was
envisaged to be the case with the AREVT, as the person-centredness permitted by it is
dependent on its delivery to older adults.

Conceptualisation Phase Two—the framework development—is guided by the preceding
studies related to fall prevention industry insights, the goals of older adults, their
motivations and their individual needs.
8.2.3.1 Implementing co-design tools in fall prevention services

I do not advocate that the AREVT should be the only solution to mitigate design comprehension and enablement issues linked to fall prevention and older adults. Rather, it is intended as a supplementary tool whose use will depend on the circumstances. To argue that the AREVT is appropriate for all older adults would contradict the findings presented in this thesis, and be counter-intuitive to person-centredness. Therefore, careful thought is required in the design of fall prevention services. An environment must be created in which a fall prevention service is not reliant on technology alone to connect with people about their needs. Without this humanistic element driving the handling of a technological medium, the AREVT may itself increase the level of stigmatisation.

One of the most important findings in Study Three was that older adults are uncertain of their role in their own fall prevention; this is commonly linked to the reluctance to engage with services. For fall prevention service providers to deliver a person-centred service that facilitates client control through engagement, clinicians need to be mindful of the goals of older adults, make these goals drivers in the design, and communicate possible solutions in a visually-communicable manner. Equally, older adult clients need to comprehend the recommendations made by the clinicians. Therefore, mutual understanding between both designer groups is required. While the AREVT does promote this, an appropriate service model is required to enforce it.

8.3 A person-centred fall prevention service model for technology use

Stickdorn and Schneider (2010) argue that real-world design processes are non-linear; however, it is possible to illustrate a general structure to guide them. They also maintain that service design thinking is an iterative process between exploration, creation, reflection and implementation. In the context of service design and fall prevention, each stage in the process should be considered as malleable. Therefore, it is critical that the service design model is understood as an open, person-centred framework, and one that is not highly prescriptive.
When considering the person-centred fall prevention service journey, it is important to reflect on the whole process holistically, taking into account the various touchpoints along the way. The iterative nature of service design thinking, and its four key elements as highlighted by Stickdorn and Schneider (2010), correlate directly with The British Design Council’s ‘double-diamond’ model (Design Council, 2015). For example, a service journey can be divided into the four stages of exploration, creation, reflection and implementation. While the thematic sequence of these service elements may differ in the double-diamond model (discover, define, develop and deliver), the iterative nature of service design thinking supports a malleable process in which the order of these stages may be moved when appropriate.

8.3.1 The double-diamond model

The British Design Council’s double-diamond model was developed in 2005, and provides a general and graphical framework that describes the four stages of an iterative design process (Design Council, 2015). Occupational therapists and older adults in this stakeholder network will apply different approaches and various specialisations based on their own individual interests, experience and goals. It is understood that the British Design Council developed the double diamond to allow for these design process inconsistencies and individualities (see Figure 8.1). Furthermore, the double-diamond model serves as a boundary object. A boundary object is a theoretical tool which can be adopted by various disciplines (Starr & Griesemer, 1989). Furthermore, a boundary object provides a lens where complexities are simplified and various parties can communicate despite conflicting goals and interests. For example, the service structure dictated by the model provides a framework for communication and negotiation.
The double diamond is separated into four distinctive stages—discover, define, develop and deliver—which can be mapped progressively from left to right in the graphic above. These four stages feed and link directly with the four stages of the iterative design process: exploration, creation, reflection and implementation. Furthermore, the double-diamond structure details how a linear design process moves from open thinking to the narrowing down of ideas to focus on distinct objectives.

### 8.3.2 A service model for fall prevention

Figure 8.2 details the adapted double-diamond person-centred fall prevention service design model offered as an outcome of this research.
The sequence of the double-diamond fall prevention service model is detailed below.

8.3.2.1 Discover

The first stage of any fall prevention project is a phase of investigation and assessment to identify the functional and health requirements of older adult clientele. In the discovery phase, the problems and solutions begin to be identified. The initial assessment process is conducted to determine and identify the risks and hazards linked to that individual, and to understand the scope of the service required. For example, on examination, an older adult may require support in addition to the home modifications, so an overall action plan is developed to provide the older adult with as high-quality and all-encompassing a service as possible.

The first quarter of the diamond initiates the fall prevention project. The pathway into falls prevention can vary; it can be triggered by self-referral or referral from a local doctor. Therefore, the diamond starts from the time of first contact with the fall prevention clinician—typically an occupational therapist. An occupational therapist examines an older
client based on an assessment of the client’s intrinsic and extrinsic risks in combination with analyses of ADLs, IADLs, EADLs and PADLs to investigate their performance (see Chapter 2.3.10 for extended definitions), and identify issues of functional performance that may need to be addressed by the fall prevention service, or by a related service through further referral.

The discovery phase is conducted using quantitative and qualitative fall risk assessment methods, as in the analysis in Study One (Chapter 4). This is to gather knowledge about the older client that helps ascertain the risks and hazards to be mitigated in the proceeding service phases and outcomes.

8.3.2.1.2 Objectives

- Identify intrinsic and extrinsic risks and hazards that require mitigation by the fall prevention service
- Build knowledge of the older client, including an understanding of the functional limitations of the home environment

8.3.2.2 Define

The second quarter of the double diamond is a phase of definition in which occupational therapists aim to identify and understand the goals of older adults, and their interplay with the risks and hazards identified in the preceding Discover phase. The Define stage aims to channel these findings towards a series of actionable tasks.

Older adults strive towards independence and the retention of their own self-identity through fall prevention services. Therefore, this secondary phase is targeted towards collecting, understanding and communicating goals with older adults. To define goals, occupational therapists are encouraged to go beyond surface understandings of functional independence to identify the mechanisms that truly provide their clientele with independence in their lives. These must then become design drivers.
The step between Define and Develop is iterative. The service can jump back and forth in order to define the problem space with the older adult, and to define a development process that is in accordance with both their goals and the health and safety requirements of the service providers. This step does not have to be completed in one session; deliberation time is necessary and common, as occupational therapists often split their workload into multiple visits to avoid overwhelming their clientele.

**8.3.2.2.1 Objectives**

- Examine the outcomes of the discovery phase
- Synthesise the findings into a series of actionable tasks in accordance with the goals of older adults

**8.3.2.3 Develop**

The third quarter of the double diamond initiates a period of development where possible fall preventative home modification outcomes are discussed, envisioned and tested with older adults using visual technology—in this case, the AREVT. This is a process of trial and error, in which clinicians can walk through the recommendations with older adults through scenarios informed by individual goals. As indicated in the service model, the Define and Develop stages are iterative stages in the fall prevention service process that are supported by a supplementary visualisation technology—the AREVT in this instance.

The AREVT’s key feature is that it facilitates transparent communication of fall prevention design ideas between clinician and client to establish where additional definition may be required. Moving backwards and forwards between stages is appropriate, as this trial-and-error process aims to equalise the goals of clinicians and older adults to achieve a safe and person-centred solution. Additionally, this iterative process between the two stages of refinement and expansion ensures that both parties are mindful of the scope of the service, and how safety solutions can be tailored to the individual goals and preferences of older adults. The process can move back and forth between Define and Develop as many times as necessary until a point of client approval is achieved, triggering the final delivery stage. For
an example, we can refer back to Patricia’s fall prevention experience (see Chapter 7). The use of the AREVT in this instance would have allowed her to communicate her preferences to the clinician regarding the placement of the railing, and how it could have best suited her needs. The AREVT would also have been beneficial from the clinician’s perspective in helping communicate why the recommendation is being suggested.

8.3.2.3.1 Objectives

- Test and evaluate both concepts and context of proposed home modification solutions through daily scenarios supported by the AREVT
- Co-design service outcomes together (clinician/older adult) as part of a holistic goal-driven experience
- Provide older adults with a feeling of ownership and control throughout the design process
- Achieve client approval

8.3.2.4 Deliver

The final phase of the service model is the Deliver stage. At this point, the clinician and client have conceptualised a final fall preventative home modification solution that meets the goals of older adults, as well as the safety standards of the service provider.

The key activities in this stage include installation and building of the final solution. In addition, it is important to maintain an open dialogue with older clients to identify possible issues, limitations of the final outcomes, and to prevent possible future challenges.

8.3.2.4.1 Objectives

- Turn a final recommendation concept into an outcome
- Ensure that older client feedback mechanisms are in place and encouraged
8.4 Conclusions

Service design is a research paradigm which originates from a human-centred approach to design and includes technologies in new and existing service structures. In the case of person-centred fall prevention and the research presented, careful consideration is necessary to establish a service process that is built on healthy human relationships and the goals of older adults, while also being mindful of the empowering use of the AREVT.

In this chapter, I further explored service design to create a conceptual service framework in which the AREVT can be envisioned and embedded in future services. Providing a model for the service utilisation of the AREVT is critical in reinforcing its use as a person-centred technology. The model has been conceptualised via close consideration of existing service structures and the findings presented from the three studies in thesis.

The following chapter concludes the thesis. A summary of the key findings is provided, as well as a reflection on the aims of this thesis. The contributions to theory and practice and highlighted. Limitations of the investigation are presented, as are future research directions.
Chapter 9. Discussion and conclusions

“The task of developing and testing home modifications and new types of technologies for older people is indeed complex and involves multiple steps. Researchers must not only develop the viable technology or home modification service, but also must substantiate the theoretical base for the effectiveness of the technology or program, demonstrate its acceptability and compliance in use, its utility for older adults, caregivers, or health professionals; the specific anticipated outcomes, the training needs of the user, and its cost and cost-effectiveness.”

(Gitlin, 2003, p. 197)
9.1 Chapter overview

Chapter 9 delivers an overview of the research and its key findings. A discussion of the implications of the results in two areas—theory and practice—are offered. A review of the aims of the research is presented, including a discussion of the major contributions and outcomes of the thesis. The limitations of this research are also outlined. Chapter 9 concludes by suggesting opportunities for further research.

9.2 Research overview

In this section, an overview of the research and its theoretical and practical contributions presented. Figure 9.1 provides a graphical summary of the overall contributions of the research. The green portions indicate where contributions have been made.

<table>
<thead>
<tr>
<th>Theory</th>
<th>Practice (fall prevention service process)</th>
</tr>
</thead>
<tbody>
<tr>
<td>person-centered care</td>
<td>understanding and communicating individualised goals</td>
</tr>
<tr>
<td></td>
<td>interventions (with technology as a support mechanism)</td>
</tr>
</tbody>
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Potential outcomes of research application if taken forward

- decrease in falls via higher acceptance rates of co-designed home modifications

Fall prevention industry professionals aim to provide person-centred services for their older adult clientele. However, a disconnect exists between service management and clinicians working the field. In brief, this is commonly attributed to hierarchical misunderstandings regarding the importance of person-centredness and its translatability into service practices. While not ill-intentioned, this breakdown in the implementation of
person-centred fall prevention services carries ramifications for management, clinicians and older adults as service consumers.

Current person-centred fall prevention services do focus on the older individual; this is reflected in the lengthy assessment processes and detailed work that clinicians do daily. However, based on an analysis of the documents and tools used in the field, there are opportunities for misunderstandings to arise, because of the way in which home modifications are visually communicated. Poor visual representations of home modifications create a dissonance between proposal and end product. This creates a service obstacle, as older adults remain uncertain about their proposed home modifications. Therefore, it is important for fall prevention services to provide older adults with a better chance to retain control and become engaged in the design of home modifications. This is critical, as the level of control an older adult perceives throughout the fall prevention process directly correlates with the likelihood of their compliance with that intervention (Clemson et al., 1999). Therefore, control theory is an applicable theoretical framework upon which to base the research (Schulz & Heckhausen, 1999).

The importance of service mechanisms in engaging older adults in fall prevention is currently understated. A support mechanism is required to demonstrate to older adults that they are welcome to play an active role in fall prevention services, specifically the design of home modifications. Currently, many older adults immediately disqualify themselves from providing design input, as they perceive it as either invalid or non-professional. It is the same with their goals. The current fall prevention service documents and tools used to collect and share visual information fail to provide visual engagement based on goals. Therefore, it appears that older adult goals are not differentiated enough, and it becomes necessary to coax them through the service process to motivate them to accept home modification design solutions.

This research connects older adults with their goals, which can translate into a shared visual communication process between clinician and client. A co-design process is adopted, and a technological intervention is offered as a way to facilitate this conversation. Therefore, the research extends beyond a theoretical contribution, and provides a practical
means to address the problems identified. Therefore, the technology-supported service model offered becomes a boundary object in the service conversation aimed at increasing the uptake of home modification recommendations by older adults.

9.3 Summary of the key findings

This research began with an acknowledgement that although fall prevention outcomes are beneficial in allowing many older adults to remain living at home, barriers and problems persist regarding compliance with and uptake of proposed home modifications for environmental safety. This research has been motivated by these limitations. In this thesis, an investigation of fall prevention and the role played by older adults in person-centred fall prevention services is presented. Three studies have closely examined home modifications for fall prevention from different stakeholder points of view, as well as the design methods supporting safety recommendations.

9.3.1 Study One

Study One (Chapter 4) focussed on older adults and their role in person-centred falls prevention services. Findings demonstrate that while many older individuals aspire towards independence, their specific goals associated with independence are heterogeneous. Older adults hold various interpretations of independence. These depend on the older individual’s own circumstances, and a combination of the various compounding factors that may or may not affect them on a physical, emotive or cognitive level. As part of person-centred processes, older adults are encouraged to share their goals in the setting of the fall prevention service. The aim is to ensure that outcomes can be tailored to their individual needs. The document analysis has shown that while information on goals is collected, the influence of this on final recommendations can be difficult to determine. The goals of older adults commonly extend beyond the limitations of functional and physical decline, and denote the desire to retain their self-identity, individuality and purpose. This is what motivates older adults’ fall prevention activities.
The current methods of design communication in fall prevention services fail to provide realistic representations of client goals in fall prevention recommendations. Analogue design methods and tools are limiting, inhibit client understanding and communication, and restrict the input and visual engagement of older adults. The above-mentioned negative factors create a dissonance between fall prevention service providers and older adults. Goal communication is narrowed by traditional deficit-driven rather than person-centred models of care. For example, while a fall prevention service provider may try their best to visually demonstrate a goal-oriented home modification, the restrictive visual tools currently used by occupational therapists limit face-to-face communication abilities and efforts.

The results of Study One extend beyond the preliminary understandings established from the body of literature. They highlight the following requirements of person-centred fall prevention services: (i) greater person-centredness in practice to produce recommendations with a higher likelihood of compliance; (ii) shared engagement regarding the goals of older adults as design drivers in fall prevention services to achieve greater client uptake and control; and (iii) service insights that can be integrated into design solutions for older adult fall prevention.

The initial findings provide a grounding for an evaluation of fall prevention services and an assessment of the Augmented Reality Environmental Visualisation Tool (AREVT) (see Chapter 5). The service evaluation generates understandings pertaining to the conduct and current state of person-centred fall prevention procedures. The AREVT is evaluated as a means of bridging the communication gaps uncovered. These subsequent studies include fall prevention industry professionals (Chapter 6) and older adults (Chapter 7).

**9.3.2 Study Two**

Study Two (Chapter 6) explored current older adult fall prevention processes, barriers and limitations from the perspectives of 11 fall prevention industry professionals (Stage A), with a focus on person-centredness. The interviews also included an evaluation of the
AREVT in fall prevention services as a proposed method for design communication in practice (Stage B).

The results from Study Two A demonstrate that while current fall prevention processes are modelled on an evolving and emerging person-centred approach, barriers and problems related to compliance and uptake persist. The fall prevention industry is mindful of the goal communication barriers between clinicians and their clientele. However, disparities were identified between service management and the clinicians working in the field; the top down approach to implementing person-centredness in services limits the proclivity of clinicians to aim for even more goal-oriented models of care. It was found that there is clinical awareness of these issues; however, the methods and appropriate tools to address this are lacking. While those in managerial positions advocate the value of person-centredness, clinicians in the field commonly express difficulty and frustration with fully implementing person-centred practices.

In Study Two B, the ARVET was thought to be a viable approach to improve compliance and uptake of interventions through the ability it provides to personalise the care experience for older adults, and give them a stronger voice in the process. The following quotation from Participant H (occupational therapist – management - domiciliary care) captures the industry perspectives about the AREVT and a true co-design process.

“[Older adults] can feel that they are being engaged in the process and that they have got some decision-making capacity in the process. Therefore you get enhanced uptake of recommendations; then that should have a follow-on positive effect on the reduction in falls risk.”

An augmented reality design mechanism is foreseen as assisting health professionals in demonstrating the rationale behind their recommendations in a manner that is time-efficient, truthful and innovative. Based on the results from Studies One and Two, it is concluded that the current older adult fall prevention industry lacks appropriate goal-oriented design tools to support and enable clients in a person-centred manner. In support of this, many clinicians working in the field interpret the lack of understanding and
engagement of older adults in fall prevention as a serious barrier that restricts the services they provide.

9.3.3 Study Three

Study Three (Chapter 7) investigated the everyday lives of 10 older adults living in their own homes, including their goals, living habits and past falls prevention experiences (Stage A). As part of this investigation, the AREVT was demonstrated and evaluated in the home environments of the older participants (Stage B).

The findings of Study Three A clearly established that older adults often feel discouraged to share their design preferences and opinions regarding fall preventative home modifications; this is commonly because they feel their own opinions are not as qualified as those of health experts. The older adults felt detached from their own fall prevention experiences, and said they felt so throughout the activity.

The home environments of older adults were explored and documented to understand the relationship between their goals, the mobility needs that support and enable them as individuals, and the home modifications actually implemented. These individual home journeys delivered significant insights into the various life circumstances of each older adult, creating greater understandings of their individuality and goals, and what worked or did not work for them in terms of the process and solutions. These insights were reflected upon during all Stage B interviews.

Study Three B highlighted that the AREVT created an open discourse between us (the researchers) and the older adults regarding their fall prevention journeys. Augmented reality provided an effective communication medium in which older adults became engaged and willing to discuss possible home modifications, and could visualise their own ideas in context. This research has shown that a simplistic, mobile application such as the AREVT can create a design dialogue in which older adults can take part. They can see their ideas played out in real-time in the real-world environment, with their goals as supporting context. In addition, the AREVT signifies that the input of the older client is encouraged and
necessary. The assessment of the AREVT showed that the level of person-centredness in fall prevention processes can be increased via the use of augmented reality that allows older consumers to comprehend and actively engage with their own care decisions.

In this thesis, I have reported on—and redefined—the role of older adults in person-centred fall prevention services. Older adults are represented by their goals. By utilising and reflecting goals as design drivers, fall prevention service providers can curb compliance issues. Therefore, a person-centred fall prevention service model is offered that integrates and guides the utilisation of the AREVT. The model provides a means for life goals to be identified in the service process, and for them to be visually communicated to facilitate an informed two-way discourse. It is important to demystify current design processes in order to engage older adults and establish a sense of control and empowerment in person-centred fall prevention. Therefore, it is expected that this will raise compliance with recommendations, ultimately creating safer environments for older adults. The AREVT and the service model enable this.

9.4 Addressing the aims of this thesis

Chapter 1 presented seven aims that demonstrate the motivations of this thesis throughout its various phases. These are addressed in the following sections.

9.4.1 Aim one

*Explore the current research surrounding fall prevention and enabling technologies and their effects upon the design processes regarding age-related decline and disability (Chapter 2).*

Chapter 2 provided a critical review of the literature related to the ageing population of Australia, person-centred care, fall prevention, home modifications, and the role of HCI (Human-Computer Interaction) in this space. A particular challenge identified was the need to develop a greater understanding of the role of older adult individual goals, and how these can influence and reshape the delivery of fall prevention services. Control, engagement and person-centredness emerged as prominent factors that can play an active
role in the lives of older adults. These elements influence user behaviour, and bolster the sense of self-identity and independence. These are important and understated considerations in the field of fall prevention. Control theory (Schulz & Heckhausen, 1999) arose as an applicable theoretical base to bring together the elements encompassing this multifactorial research, which concerns ageing, health care and HCI.

9.4.2 Aim two

*Extend the understanding of fall prevention processes and the design methods linked to home modification outcomes (Chapter 4, Study One).*

The knowledge and insights gathered from the literature review were further investigated and expanded in Study One. The goals of older adults were examined in conjunction with the current methods of fall prevention design communication. The documents analysed highlighted the processes followed to direct and document fall risk assessments. A dissonance remains between the role of older adult goals and their influence on the home modification design process. The fall risk assessment documentation also provided a clinical perspective on how well understood fall prevention recommendations were among older adult clientele. This area is not covered in the literature. The findings from Study One provided preliminary insights beyond the literature review, highlighting the need for greater person-centredness in fall prevention practice. The results also showed the value of client control, and revealed the current methods of design communication. The findings made it clear that further exploration was needed, along with substantiation by fall prevention industry professionals (Study Two) and older adults (Study Three).

9.4.3 Aim three

*Develop a technology-supported service to support both older adults and fall prevention clinicians to create successful person-centred interactions and outcomes (Chapter 5).*

Based on the gaps and insights revealed through the literature review and the results from Study One, it was deduced that a technological tool could potentially support design methods in fall prevention and communication between the parties. The AREVT was then
conceptualised and generated as a proof-of-concept tool to assist clinicians in communicating design outcomes that reflect the goals of older adult clientele. The rationale supporting the AREVT is in line with person-centredness. In the ensuing studies, the AREVT was subject to assessment among fall prevention industry professionals and older adults.

9.3.4 Aim four

*Assess the utility of the technology-supported service among fall prevention professionals (Chapter 6).*

Fall prevention services were investigated among a group of 10 fall prevention industry professionals to generate greater insights into the strengths and barriers in current service processes (Stage A). Based on these insights and the rationale supporting the conceptualisation of the AREVT, the technology was assessed as a supplementary mechanism in fall prevention services among fall prevention industry professionals (Stage B). Overall, the findings from Study Two highlighted that the AREVT was predicted to provide greater person-centredness in fall prevention design processes. These results required exploration with older adults as well, to determine whether the AREVT could increase control and engagement throughout the fall prevention design process.

9.4.5 Aim five

*Evaluate the success of the proposed technology-supported service among older adults regarding its ability to provide person-centred outcomes (Chapter 7).*

To accurately evaluate the AREVT, the goals, fall prevention experiences and home environments of older adults needed to be investigated. Study Three A established the goals and lifestyles of 10 older adults in their home environments. The insights gathered from Stage A were beneficial to the ensuing evaluation, as Stage B encompassed an assessment of the AREVT as a potential fall prevention service mechanism. The success of the AREVT was measured by the older adult feedback and insights as to whether this technology would have been beneficial in their own service experience.
9.4.6 Aim six

Based on the combined findings, develop a theoretical service framework by which the method should be utilised in practice to ensure that its use is in fact person-centred (Chapter 8)

Based on the results of the literature review and Studies One, Two and Three, it was understood that a fall prevention service framework was required to ensure that the AREVT is used in a person-centred manner. For example, it was necessary to determine a service structure that would guide the use of the AREVT in such a way that specifically addresses older adult goals, and uses them as design drivers. Building on a double-diamond model (Design Council, 2015), a person-centred fall prevention service framework was proposed. This framework aimed to converge divergent thinking between clinicians and clients by employing an iterative design process aided by the AREVT. The intention of the fall prevention service model is to drive a service process that allows older adult fall prevention service clients to retain control throughout the design and decision-making fall prevention processes.

9.5 Contributions to theory

In the literature review, an older adult’s personal perception of control was highlighted as a factor that influences the uptake of fall prevention recommendations made by occupational therapists (Clemson et al., 1999). Furthermore, it was highlighted that greater control can be achieved for older adults through personal engagement with their own environment, which mitigates and offsets the loss of personal abilities (Gitlin, 2003). Gitlin (2003) emphasises that engagement is a fundamental component in any effort to retain control and personal abilities. With regard to person-centredness, it is a healthcare ideology that is driven by client engagement and the reflection of goals in services (National Ageing Research Institute, 2006; Sanderson, 2000; Sanderson et al., 1997). Therefore, control theory has been adopted as the theatrical foundation for this research (Schulz & Heckhausen, 1999). The results highlighted in the thesis contribute greatly to our
understanding of older adult control in fall prevention services, extending our knowledge of the value of control in person-centred health services.

Health care providers should adopt a person-centred mindset, whereby the goals and individuality of patients are understood and reflected in the conduct and outcomes of health services (Eissens van der Laan et al., 2014; National Ageing Research Institute, 2006; Sanderson, 2000; Sanderson et al., 1997). Person-centredness is inherently related to control theory, as the goals of patients directly influence their primary and secondary control retention mechanisms. The application of true person-centredness in fall prevention provides an opportunity to address these mechanisms in a manner that is in accordance with the intrinsic motivations of older adults.

Throughout this thesis, the value of person-centredness was highlighted as an important component in the delivery of engaging fall prevention services. The research has demonstrated that the goal-driven ideology of person-centredness does correlate with and contribute to greater engagement and control in fall prevention services. For example, as demonstrated in the results, current visual design communication methods limit older adult engagement in fall prevention services related to home modification design. The AREVT and the supporting fall prevention service model help prevent these issues by highlighting active engagement as a necessary component in any person-centred fall prevention service. Sanderson et al. (1997) state that person-centredness extends beyond new techniques, and must involve the inclusion of those being cared for. While the AREVT is a simple tool to curb home modification design issues, the fundamental contribution to person-centredness is in the application of the fall prevention service model offered. The model is goal driven, and reliant on active older adult engagement with clinicians to progress though the fall prevention service. To work through the stages, distinctive steps of engagement are required to move to the double-diamond model. Thus, embedding engagement is a necessary component of a visual technology-supported fall prevention service.

Control is an essential component of fall prevention services; this was examined in Study One and highlighted in Studies Two and Three. As stated previously, control and person-
centredness are closely connected—the more person-centred the service, the more likely fall prevention clientele are to be able to retain control. The main factor contributing to this is more opportunity for engagement, and less hierarchical services.

The research described in this thesis demonstrates the value of control, and how it can be adopted and extended in conducting fall prevention services. For example, the AREVT and the fall prevention service model act as bridging mechanisms between clinicians and their clientele. As a supplementary service tool, the AREVT does not facilitate greater service engagement on its own. Rather, it provides a means to visualise older adult goals within a person-centred service model. The successful application of the fall prevention service model is dependent on engagement by older adults in fall prevention services. As shown in the findings from Studies Two and Three, augmented reality provides a means to communicate goals and environmental modifications. However, to use this medium in a way that is truly engaging, clinicians are required to conduct their service in accordance with the goal-oriented procedures outlined in the suggested model. Therefore, the contribution to control theory in fall prevention stems from the application of person-centred digital visualisation tools in goal-oriented services.

Human-computer Interaction (HCI) is fundamentally related to person-centredness through its close ties with user-centred design (UCD). Both place a high value on goals (Rosson & Carroll, 2002; Sanderson, 2000; Sanderson et al., 1997). A contribution to theory is made through the application of control theory (Schulz & Heckhausen, 1999), which binds the two distinct yet complementary paradigms of older adult fall prevention and HCI. HCI and control theory are embedded in the schema that represents older adult goals as part of a person-centred fall prevention service. The schema is a user-centred, technology-supported service that includes older adult goals in the process of designing fall prevention home modifications.

The research in this thesis has combined person-centredness and elements of HCI, based on similarities to the typical goal-oriented nature of UCD. Overall, control theory benefits this research, as the new findings demonstrate the applicability of this theoretical construct as a binding object in this multidisciplinary research.
9.6 Contributions to practice

The thesis began with an acknowledgement of the issues surrounding falls in older adults. Fundamentally, the work strives to reduce older adult falls through their greater acceptance of and compliance with recommended home modifications. However, for this to occur, significant advancements and contributions must be made to address persistent issues relating to the uptake of and compliance with clinical fall prevention recommendations.

The following sections describe the contributions to practice, beginning with an overview of the broader contributions. The more specific contributions made in relation to the two key stakeholder groups—fall prevention industry professionals and older adults—are then outlined.

9.6.1 General

- **Person-centred fall prevention and digital innovation**

A major contribution of this research is the creation of an effective digital method for older adults and clinicians to discuss and communicate fall prevention design ideas. The inclusion of a supplementary service technology such as the AREVT is engaging and person-centred. The findings from this research also highlight that fall prevention is understated and undervalued as a context in which digital innovation can be exercised. There are many ways in which new technologies can enhance this field in the future.

- **Service timeliness and client satisfaction**

As highlighted in the literature and the findings from the three studies, fall prevention service providers work within limited time constraints. The use of a simple digital home modification design tool such as the AREVT in fall prevention services was predicted by both industry and older adults to be a way of speeding up service processes.

- **Expected reduction in older adult falls through greater uptake of recommendations**
The primary aim of fall prevention service providers is to reduce falls in the older adult population. While not all falls can be avoided, older adults’ acceptance of and willingness to abide by fall prevention recommendations greatly reduce their risk of falling. The evaluation of the AREVT in Studies Two and Three highlighted an increased level of engagement among older adults, this leads to more control (Schulz & Heckhausen, 1999), greater control leads to an expected increased compliance rates with fall prevention recommendations (Clemson et al., 1999).

- *Shared interaction and co-design of home modifications to achieve person-centredness*

The research offers a practical method to undertake a co-design approach with older adults regarding fall preventative home modifications. This co-design process is facilitated by the utility of the AREVT in conjunction with the person-centred service model, resulting in co-designed home modifications outcomes. The person-centred service model highlights a service method that is readily deployable in fall prevention services. Its applicability to other health care domains remains unexplored, and could provide opportunities for future research.

**9.6.2 Implications for stakeholder groups**

**9.6.2.1 Fall prevention industry professionals**

- *Clinical guidance on person-centredness*

The findings highlight disparities in fall prevention services, and specifically the value and understanding of person-centredness among different groups of professionals in the industry hierarchy. The insights demonstrate that person-centredness is considered valuable by all; however, there are disparities between management and clinicians. Having identified these issues, it is hoped they can be properly addressed.

- *A means to better address design disparities*
As stated above, the AREVT and the accompanying service method provide a means to increase client understanding during the design process. Home modifications are usually designed using pen-and-paper sketches and shape manipulation in Microsoft Word. The AREVT offers a method whereby designs can be demonstrated accurately and quickly.

9.6.2.2 Older adults

- *A fall prevention service process that encourages engagement*

The research suggests a process in which older adults are encouraged to be active contributors in their own fall prevention. The AREVT and the service model create a means to engage older adults in the home modification design process in a goal-oriented manner.

9.7 Limitations and recommendations

In this section, I provide a critique of the overall research process, and recommend how to address these criticisms.

9.7.1 Qualitative analysis

The data collected in the three studies was analysed via a qualitative approach, which included the following:

- Study One: document analysis (content analysis)
- Study Two A: semi-structured interviews (transcription and content analysis)
- Study Two B: semi-structured interviews and prototype evaluation (transcription and content analysis)
- Study Three A: semi-structured interviews and photographs (transcription and content analysis)
- Study Three B: semi-structured interviews and prototype evaluation (transcription and content analysis)
The methods adopted in each study are accepted qualitative methods of data collection and analysis techniques (Bowen, 2009; Hsieh & Shannon, 2005; Koskinen et al., 2011; Moon et al., 2011; Patton, 2002; Rogers et al., 2011; Saldaña, 2009).

Data triangulation was conducted through a variety of data collection methods and cross-referencing between different participant and data groups.

The design and conduct of the research meet ethical requirements.

**9.7.2 Single analyst**

In any study, the inclusion of a second analyst bolsters the credibility of the findings and conclusions drawn when analysing qualitative data. There was no independent party involved in the analysis of Studies One and Two. However, a secondary researcher was present during the data collection phase for Study Three. Analysis and discussion of the Study Three findings were shared iteratively between me and the secondary researcher.

To moderate the lack of a second analyst in Study One, the results underwent a member-checking process with many of the creators of the documents; this was undertaken within the fall prevention industry interviews in Study Two. This process was helpful, and allowed me substantiate the findings through a comparison with the findings of Study One.

**9.8 Future directions**

During the course of this project, several areas for future research became evident. These are outlined below.

**9.8.1 AREVT improvements**

As demonstrated in the results for Studies Two and Three, improvements could be made to the AREVT to make it a deployable application. These are presented in detail in sections 6.8.2 and 7.8.3. The key points are summarised below:

- Greater stability with larger interventions such as ramps
• A measuring system for the home environment
• A case-logging system
• Printability of modifications as summary of expert/client discussion
• An accompanying texture swatch pack that enables older adults to feel the texture of rails

As noted, the AREVT is based on an existing augmented reality application, Augment. It was beyond the scope of this project to create an augmented reality application from scratch; the Augment application was a perfect platform to explore as a proof-of-concept device. To employ the above suggestions into a workable application, it is likely a new system will need to be created.

9.8.2 Deployment of a future AREVT

After considering the improvements to the AREVT proposed above, proper trials of the augmented reality platform should be undertaken with fall prevention industry professionals under the guide of the supporting service model (see Section 8.3.2). While the service model is based on person-centred thinking, and on the service and technological insights from Studies One, Two and Three, it would be worthwhile to assess the success of the AREVT and the fall prevention service model in a long-term trial.

9.8.3 Guidelines on how to use the service model

The fall prevention service model could be extended into a series of deployable service guidelines to further simplify and clearly outline the steps involved.

9.8.4 Introduction of further technologies into the service model

The fall prevention service model offered is not only applicable to the AREVT; it can extend to any medium where goals can be visually communicated. Therefore, the service model could be tested with other forms of visual accompaniment.
9.8.5 Standards

As highlighted in the research, there is some doubt as to the applicability of the Australian Standard—Design for Access and Mobility 1428.1 2009 (Standards Australia, 2009)—to older adult fall prevention. Research should be conducted to further highlight these disparities to determine whether there is a need for a more relevant standard.

9.9 Conclusions

This research has examined older adult fall prevention and the utility of augmented reality as a supplementary clinical medium to communicate and design for goals in a proposed person-centred service model.

A review of the relevant literature about the ageing population, falls, fall prevention and service design was presented. The review provided insights into fall prevention processes and barriers to the uptake of recommendations by clinicians. It also revealed a theoretical construct that could be applied to assess and increase the uptake of proposed safety interventions—control.

The research began with an examination of current fall prevention processes through a content analysis of fall risk assessment documentation. A number of barriers and problems became apparent throughout the analysis. These concerned communication of and engagement with visual representations of client goals, and the relationship between personal goals and fall prevention outcomes. Consequently, these findings provided insights into further barriers related to the uptake and acceptance of fall prevention recommendations. It was discovered that visual communication of older adult goals could easily be misinterpreted and misrepresented in home modification proposals. This provided a rationale for developing an Augmented Reality Environmental Visualisation Tool (AREVT). In the two subsequent studies, fall prevention was examined as a service experience among fall prevention industry professionals and older adults. Both participant groups evaluated the AREVT. Based on the findings from the studies, a technology-supported fall prevention service model was developed.
Used in conjunction with a goal-oriented model of service delivery, augmented reality provides the opportunity to increase the person-centredness of fall prevention home modification services. The overall solution is offered in the form of a person-centred service model for fall prevention. The model incorporates the use of an appropriate visualisation technology—such as the AREVT—to guide a goal-oriented design procedure whereby older adults are better engaged in service processes. The insights suggest that this will have a positive effect in practice, with an expected increase in the acceptability and uptake rates of home modification recommendations. Further research could be conducted in the future to establish whether this is the case.
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Appendix A. Ethics clearance

The research presented in this thesis has been conducted in accordance with the ethics clearance granted by the Peninsula Health Human Research Ethics Committee (PHHREC). It also received an expedited clearance through the Swinburne University of Technology Higher Research Ethics Committee (SUTHREC). The order in which this ethics clearance was conducted was necessary, as the PHHREC abides by a higher-grade NEAF protocol than does SUTHREC.

An ethics submission was made to the PHHREC in accordance with the National Ethics Application Form (NEAF); the submission was 141 pages in length. Given the length of the NEAF and its supplementary documentation, I have opted to include only the initial full approval clearance letter to demonstrate ethics approval of the research undertaken (see Figure 10.1). Following clearance from the PHHREC, an expedited ethics clearance was sought and approved through the Swinburne University of Technology Higher Research Ethics Committee (SUTHREC) (see Figure 10.2). The final reports for this research have been submitted to each ethical body.
Figure 10.1 Full ethical clearance from the PHHREC

Peninsula Health
PO Box 52
Frankston Victoria 3199 Australia
Telephone 03 9784 7777

HUMAN RESEARCH ETHICS COMMITTEE

Full Approval

15 September 2014

Mr Michael Lo Bianco
28 Zarro Street
SCORESBY VIC 3179

Dear Mr Lo Bianco

PROJECT: HREC/14/PH28
TITLE: Stigmatisation and community fall prevention - the next step in housing modification for elderly Australians.

Thank you for submitting the above project which was first considered by the Peninsula Health Human Research Ethics Committee on Wednesday 20 August 2014 in accordance with the National Statement on Ethical Conduct in Human Research (2007). Following review of requested amendments I am pleased to advise that full approval to commence has now been granted.

The documents approved include:

Application:

- NEAF: 5 September 2014
- SSA: 8 August 2014
- VSM: Version 3: 5 September 2014

Participant Information Sheet:

- Staff: Version 3: 5 September 2014

Research Tools:


At Peninsula Health we value:
Service Integrity Compassion Respect Excellence
To: Dr Sonja Pedell - FHAD

Dear Dr Pedell,

SHR Project 2014/260 Stigmatisation and Community Fall Prevention – The Next Step in Housing Modification for Elderly Australians (Peninsula Health HREC/14/PH/28)

Dr Sonja Pedell, Mr Michael Lo Bianco – FHAD
Approved Duration: 01/11/2014 to 01/11/2016

I refer to the application for Swinburne ethics clearance for the above Swinburne-administered collaborative project based on the prior ethical review of the protocol and related documents by Peninsula Health Human Research Ethics Committee (Peninsula Health reference number: HREC/14/PH/28).

Relevant documentation pertaining to the application was received on 08 October 2014, and additional documents submitted via emails sent on 30 October 2014. Expedited ethical review of the proposed research was undertaken by a delegate of Swinburne’s Human Research Ethics Committee (SUHREC) significantly on the basis of the Peninsula Health HREC review.

I am pleased to advise that, as submitted to date and concerns Swinburne, ethics clearance has been given for the project to proceed in line with standard on-going ethics clearance conditions here outlined. (Nb Peninsula Health HREC may need to be apprised of the Swinburne ethics clearance. Should the proposed research, as regards research conducted under Swinburne auspices, require additional/other HREC review, please forward a copy of the clearances issued and approved consent instruments being used to our office for the record as soon as practicable. Should further detail or documentation be required for endorsement, we will let you know.)

All human research activity undertaken under Swinburne auspices must conform to Swinburne and external regulatory standards, including the current National Statement on Ethical Conduct in Human Research and with respect to secure data use, retention and disposal.
The named Swinburne Chief Investigator/Supervisor remains responsible for any personnel appointed to or associated with the project being made aware of ethics clearance conditions, including research and consent procedures or instruments approved. Any change in chief investigator/supervisor requires timely notification and SUHREC endorsement.

The above project has been approved as submitted for ethical review by or on behalf of SUHREC. Amendments to approved procedures or instruments ordinarily require prior ethical appraisal/clearance. SUHREC must be notified immediately or as soon as possible thereafter of (a) any serious or unexpected adverse effects on participants and any redress measures; (b) proposed changes in protocols; and (c) unforeseen events which might affect continued ethical acceptability of the project.

At a minimum, an annual report on the progress of the project is required as well as at the conclusion (or abandonment) of the project. (Reports and requests made to Peninsula Health HREC also being submitted to Swinburne Research for processing/endorsement may suffice.)

A duly authorised external or internal audit of the project may be undertaken at any time.

Please contact the Research Ethics Office if you have any queries about Swinburne on-going ethics clearance, citing the SUHREC project number. A copy of this clearance email should be retained as part of project record-keeping.

Best wishes for the project.

Yours sincerely,

Figure 10.2 Expedited clearance from SUHREC
Appendix B. Study One: Contextualising current fall prevention practice

B.1 Analysed document examples

B.1.1 Occupational therapy home assessment reports

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| Contents | Reasons for fall risk assessment  
Existing supports in place  
Falls history  
Living situation  
Hazard/risk assessment,  
Barriers/actions/recommendations  
Care plans  
Diagrams and proposed interventions |
| Completed by | Occupational therapist |

Figure 10.3 Occupational therapy home assessment reports
Figure 10.4 Collection of home modification designs
### B.1.2 Occupational therapy home assessment reports – open coding

#### Figure 10.5 Open coding of occupational therapy home assessment reports in Microsoft Excel

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</tbody>
</table>

Note: The table above illustrates the open coding process used to analyze occupational therapy home assessment reports. Each row represents a case, detailing the reason for assessment, falls, history, ADLs, social situation, home description, plant access, near access, indoor access, outdoor access, communication and bed mobility, sensory, motor, A14Q6.1, and OT notes. This information is crucial for planning and adapting accommodations in the client's environment to improve their quality of life and safety.
B.1.3 Deviation from AS 1428.1 forms

<table>
<thead>
<tr>
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<td>A</td>
</tr>
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<td>Sample</td>
<td>2</td>
</tr>
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<td>Pages</td>
<td>1</td>
</tr>
<tr>
<td>Contents</td>
<td>Justification for deviations from the Australian Standard 1428.1</td>
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<tr>
<td>Completed by</td>
<td>Occupational therapist</td>
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<td>Included</td>
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![Figure 10.6 Deviation from AS 1428.1 forms](image)
B.1.4 Occupational therapy electronic progress notes

<table>
<thead>
<tr>
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<td>A</td>
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<tr>
<td>Pages</td>
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<tr>
<td>Contents</td>
<td>Journal-like documentation of client service journey including feedback of outcomes.</td>
</tr>
<tr>
<td>Completed by</td>
<td>Occupational therapist</td>
</tr>
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Figure 10.7 Occupational therapy electronic progress notes
### B.1.5 Screening assessment for fall evaluation reports

<table>
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<td>Sample</td>
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<td>Pages</td>
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</tbody>
</table>
| Contents | Reasons for fall risk assessment  
Existing supports in place  
Falls history  
Medical history  
Intrinsic/extrinsic risk factors  
Activities of daily living  
Living situation  
Management and care plans |
| Completed by | Occupational therapist |

Figure 10.8 Screening assessment for fall evaluation reports
<table>
<thead>
<tr>
<th>B.1.6 Screening assessment for fall evaluation reports – open coding</th>
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<tr>
<td>Figure 10.9 Open coding of screening assessment for fall evaluation in Microsoft Excel</td>
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**B.1.7 Care assessment forms**

<table>
<thead>
<tr>
<th>Document</th>
<th>Care assessment forms (pre-person centred care driven)</th>
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<tbody>
<tr>
<td>Organisation</td>
<td>B</td>
</tr>
<tr>
<td>Sample</td>
<td>10</td>
</tr>
<tr>
<td>Pages</td>
<td>Approximately 20</td>
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</tbody>
</table>
| Contents | Health and wellbeing profile  
Care goals  
Relationships  
Assessment summary  
Home risk assessment profile  
Task list |
| Completed by | Case worker |
| Included in | Community services |

Example document provided over the page.
### B.1.8 Care assessment forms – open coding

<table>
<thead>
<tr>
<th>Client Code</th>
<th>Form Type</th>
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<th>Age</th>
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<th>Care Book</th>
<th>Interest &amp; Background</th>
<th>Medical History</th>
<th>Falls History</th>
<th>Health Issues Affecting Daily Activities</th>
<th>Mobility</th>
<th>Behaviour</th>
<th>Advanced Care Planning</th>
<th>Assistance Technologies</th>
<th>Home Environment</th>
<th>Identified Home Hazards</th>
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<tr>
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**Figure 10.11 Open coding of care assessment forms in Microsoft Excel**
**B.1.9 Consumer-directed care assessment forms**

<table>
<thead>
<tr>
<th>Document</th>
<th>Consumer-directed care assessment forms (post-person-centred care driven)</th>
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<tr>
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<td>10</td>
</tr>
<tr>
<td>Pages</td>
<td>Approximately 20</td>
</tr>
</tbody>
</table>
| Contents | Relationships  
Social and community access  
Care goals  
Health history  
Pain management / medications  
Mobility assessment profile  
Cognition and behaviour  
Communication methods  
Assistive equipment / technology  
Nutrition  
Continence / toileting  
Personal care  
Advanced care planning  
Emergency / evacuation planning  
Assessment summary  
Home risk assessment profile  
Task list |
| Completed by | Case worker |
| Included in | Community services |

Example document provided over the page.
Figure 10.12 Consumer-directed care assessment forms
### B.1.10 Care assessment forms – open coding

Figure 10.13 Open coding of consumer-directed care assessment forms in Microsoft Excel

<table>
<thead>
<tr>
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<tr>
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23
B.2 Axial coding: concept map (service goals)
B.3 Axial coding: concept map (client care maps)

Figure 10.15 Concept map (individual care map) 1/20 in Popplet
Figure 10.16 Concept map (individual care map) 2/20 in Popplet
Appendix C. Study Two

C.1 Interview guideline (Stage A)

Guideline for interviews with fall prevention industry professionals.

- Can you describe for me in as much detail as possible your history working in fall prevention?
  - Does this include the consideration of innovative methods of providing care?
- How are service changes implemented?
  - How are changes typically received? Industry? Older adults?
- What is the current landscape of person-centred care in Australia?
- Are care providers becoming more person-centred in their processes? How?
- How well tailored are solutions for older adults? Are their goals fully reflected? If not, why?
- If you could make any change to the system in Australia, what would it be?
- Can you please describe for me in some detail fall and community fall prevention?
- Please describe for me the process involved in fall prevention?
- What is the greatest problem relating to falls in older adults?
  - What is the value of control?
  - What are the barriers and problems?
  - What can be done to fix this?
  - Would this be considered person-centred?
- If you could make any change to fall prevention procedures, what would it be?
- What kinds of fall prevention recommendations are commonly made?
- Are any of these interventions asked for specifically?
- What are the biggest barriers to the acceptance of fall prevention interventions?
- What determines the appropriateness of particular interventions?
- When making recommendations, how are the daily routines of the older adult considered?
  - What works well?
  - What doesn’t work well?
- How do you feel about the home modifications?
- How does the layout of existing homes affect your work?
- Do you believe fall prevention interventions can be stigmatising for older people?
- Do you follow the Australian Standard 1428.1 when recommending home modifications?

Figure 10.17 Fall prevention industry participant interview guideline for Study Two A
C.2 Interview guideline (Stage B)

Interview guideline for the evaluation of the Augmented Reality Environmental Visualisation Prototype (AREVT) among fall prevention industry professionals.

- Do you have any comments on the application?
- If you could change something about it, what would it be?
- Do you think the older adults would be more accepting of home modifications/assistive technologies if they could see what they looked like beforehand?
- If not, why?
- Given your history working in aged care, do you feel as though a system like this would benefit older adults? And what about aged care providers?
- How can digital technologies enhance person-centred care in fall prevention?

Figure 10.18 Fall prevention industry participant interview guideline for Study Two B

C.3 Transcript sample

*Can you describe for me in as much detail as possible your history working in fall prevention?*

*I have been an occupational therapist for 36 years, and my work has varied from acute inpatient and community. And even though it is community inpatient, a large percentage of the work is with older people, because they’re the primary users of the health care system. My community care role has been very specifically around domiciliary care and falls prevention which is targeted towards the older population. Now I manage nine programs that deliver rehabilitation or specialist care primarily to older people, but not exclusively to older people. It depends what the person’s needs are—it could be from quite young, right through to very old.*

*Can you elaborate a little bit more on your role in the community?*

*I have worked with the domiciliary care team at Mt Eliza Centre in the early 1980s where I was the occupational therapist for the team. I would receive referrals from doctors, the hospital and patients themselves. I would visit them at home and conduct a comprehensive occupational therapy assessment, and make recommendations dependent on what their needs were, right through to complex home modification, wheelchair prescriptions—those types of things. I then did a stint in patient acute; I then came back to domiciliary care in the early 2000s and I*
also worked in the falls prevention service, doing home-based comprehensive falls prevention assessments and development of recommendations for people to reduce their risk of falls and injury.

**From the 1980s, you would have seen some radical changes in the domiciliary field?**

Oh, yes. One of the things back then was there was no mobile phones or anything. From a clinician perspective, you would get your referrals, get in your car, head off for the day and nobody had the capacity to contact you. We used to have to find telephone boxes to call people up. So, we did a lot of cold calling, because you couldn’t necessarily forecast exactly whom you were seeing during the day. But there was much less option in terms of wheelchairs, home modifications, bedroom equipment and things—it was all pretty basic back then. I also understand that the domiciliary care team now use iPad to do all of their drawings of home modifications and things. We had to use a ruler and a pen, so you know the technology has really helped a lot as well.

**I was going to touch on that, so over time ...**

When I went back to Frankston Hospital in 1990, that was the first time I had ever used a computer, and you had to put discs in and out to do word processing, it was so complex, that basically nobody hardly ever used it. Now, with the mobile technology, you can take it with you; at your fingertips you can look up your books. We used to have to carry a bag full of brochures and things like that, so if we were describing things to a client, we would have to get out the supplier’s brochure and look it up and show it to them. These days you can put everything up on a tablet and actually even do like a simulated thing where people can look and see how it would work in their environment. We had nothing like that. We had filing cards where we wrote our notes on, and the referral.

**With your position at the moment, does this include consideration of innovative methods of providing aged care?**

We are constantly looking for different ways to deliver our services to our clients. In the community rehab program, we are constantly looking at ways to have better transition into the program to offer more comprehensive programs. We have
started to look at robotics, particularly with patients with neurological disorders. I have to say that we don’t have access to iPad for the clinicians, apart from the community nurse who looks after the orthopaedic patients has one, and the in-patient occupational therapist has one, and that comes down to funding. Many of the clinicians would love to have that sort of technology to take with them, but I have to decide where the resources go, and frankly at the moment I have to put that into people rather than technology.
C.4 Analysis process sample

C.4.1 Open coding

---

**Study #02 - Industry Interviews**

**Fall prevention**

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<thead>
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<tr>
<td>BUS</td>
<td>M</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

- Can you please describe for me in some detail the climate surrounding falls and community fall prevention? Assessment drove, and whenever the caseworkers go in and they are doing assessment on potential hazards and areas that could be improved. We work quite well with a number of organizations looking for this type of funding and there can be a lot of help available. For example, if the home is very large, or if there are other household members, it can be a big task. We often see situations where someone is at risk. The community focus is really on visiting those homes where there is a lot of lack of support and where there is a lot of confusion. Sometimes it is much easier to go out and see what is going on rather than to go through a more traditional approach to assess support needs. So there is a whole range of approaches out there, there's a whole range of supports and systems in place to support people, but there is a big task to do that needs to be managed. The lack of support and funding can certainly be an issue that it seems to be. There's a management through rehabilitation and prosthetics for replacement through rehabilitation is certainly there.

- Can you please describe for me in some detail the climate surrounding falls and community fall prevention? Industry interviews? We find falls are something that we are looking at closely as we want people to be able to get to the community. But Victoria doesn’t have that anymore. We think that it’s something that we would bring in the first assessment with somebody. It is what we would advise our priority system. How can we see someone is dependent on their feet and they’re a fall risk, or they fall from that impact on their function? So rather than waiting five months, if they have had a fall and something is critical then we can see them sooner. Also, documenting falls and implementing fall prevention strategies and referring onto different services. So yeah, it’s a high on the priority list.

- Can you please describe for me in some detail the climate surrounding falls and community fall prevention? Industry interviews? Probably older people who become less active, the thing with aging is that you need more exercise to maintain the same muscular strength and so people tend to become more loss and less active, even if they maintain the same actions as when they were younger they still don’t maintain the same muscular strength. That creates significant muscular weakness. This leads to poor balance, which makes people more vulnerable to falling to that on one big issue. In terms of the research, exercise and falls is probably the single most important thing that the evidence shows works in terms of falls prevention. The other thing is nutrition, a lot of older people lose interest in food, have poor appetite and think that they don’t need as much food, but don’t realize that it is important to have the same variety of food as when they are younger, so a lot of people are undernourished. So that is one of the other issues that a big impact on people. I can talk about all of the risk factors. Shoes, vision deterioration, many goals, and a lot of older people have glasses. Glasses can be problematic for people who can assess the community or managing stairs and cuts. Things like that because their depth perception is affected, that is a common that affects people so well.

- Can you please describe for me in some detail the climate surrounding falls and community fall prevention? Industry interviews? It is fluid with changing demands, the aging population, more people are having falls, we now have more clients, we always need more clients. It is a growing area, and Permaclick, we’re thinking about our own business, more retail clients, more aged care. The climate is going to be a growing area, so your research is going to be valuable.

- Can you please describe for me in some detail the climate surrounding falls and community fall prevention? Industry interviews? There is a lot of emphasis on addressing falls. We did a falls prevention study here a few years ago that was aimed at collecting information and looking at how we assess for falls and interventions related to falls. It defines big by big and with the aging population it is becoming more and more important to try and prevent people from falling and to allow them to remain safe within their own home. So it is a huge task.

- Can you please describe for me in some detail the climate surrounding home retrofitting for fall prevention? Industry interviews? It’s extremely busy at this moment. There are a number of builders who will tackle projects on an hourly basis. In 2023 we are still seeing a similar amount of projects, so the population aging increases more and more and need it. It is an area that can be cleared out because there are a lot of consistent issues. It is a fairly narrow and small area, but there are a lot of builders who want to get into this area, because in less than 5 years you can do a bathroom. In these less than 2 years they can put a roof on a house. They are looking at ways to reduce their costs, our builders are bringing in products that are getting the price down. It is the field is sick. It is a very much old school, the building industry is still stuck in it. I think I just put purely because of the industry that they don’t see to have the same thing, and they are not necessarily look for any easier way to do it, because they’re looking for cheaper ways, always. Having said that, they are now starting to bring in software packages to assist with estimating.

- Can you please describe for me in some detail the climate surrounding falls and community fall prevention? Industry interviews? Falls prevention really relates to every health service and every discipline. It’s really team work and people taking it from a different angle though, from a hospital you are looking at people who might have memory issues or be affected by medication and not have falls in that setting, whereas we are trying to keep people active and put home minds and things like that in place to prevent falls proactively. I think it is a little bit segmented in that way, people coming in through the Anglia into here, we would like to be able to streamline the process and get it much quicker, so we are rehabilitating and preventing.

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FIGURE 10.19 Open coding of the industry interviews in Microsoft Excel; the ‘fall prevention’ theme is depicted.
C.4.2 Axial coding

Figure 10.20 Axial coding of the industry interviews in Annotations

048 - The role was essentially two parts. One half was internally focused around efficiencies and developing systems and trying to do things better within the organisation. The other half was externally focused, dealing with community, government and other organisations in the sector, as well as other businesses and trying to develop collaborations and partnerships that would benefit the organisation, the people that we support and the sector generally. So there were those two roles.

A lot of it was around looking to programs or projects that could be advanced to provide innovation or development opportunities across the services provided.

So a big part of was that focus on innovative project and opportunities?

154 - Yes.

What kind of projects would typically be classified as innovative?

159 - They could be something looking at processes, so for example, looking at the application of lean processes to operations – looking at how each of the different areas within the organisation could work more collaboratively together to achieve better outcomes. Research projects, with educational institutions, working with local government and other local organisation to pool in resources to achieve common goals. An example of that would be around reconciliation action plans and how as an employer in a particular area we can work with other stakeholders to help promote and advance those sorts of projects.

How are those changes implemented?

307 - The initial processes of meet and greet, talking through a proposal or an idea – brainstorming. And then getting the buy-in from each of the relevant stakeholders as to an over arching vision or concept, and then working through a task force or a working group that would work to document the process to find objectives and put in place the steps that needed to happen to work those things through. Working through resourcing who was going to do what when,
Appendix D. Study Three: Interviews with older adults

D.1 Interview guideline (Stage A)

Guideline for interviews with older adults living in their own homes.

- Please tell me a little bit about yourself.
- What are your interests? What do you enjoy doing?
- What makes you proud?
- Tell me about your daily routines and what makes a good day for you.
- Could you please describe for me an average day?
- What do you enjoy doing? Hobbies?
- What do you want in life?
- Is there anything that is not working well, and what needs to happen to change?
- What helps you the most?
- Can you please tell me a little bit about your home?
- How long have you lived here?
- What do you like about it? What don’t you like about it?
- Would you change anything?
- What do you like doing at home? Whereabouts?
- Do you have difficulties managing any areas of your home?
- Do you feel safe in your home?
- What made you contact the fall prevention service?
  - Have you had a fall at home? If so, where and why?
- Do you feel as though your goals have/are being met?
- Do you use any assistive equipment?
- Have any modifications been made to your home to help you manage the environment?
- Please describe for me the modifications/equipment in your home.
  - How do you feel about these?
  - Do you use them often?
  - Did you ask for any of these modifications? Or were they recommended?
  - How much choice did you have in the design on the modification?
  - Did you understand what it was going to look like once it was finished?
  - How do you feel about the design of home modifications?
  - How do the modifications address your goals?
- Would you feel comfortable with ramps/rails being installed in your home?

Figure 10.21 Older adult participant interview guideline for Study Three A
D.2 Interview guideline (Stage B)

Interview guideline for the evaluation of the Augmented Reality Environmental Visualisation Prototype (AREVT) among older adults.

- Do you have any comments on the application?
- If you could change something about it, what would it be?
- Would you feel more accepting of home modifications if you could see what they looked like in your home beforehand?
- If not, why?

Figure 10.22 Older adult participant interview guideline for Study Three B

D.3 Transcript sample

*Can you please tell me just a little bit about yourself?*

Oh well, I am 88 years old.

*What are your interests? What do you like doing and your hobbies?*

Oh, bird carvings, ships and clocks.

*I see lots of these carvings around your house; can you tell me a little bit more about them?*

Well, the birds, I started to do them when they started to disappear, to keep a record of what used to be in this place before the suburban barbarians moved in. It just grew from that. I didn’t know anything about carving, but it was a matter of trails of trial and error, but over the last 20 years, I think I have done about 75 or so birds. I was a watchmaker; I still dabble with a few clock repairs, because we had a shop—a jewellery shop—and it is still running. My son and daughter have taken that over and they bring me clocks to repair; it keeps you occupied.

*So how long have you lived in the area?*

I retired about—nearly 20 years go, and it was originally a weekend place. We have the business and we didn’t get any holidays, and we bought this old fibro shack; I can’t remember how long ago it was—maybe 60 years I suppose. Because of the business we couldn’t take holidays, and we didn’t want to travel too far, and
this was a nice distance from Moorabbin to here, and we have the beach and it was a lot of scrub; it has changed now of course. So, when I retired, I moved in.

*I love all of these little clocks and birds, and all of the little ticking that goes on in your house. Do you take pride in these particular things? Is that why they are all on display?*

No, I just like doing it, you know. You try different things. Like those two black dial clocks over there, they’re made from the lids of tobacco tins and old watch dials. They’re spray painted black, and then when it is dry you stick the old dials on and then cover them with this liquid plastic finish. So, it is quite effective.

*Tell me about your daily routines, and what makes a good day for you here?*

I get up around about 8 o’clock, have breakfast and all of that stuff, and then I go out to the workshop and fiddle around with whatever I am doing at the time.

*What sorts of things do you do in the workshop?*

Clock repairs, carvings, a bit of pyrography—it’s burning—I have made up a little gadget. On birds you can carve up the fine details, so you burn it in. This little tool I have made, it doesn’t rough up the wood—it just leaves a mark on it.
D.4.1 Open coding

Figure 10.23 Open coding of the older adult interviews in Microsoft Excel: the AREVT feedback is depicted.
D.4.2 Axial coding

Figure 10.24 Axial coding of the older adult interviews in Annotations

workshop and fiddle around with whatever I am doing at the time.

What sorts of things do you do in the workshop?

2:15 – Clock repairs, carvings, a bit of pyrography – it’s burning. I have made up a little gadget, on birds you can carve up the fine details, so you burn it in, this little tool have made, it doesn’t rough up the wood, it just leaves mark on it.

Do you paint them yourself?

5:49 – Oh yeah, that is something else that you have to learn, it is acrylic paint.

How is the bird carving going? Do you still do lots of it?

6:12 – I have got about 75 different species, when I was fitter I used to go to service clubs and other places to display the birds and talk about them, but I don’t do that anymore, my old car is broken down and I am broken down. I can’t transport them, although I did have a display at the Mornington library six months or so ago with the bird group from Mt Martha, BRG they’re called. They has a book that they published, and I went in and displayed, I have a video of it somewhere, this was in the library at Mornington.

Can you please describe me just an average day for you? What would you do?

7:43 – I would have breakfast, go out into the workshop and fiddle around, do a bit of reading, watch the television. What do you enjoy reading? Factual stuff, I have got a good book there. The Dog Fence, to keep the dingos out of the grazing land they put up this fence that goes for hundreds of miles, it wasn’t very effective. The dingo is a problem, they tried to keep their numbers down and catch the things.

What are your hobbies?

8:56 – Oh, the bird carving that is the main thing.

What do you want in life?

9:17 – Oh I have had enough of this life. At 88 you have got no future, and you have aches and pains, you’re unstable I have got to use this walking thing. You have troubles falling down and