

PROFESSIONAL SERVICES



**Housing for people with disability:
evidence review of post-occupancy
evaluation instruments**



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Professional Services has worked extensively for a range of state and territory governments and non-government agencies. Professional Services outputs have included reports, annotated bibliographies, brief papers, publications, dissemination events and facilitated research engagement workshops. Examples of previous research and reports are on our website <http://www.ahuri.edu.au>.

Summer Foundation

The Summer Foundation is an Australian not-for-profit organisation. The Summer Foundation aims to lead change in human services policy and practice related to young people in residential aged care. More than 6,200 younger Australians currently live in residential aged care; these young people lead marginalised and isolated lives.

The Summer Foundation designs and pilots system solutions, and evaluates these solutions through action research. Research and the perspectives of young people with disability in residential aged care, along with their families, are central to the design of prototype solutions.

Since the introduction of the National Disability Insurance Scheme (NDIS), the Summer Foundation is focussing on what needs to be done in parallel with the NDIS to achieve a full, systemic resolution to the issue of younger people in residential aged care. The Summer Foundation's current strategic priorities are: to stimulate an increase in the quantity and diversity of affordable, accessible housing; to ensure that younger people with complex support needs are being appropriately connected to the NDIS and finding their way into suitable housing; and to work with the health sector to develop appropriate pathways from hospital back into the community for younger people with complex support needs. For more information on the Summer Foundation and its work, see the Summer Foundation website <https://www.summerfoundation.org.au/>.

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Acronyms and abbreviations used in this report

ADL	Activities of Daily Living
AHURI	Australian Housing and Urban Research Institute
BOSSA	Building Occupants Survey System Australia
C-CAP	Client-Clinician Assessment Protocol
CEHL	Common Equity Housing Limited
DOHM	Dimensions of Home Measure
DQI	Design Quality Indicators
ECH	Extra-Care Housing
EQUAL	Environmental Quality Assessment for Living
EVOLVE	Evaluation of Older People's Living Environments
HACC	Housing and Community Care
HoPE	Home Assessment of the Person-Environment Interaction
HPW	Queensland Department of Housing and Public Works
HQI	Housing Quality Indicator
HRQoL	Health-Related Quality of Life
IADL	Instrumental Activities of Daily Living
ISL	Independent Supported Living
LHDG	Livable Housing Design Guidelines
LHS	Lifetime Homes Standard
MOHO	Model of Human Occupation
MSQoL	Multiple Sclerosis Quality of Life
NDIA	National Disability Insurance Agency
NDIS	National Disability Insurance Scheme
OLS	Overall Liking Score
PADL	Personal Activities of Daily Living
PIADS	Psychosocial Impact of Assistive Device Scale
POE	Post-Occupancy Evaluation
QoL	Quality of Life
QUT	Queensland University of Technology

REIS	Residential Environment Impact Scale/Survey
RIPL	Residential Independence Pty Ltd
SDA	Specialist Disability Accommodation
SEIQoL-DW	Schedule for Evaluation of Individual Quality of Life—Direct Weighting
SF	Summer Foundation
TAC	Transport Accident Commission
UIMH	Usability In My Home
UK	United Kingdom
US	United States of America
WA	Western Australia

Executive summary

AHURI has worked in collaboration with the Summer Foundation to review and analyse the evidence on post-occupancy evaluation (POE) instruments suited to assessing dwellings for people with disability who require high levels of physical support.

Study aim

The evidence review aims to inform development of a rigorous framework for the POE of dwellings for people with disability who require high levels of physical support with a view to enabling providers to continually evaluate and improve the design and suitability of their housing.

POE definition

POE is defined as the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time. Advancing the design of future housing is generally the impetus for POE, with clients, designers, builders, facilities managers, and other built environment professionals benefiting from the knowledge mined in the POE process.

Research approach

This research focused on diagnostic POEs that examine the objective and subjective interaction between the environment and the occupant.

The research initially identified 172 POE studies, 55 of which were selected for analysis, based on their relevance and the rigour of the study. Ten POE instruments were chosen for in-depth analysis based on their currency, relevance and whether the instrument was available to be reviewed (as opposed to descriptive studies about the tool), and whether the tool had been evaluated.

The research reviewed POE instruments in relation to five criteria (domains of interest), which are consistent with the Summer Foundation's aspirational vision for its apartment projects:

- capacity to enable social inclusion
- capacity to facilitate physical independence
- a home-like environment
- high amenity
- affordability.

The research also considered the overall cost-effectiveness and livability of housing designed for people with disability with high physical support needs.

In addition, the report identifies national and international researchers and leaders in POE of housing for people with a disability.

Two principal factors were used to determine an instrument's applicability:

- the instrument's suitability to the environmental context (focus on built environment and person interaction, entire home design rather than home modifications, applicability to a range of disability types, alignment with domains of interest)

- the demonstrated quality of the instrument in peer-reviewed studies (reliability, validity, conciseness, sensitivity, clinical utility).

Appendix 1 provides a summary of POE instruments against evaluation criteria.

Key findings

Very few POE studies specifically address housing for people with a disability; most of the literature focuses on POE of housing adaptations and home modifications for the elderly and older disabled people. Younger people with a disability have been infrequent participants in these studies.

Each instrument is designed for specific housing contexts (e.g. nursing homes, shared accommodation, home adaptations/modifications) or is intended to inform housing design. Instruments designed for individual homes are more readily applicable to the review context, but instruments that focus on shared homes also contain relevant elements.

No single POE instrument addresses all of the Summer Foundation's aspirational housing performance domains for people with disability who have high physical support needs. Some instruments targeting home adaptations (Housing Enabler, A Way to Stay) are more likely to address the physical independence and high amenity domains, while other instruments also focusing on home adaptations (REIS and DOHM) focus on the social inclusion and home-like environment domains.

Instruments designed for individual homes are more readily applicable to housing for people with disability with high physical support needs, than instruments that focus on shared homes.

POE instruments suited to evaluating homes for people with a disability focus on different demographics.

- The majority focus on **housing for elderly people**; these include UIMH, DOHM and EVOLVE (designed for use in shared accommodation for older people).
- Others focus on **people with a disability** (e.g. A Way to Stay, HoPE, C-CAP) or are adapted for this cohort (REIS).
- The HQI instrument **can be applied to any housing demographic**.

POE tools are designed for different contexts and purposes, including

- **nursing homes and shared accommodation** (EVOLVE, C-CAP, REIS)
- **home adaptations/modifications** (Housing Enabler, UIMH, A Way to Stay, HoPE, DOHM, REIS short form)
- **housing design** (HQI).

Instruments delivering a technical evaluation of home feature presence and performance (HQI, EVOLVE) typically only indirectly relate to most of the domains of interest. This is because a first hand account or observation of individual experience of the home is necessary to sufficiently evaluate a resident's relationship to the built environment.

POE instruments demonstrate varying degrees of reliability, validity and internal consistency. Some have been shown to be reliable and valid (UIMH, Housing Enabler, HoPE), while others have been criticised for a lack of internal scale validity (C-CAP), or

questions have been raised about the instrument's validity and reliability in certain contexts (REIS).

Only one POE instrument identified for this report is applicable to assessing housing intervention **cost-effectiveness**. Australian researchers have used the HRQoL measure to determine health related quality of life improvements following home modifications for older people, including people with a disability. QoL/HRQoL can be used to derive a cost-utility ratio when analysed in conjunction with housing intervention costs. However, this method applies more readily to cost-effectiveness evaluations of an *entire* home intervention, and determining the cost-effectiveness of *individual* home features using the QoL/HRQoL approaches is more challenging.

POE instruments demonstrate **varying degrees of reliability, validity and internal consistency**.

- A number of studies have shown the UIMH instrument to be reliable and valid.
- The HoPE instrument has a high content validity, test-retest reliability and inter-rater reliability.
- The Housing Enabler instrument has displayed sufficient reliability and validity in the Nordic practice and research context.
- Some studies utilising C-CAP have demonstrated a lack of internal scale validity.
- The REIS instrument has demonstrated reliability and validity, but researchers have raised concerns about its reliability and validity in certain contexts.
- The current version of the DOHM demonstrates preliminary evidence of construct validity, however 'ongoing investigation of the unidimensionality, targeting and appropriateness of the rating scales following revision of the DOHM will be required' (Aplin et al. 2016: 54).

The UIMH and HoPE instruments show promising applicability to dwellings designed for people with disability with high physical support needs. The first English language version of the HoPE instrument is currently in development, while a psychometrically tested update of the UIMH instrument could become available in English in the near future.

The POE instruments investigated in this report vary considerably in their coverage of domains of interest.

- Instruments targeting home adaptations (Housing Enabler, A Way to Stay) are more likely to meet the **physical independence** and **high amenity** domains of interest, while only the REIS and DOHM instruments dedicate a significant focus to the **social inclusion** and **home-like environment** domains.
- Table 1 provides a broad indication of instruments' capacity to meet the domains of interest. Table 1 should be interpreted in conjunction with the detailed observations on the POE instruments in Section 2.

Table 1: Domains of interest

	Social inclusion	Physical independence	Home-like environment	High amenity	Affordability
REIS	✓	✓	✓	✓	✗
UIMH	na	na	na	na	na
Housing Enabler	✗	✓	✗	✗	✗
A Way to Stay	✓	✓	✓	✓	✗
QoL	na	na	na	na	✓
C-CAP	✓	✓	✓	✓	✗
HoPE	na	na	na	na	na
DOHM	✓	✗	✓	✓	✗
EVOLVE	✓	✓	✓	✓	✗
HQI	✓	✓	✗	✓	✗

Source: Authors.

Recommendations

It is clear from the review of the evidence that no single POE tool is suited to the POE of dwellings for people with disability who have high physical support needs, and aligns with the Summer Foundation’s aspirational housing performance domains. Consequently, it will be necessary to use a combination of existing POEs or their components, or to develop a new bespoke POE instrument.

The following recommendations set out key principles for the development of a framework for the POE of dwellings for people with disability who have high physical support needs.

- 1 The POE framework should combine technical evaluation of the performance or presence of home features with users’ subjective experience of the home.

Many of the POE instruments reviewed provide either a technical evaluation of the performance or presence of home features (HQI, EVOLVE) or an account of the subjective experience of the home from the resident (C-CAP, DOHM), while some include varied combinations of both (A Way to Stay, REIS, Housing Enabler) or include observation (A Way to Stay, REIS, HoPE, C-CAP). This review recommends adopting an approach that uses both methods in conjunction to better target home performance and home requirements. This would enable cross-referencing of identified issues in the home between the objective evaluation of home feature technical performance and subjective resident account of interaction with home features.

- 2 The framework should ensure that POE instrument(s) are intelligible and suitable to users and are applicable to people with a range of disabilities.

Care should be taken to avoid POE instruments that use abstract questions, long questionnaires or physically arduous and lengthy daily task performance observations. Instruments that rely on these features should not be used, unless they

can be replaced by alternative methods without compromising the instrument's reliability and validity.

- 3 As no existing instrument sufficiently meets all of the Summer Foundation's domains of interest, the framework should use a hybrid approach incorporating the most relevant elements of existing instruments.

POE instruments vary considerably in their coverage of domains of interest. This is summarised in Table 1. Note that Table 1 should only be interpreted in conjunction with the detailed observations on the POE instruments in section 2.

- 4 The framework should consider using QoL/HRQoL scores in conjunction with housing intervention costs to derive a cost-utility ratio.

A QoL/HRQoL outcome-based approach to home evaluation for the purposes of providing a quantitative input to cost-effectiveness evaluation appears to have merit. QoL/HRQoL scores can be analysed in conjunction with housing intervention costs to derive a cost-utility ratio. This method applies more readily to cost-effectiveness evaluations of an *entire* home intervention, and determining the cost-effectiveness of *individual* home features using the QoL/HRQoL is more challenging. Nonetheless, QoL/HRQoL is the only POE instrument identified that offers possible integration with housing intervention cost-effectiveness.

- 5 The framework should adopt an iterative approach to evaluation of apartments with key stakeholders and tenants.

Very few POE instruments have been evaluated by independent sources for reliability and validity. Also, instrument reliability and validity has not necessarily been tested in the context of housing for people with a disability, with elderly people typically the subjects in POE studies. Thus, it is important to consider the differences in capabilities of these groups and the degree to which this might compromise the efficacy of a POE instrument.

Consequently, it is recommended that the framework should adopt an iterative approach, which involves a trial POE with opportunity for feedback from tenants and people administering the instrument, or extensive pre-POE consultation and feedback. This will provide an opportunity for tenants and those administering the instrument to identify issues before significant resources are committed.

Section 1: Background

1 Introduction

AHURI and the Summer Foundation (SF) have collaborated to review and analyse the available evidence on post-occupancy evaluation (POE). The aim of the evidence review is to inform a rigorous framework to evaluate the built design of housing projects for people with disability who have high physical support needs. In addition, the evidence review identifies the national and international researchers and leaders in POE of housing for people with a disability. An environmental scan was undertaken to ensure currency of the research.

1.1 Objectives

The evidence review aims to inform the development of a POE framework for dwellings for people with disability with high physical support needs.

The framework is intended to be used to continually evaluate and improve the design of housing projects for people with a disability. Consistent with the Summer Foundation's aspirational vision for its apartment projects, it is intended that the framework will evaluate housing in relation to the following domains:

- **social inclusion:** location, mix, opportunity for interaction
- **physical independence:** safety, accessibility, flexible use, understandable, low effort, customisable, encouraging skill development
- **home-like environment:** privacy, dignity, non-institutional aesthetic, personalisation, capacity for real-life opportunities
- **high amenity:** outlook and connection with the outdoors, environmental comfort, sufficient storage
- **affordability:** cost efficient specialisation, customisation and maintenance; smart investment.

Cost-effectiveness and livability are also considered.

1.2 Research questions

The evidence review addresses the following research questions:

- 1 What instruments have been applied to the POE of housing for people with a disability?
- 2 What instruments are most suitable for evaluation of housing designed for people with disability with high physical support needs?
- 3 Who are the leading researchers and practitioners involved in the area of POE and housing for people with a disability, locally and internationally?

1.3 Summer Foundation Demonstration Projects

The Summer Foundation (SF) builds housing demonstration projects, with apartments designed for people with a disability dotted throughout larger residential developments. Disability support is provided on site with 24-hour on-call support. SF established their first housing demonstration project in 2012, in collaboration with the Transport Accident Commission (TAC) and Common Equity Housing Limited (CEHL). The inner Melbourne housing project has six fully accessible self-contained one bedroom apartments integrated into a 59-unit mixed private and social housing development. A disability support provider was chosen through a select tender process to provide disability supports to both TAC claimants and tenants in housing designed for people with disability with high physical support needs. CEHL manages the SF tenancies and the properties.

The National Disability Insurance Agency (NDIA) has released a *Specialist Disability Accommodation (SDA) Decision Paper on Pricing and Payments*. The policy is designed to increase the long term supply of housing for National Disability Insurance Scheme (NDIS) participants and foster the development of innovative housing solutions. For 28,000 NDIS participants with the highest levels of disability, this housing payment will bridge the gap between what people with disability can reasonably afford and the cost of building highly accessible housing. After decades of under-investment, governments have now made the funding available to replicate and scale a range of innovative housing and support options, such as housing designed for people with disability with high physical support needs. This policy lays the foundation to develop the range and scale of housing needed to resolve the issue of young people with a disability living in nursing homes.

JBWere completed initial financial modelling using the costs of the SF housing demonstration projects and the pricing and assumptions outlined in the NDIA SDA Decision Paper. This modelling shows that the NDIS SDA payment stream is sufficient to finance the replication and scale of the SF's integrated model of housing and support.

The SF has a strategic interest in financing the replication and scaling of housing projects in major cities across Australia through an investment model that provides a market return, as well as a measureable social impact. In 2017, the SF established a sister organisation called Summer Housing to replicate and scale these housing projects. Evaluation of these housing projects is critical to the iterative process of learning and continuously improving the design and efficacy of this model of housing and support. The SF is collaborating with a range of partners to develop an outcomes framework which will complement rather than duplicate the data routinely collected through the NDIS Outcomes Framework, and focus on:

- tenant outcomes
- support evaluation
- POE of built design
- evaluation of smart home and communications technology.

The POE of built design framework will:

- evaluate the impact of the built design on tenant outcomes, independence and cost of paid supports
- evaluate the cost and utility of specific adaptable features incorporated into housing built for people with severe disabilities
- document tenant, family and support worker experiences of the built design

- evaluate whether the dwelling is home-like
- foster continuous improvement in the function and design of housing built for people with severe disabilities.

2 Methodology

The methodology comprised an evidence review using a research synthesis methodology and an environmental scan.

2.1 Research synthesis

Research synthesis is a proven methodology for cost-effective and timely use of existing research findings for a specific policy concern. It facilitates evidence-informed policy and practice development and typically involves:

- the search for primary studies
- quality appraisal and data extraction
- synthesis of findings and knowledge transfer.

The research synthesis methodology is based on Ray Pawson's 'realist synthesis' approach (Pawson 2006), developed to help identify which social policy interventions work for whom and in what circumstances. It is concerned with identifying the mechanisms and contextual conditions that facilitate a particular outcome of a social policy intervention.

Our research synthesis used the following methodology:

- Search terms derived from the research questions were used to iteratively search the national and international research and grey literature in order to identify relevant studies published since 2006, including:
 - academic journal databases in the disability, design, occupational therapy and related social science fields
 - general internet searching of online policy communities and information clearinghouses (including government departments)
 - follow up of bibliographic references in found studies.

Research conducted prior to 2006 was only considered on the basis that it was a seminal source or provided necessary background.

- A bibliography was prepared and analysed for overall themes, scope and quality of the evidence base. This included:
 - review of abstracts and executive summaries for an initial assessment of relevance to the research question and quality
 - where abstracts and executive summaries provided insufficient information to decide on inclusion or exclusion in the review, the full publication was reviewed
 - on the basis of this information, a list of publications for inclusion in the research synthesis was prepared.
- The selected studies were assessed for quality, research rigour and relevance to the research question. Studies were also chosen to attain geographic diversity in the literature, and include local and international perspectives.
- Data was extracted to construct a synthesis of the evidence, including detailed findings and overall conclusions.
- Studies most relevant to the research questions focussed on the following themes:

- measurement tools for POE
 - POE methodology
 - cost effectiveness of POE methods.
- A total of 172 studies were selected initially based on the search criteria.
 - A final cut of 55 studies were then included for analysis in this report.
 - Ten POE tools were selected for in-depth review in relation to the framework criteria
 - The search criteria comprised the following initial key search terms: post-occupancy evaluation (POE), disability housing design, dwelling for disabled, design framework, disability, NDIS, housing modifications, tenant outcomes, independence, adaptable housing features, bespoke housing, purpose-built, disabled tenants, inclusive design, universal design, universal design evaluation, accessible design, building performance design, accessibility, user participation, designed environment, rehabilitation, equitable use, flexibility in use, assistive technologies, visitable housing, evaluating disability housing, housing adaptation evaluation, universal design evaluation, inclusive design evaluation, visitable design evaluation, design for all evaluation, supported accommodation, integrated apartment living, assessing building performance, home modifications outcomes, building performance evaluation, post-occupancy evaluation tools.
 - A range of POE instruments were identified following analysis of relevant literature uncovered during the initial search. These instruments were then used as search criteria to identify any further relevant literature. The following POE instruments were used as search criteria: Residential Environment Impact Survey, Usability In My Home (UIMH), Housing Enabler, A Way to Stay, Quality of Life (QoL), Health-Related Quality of Life (HRQoL), Client-Clinician Assessment Protocol (C-CAP), Home assessment of the Person-Environment interaction (HoPE), Dimensions of Home Measure (DOHM), EVOLVE, Housing Quality Indicator (HQI), Building Occupants Survey System Australia (BOSSA), MultiMap, ADL staircase, EQUAL.

2.2 Environmental scan

This research includes an environmental scan of POE research, practice, measures and frameworks. Environmental scanning is particularly useful in compiling information on emerging evidence and current research and practice.

The scan examined published and grey literature and online information internationally to develop an understanding of the current state of evidence surrounding POE of housing for people with a disability.

Researchers and current relevant works in progress were identified by the environmental scan, which included:

- a scan of current activities of published authors and their institutions
- a scan of national research and practice networks
- a scan of international partners and key centres.

The scan considered international and Australian information, drawing on a combination of systematic and snowball sampling methods, including:

- targeting the authors of published and grey literature and their organisational affiliations to examine current activities

- scanning Australian research organisations with or without AHURI affiliations, drawing on AHURI's extensive knowledge of housing research networks and practitioners in Australia to identify any current activity relevant to a POE framework
- leveraging AHURI's network of international partners to undertake scans of key international research concentrations and practice leaders.

The environmental scan highlighted 13 current or recently completed relevant studies and 9 relevant researchers for possible collaboration. These projects and researchers are described in Appendix 2.

2.3 Scope and quality of the evidence base

Few research papers apply POE of housing for people with a disability. A breadth of literature on POE methods and instruments exists, particularly in relation to commercial and residential buildings. Additionally, there is substantial research on the design of products, public space and buildings for people with a disability. However, the extent of published studies documenting the application of a POE instrument to housing for people with a disability is primarily limited to studies validating POE instruments. The majority of the POE validation studies have focused on housing adaptations for older people.

3 Background

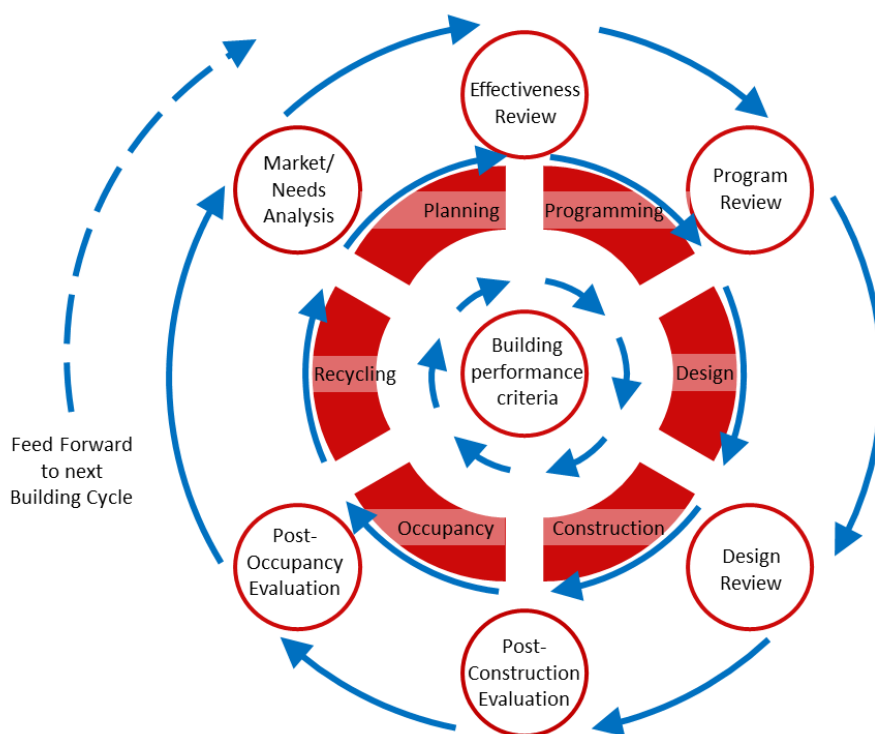
POE is defined as the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time (Preiser, Rabinowitz et al. 2015). Advancing the design of future housing is generally the impetus for POE, with clients, designers, builders, facilities managers, and other built environment professionals benefiting from the knowledge mined in the POE process (Sanni-Anibire, Hassanain et al. 2016).

3.1 POE—background, evolution, context

The term POE was first applied in the evaluation of US military facilities in the 1970s, though the practice existed prior to this with the Royal Institute of British Architects having included a ‘Stage M (feedback)’ phase in its ‘plan of work for design team operation’ (Preiser and Vischer 2005). In the US, the Environmental Design Research Association helped establish and sustain POE practice with a focus on feedback relating to psychological rather than physical aspects of user experience.

While POE was used in the evaluation of government offices and facilities in the US, Europe and New Zealand in the 1980s, the practice remained underutilised. Following a US federal committee, a database and clearinghouse of POE findings was established with the intention of re-acquiring lost in-house knowledge about buildings and encouraging its wider use in the industry (Preiser and Vischer 2005; Vischer 2001). The UK Government implemented a similar mission in 1994 (Preiser and Vischer 2005).

Figure 1: Building performance evaluation: integrative framework for building delivery and design



Source: Vischer 2001.

POE forms part of an ideal cyclical process in the life of existing buildings and building delivery. The relationship between POE and its context in the life of buildings is described in the integrative framework for building performance evaluation, which incorporates the POE process, and includes five phases—planning, programming, design, construction, occupancy, recycling (Vischer 2001).

The benefits of POE are centred on an enhanced industry capacity to improve the delivery of buildings in relation to their economic cost, environmental performance, and user interface (Sanni-Anibire, Hassanain et al. 2016; Vischer 2001). The improvement in user interface possible through POE has significant implications for people with higher and diverse sensory capabilities and needs.

Despite the many benefits, there remain several barriers to POE implementation, including:

- ambiguities regarding who should be responsible for the cost of POE
- the existence of a diverse array of POE methods, which makes it difficult to compare results and benchmark performance
- the disruption of a POE study if negative results are anticipated by managers (Sanni-Anibire, Hassanain et al. 2016; Vischer 2001).

3.2 Housing standards

Housing standards vary considerably in scope and level of enforcement across different countries. This section outlines three housing standards—in Australia, the UK, and Sweden.

3.2.1 Livable Housing Design Guidelines (Australia)

The Livable Housing Design Guidelines (Guidelines) provide aspirational targets for housing design in Australia. The Guidelines are the result of collaboration by Livable Housing Australia with all levels of government, the disability, aged, community, building and construction sectors, and were launched in 2010 and revised in 2012 and 2017. The principal aim of the Guidelines is to achieve the silver performance level for all new homes by 2020, and gold and platinum levels where applicable (Livable Housing Australia 2012: 13).

The silver performance level comprises seven core livable housing design elements. Silver level elements are intended to be of ‘widespread benefit’ while not necessarily accommodating the needs and abilities of all home occupants. Greater ease and flexibility in future home adaptations will be possible for silver performance level homes, with key structural and spatial elements incorporated in the Guidelines. The gold performance level introduces additional elements in the kitchen and bedroom areas, while the platinum level includes all 16 elements, more generous dimensions, and additions to living room and floor features (Livable Housing Australia 2012).

Certification under the Guidelines’ platinum level requires adherence to the following 16 elements: dwelling access, dwelling entrance, car parking, internal door and corridors, toilet, shower, reinforcement of bathroom and toilet walls, internal stairways, kitchen space, laundry space, ground (or entry level) bedroom space, switches and power points, door and tap hardware, family/living room space, window sills, flooring (Livable Housing Australia 2012).

The Guidelines are currently non-binding to the housing design and construction industries and function as aspirational targets rather than mandatory compliance standards.

3.2.2 Lifetime Homes Standard (UK)

In the UK, housing design is guided by the Lifetime Homes Standard (LHS), which was last revised in 2010. In most jurisdictions, housing must comply with the Standard only insofar as it aspires to level six of the voluntary code for sustainable homes (Lifetime Homes 2010).

The Lifetime Homes standard requires adherence to 16 elements: parking, approach to dwelling from parking, approach to all entrances, entrances, communal stairs and lifts, internal doorways and hallways, circulation space, entrance level living space, potential for entrance level bed-space, entrance level toilet and shower drainage, toilet and bathroom walls, stairs and potential through-floor lift in dwellings, potential for fitting of hoists and bedroom/bathroom relationship, bathrooms, glazing and window handle heights, location of service controls (Lifetime Homes 2010).

Both the Australian and UK housing standards largely adopt a voluntary approach on accessible design and rely on perceived marketing benefits and possible consumer pressure associated with industry compliance.

3.2.3 Boverket's Building Regulations (Sweden)

The National Board of Housing, Building and Planning (Boverket) Building Regulations are a mandatory set of standards for housing design in Sweden. The Regulations contain prescriptive design requirements relating to accessibility, dwelling design and room height, in addition to other environmental elements including ventilation, cooling, heating, lighting etc. However, the Regulations are not as aspirational as Australia's Livable Housing Design Guidelines. Currently, accessibility to single-family houses in Sweden is satisfied if it is 'possible to subsequently arrange a ramp to the entrance on the site using simple measures' (National Board of Housing Building and Planning 2011: 19).

3.3 NDIS

The most significant national reform affecting housing for people with a disability is the National Disability Insurance Scheme (NDIS), which will be gradually implemented by 2019 (Wiesel, Laragy et al. 2015).

Under the NDIS, individualised funding will be allocated to better suit the diverse needs of people with a disability, and allow recipients to exert greater control over the use of their entitlements. The NDIS is largely geared to improve service and support accessibility, with housing only a minor component available to a select few eligible recipients. However, a consequence of the scheme will be increased demand for affordable and accessible housing, with NDIS estimates indicating an unmet affordable housing need for 80,000 to 120,000 NDIS recipients.

It is likely that accessible housing design needs will similarly increase under the NDIS, as an increasing proportion of people with a disability begin to live more independently (Wiesel, Laragy et al. 2015).

3.4 Housing and people with a disability

People with a disability have historically experienced poor housing outcomes. While deinstitutionalisation has occurred in Australia since the 1980s, close to 4,000 people with a disability remain living in institutions (Wiesel, Laragy et al. 2015). Institutionalised living is often characterised by unsuitable living conditions, including overcrowding, disease, neglect and the subjugation of resident freedoms and independence (Wiesel, Laragy et al. 2015).

Alternative models of housing for people with a disability have led to improved community participation and living conditions; with the group home or shared supported accommodation the most pervasive housing model. The group home model is criticised for the limited self-determination offered to residents in regard to their living location and with whom they live (Wiesel, Laragy et al. 2015).

The living arrangements of people with a disability differ radically to the rest of the population, particularly for those over the age of 25, including a disproportionate number living with parents (Wiesel, Laragy et al. 2015). Additionally, many young people with a disability are living in nursing homes due to a lack of suitable housing. It is anticipated that the gap in housing outcomes between people with a disability and the rest of the population will gradually improve as the NDIS is implemented.

4 Definitions

4.1 Universal Design

Universal design advocates that design should enable equitable use of public and private buildings, urban spaces and products. The design needs of people vary considerably according to cultural background, physical and cognitive abilities, and universal design is an attempt to accommodate this diversity in the designed environment. Universal design began in 1963 as an effort to provide guidance on accessibility for wheelchair users in buildings by Ron Mace in *Designing for the Disabled*. A number of university research centres with a focus on universal design were established during the 1970s and 1980s (Clarkson and Coleman 2015).

Critics question whether it is possible to design a universally responsive environment, with some preferring a pluralist design approach that incorporates the diverse ways in which people interact with the designed environment (Imrie and Luck 2014).

Variations of universal design include supportive design and inclusive design. Supportive design proposes that designed environments can facilitate rehabilitation by including calming and restorative design features and reducing stressful features (Wright et al. 2017). Inclusive design sets out to provide inclusive spaces by quantitatively measuring the degree of design exclusion in buildings and spaces (Clarkson and Coleman 2015).

Many supporters of universal design advocate this evaluative and consultative approach and consider the relationship between designers and users, as well as a movement away from hierarchical design models, integral to the success of universal design outcomes (Imrie and Luck 2014). POE and building performance assessments are increasingly utilised in universal design evaluation (Preiser and Vischer 2005).

4.2 Visitable design

Visitable design refers to a methodology of home design, which allows 'visitability' to people of all physical capabilities, specifically to accommodate and enable participation of people with accessibility requirements (Ward and Franz 2015: 32). The design performance levels outlined in the Livable Housing Design Guidelines are an example of the implementation of visitable design in practice.

5 POE methods and tools

POEs vary in size, scope and subject and are influenced by a range of factors, including resource availability, time constraints and the overall purpose of the evaluation. POEs have three broad levels of scope (Preiser 1988):

- **Indicative** POEs are brief studies that broadly assess a building's performance. The general strengths and weaknesses of a building are usually determined in selected interviews and a walk through of the facility. Indicative POEs may be used to assess the need for a more intensive evaluation (Sanni-Anibire, Hassanain et al. 2016).
- **Investigative** POEs are more detailed studies and typically use objective evaluation criteria informed by guidelines, performance standards and published literature specific to the building type. Investigative POEs acquire data using a number of methods, including questionnaires, interviews and observation, leading to a systematic understanding of human interaction with the built environment (Sanni-Anibire, Hassanain et al. 2016; Vischer 2001).
- **Diagnostic** POEs measure an objective physical environment and subjective occupant responses, with correlations subsequently identified between the two datasets. A diagnostic study provides a comprehensive view of the relationship between the environment and occupant and creates new knowledge of building performance for practitioners (Sanni-Anibire, Hassanain et al. 2016). Data acquisition methods for diagnostic POEs include in-depth interviews, observation and physical measurements.

5.1 Performance elements

A POE may reveal both positive and negative aspects of building performance. For example, occupants may be satisfied with the physical layout of a building's interior but dissatisfied with its aesthetics or colour scheme.

According to the Queensland Government Department of Housing and Public Works (HPW), a building's performance can be categorised into technical, functional, symbolic and economic performance areas (HPW 2010). Similar categorisations of building performance have also been proposed by other authors (Blyth and Gilby 2006; Sanni-Anibire, Hassanain et al. 2016).

- **Technical** or environmental performance elements are the aspects of a building's physical systems contributing to the comfort, security and health of building users. They include lighting, acoustics, air quality and thermal conditions. Evaluation of technical elements is critically important in buildings where the occupants have specific and pervasive health vulnerabilities or security concerns (HPW 2010; Sanni-Anibire, Hassanain et al. 2016).
- **Functional** performance elements are the aspects of a building environment that directly accommodate activities conducted in the building. In the case of home occupants, functional elements include accessibility, communication, domestic activities, entrances, layout and dimensions, facilities, and communications technology (HPW 2010; Sanni-Anibire, Hassanain et al. 2016).
- **Symbolic** performance elements include the aesthetic and thematic characteristics of a building. The subjective value of symbolic elements is determined according to the art and design preferences of occupants and the community (HPW 2010).

- The assessment of a building's **economic** performance is based on the cost-effectiveness of all building elements, or the efficient allocation of building resources. Building operations, facilities management, life cycle and serviceability costs are among the areas covered (Blyth and Gilby 2006; HPW 2010).

5.2 Established POE methods

Blyth and Gilby (2006) outline a range of widely used POE methods that cater to differences in performance area assessed, intended scope and available resource intensity. These methods generally incorporate questionnaires, focus groups and other data acquisition techniques.

- The **De Montfort Method** or HEDQF (Higher Education Design Quality Forum) involves a forum and facility walk through which focuses on a process and functional performance review. The assessment, principally designed for use in higher education buildings, is envisaged to occur 12 months after occupation and is conducted over the course of a day (Blyth and Gilby 2006).
- The **CIC Design Quality Indicators** (DQI) method uses a 30 minute online questionnaire to assess building functionality, quality and impact. Over a five stage process, an independent facilitator administers the POE at the design stage and a number of times after completion (Blyth and Gilby 2006).
- The **Overall Liking Score** (OLS) method measures how people feel about their work environment and comprises a 10 minute hard copy and web-based questionnaire for occupants, using a seven point scale. Administered 12 months after occupation, the method is designed for use in educational, office and healthcare environments, and is best utilised as a diagnostic tool (Blyth and Gilby 2006). Over 25 studies have been conducted in the UK using this approach (Sanni-Anibire, Hassanain et al. 2016).
- The **PROBE method** uses a comprehensive suite of techniques, including a questionnaire, focus groups, visual surveys, and energy and environmental performance of assessment tools. User satisfaction, productivity, systems performance, and benchmark setting are the focus of the PROBE method. PROBE takes a total of approximately two days over a two month period, and it is recommended the process be conducted no earlier than 12 months after occupation (Blyth and Gilby 2006).
- The **BUS Occupant survey** method involves walk throughs and a 10–15 minute questionnaire backed up by focus groups. The primary focus of the BUS Occupant survey is occupant satisfaction and productivity, and it can be administered at any time, but is typically used after 12 months of occupation. The method may be conducted in isolation or in conjunction with other methods and is intended for use in non-domestic buildings including offices, higher education buildings and schools (Blyth and Gilby 2006; Sanni-Anibire, Hassanain et al. 2016).
- The **Energy Assessment and Reporting Methodology** focuses on energy use and potential savings. The method uses an energy use survey and data collection from energy bills. Assessors can begin the process once the building is complete, and use it in isolation or in conjunction with a secondary method, for example PROBE. A full assessment is completed over a week (Blyth and Gilby 2006).
- The **Learning from Experience** method can be conducted before, during and after project completion and provide foresight, insight and hindsight. Facilitated group discussions or interviews are the format for this method, ranging from a single

seminar to continuous evaluation. Teams learn from their individual experiences shared with one another (Blyth and Gilby 2006).

- The **Building Occupants Survey System Australia** (BOSSA) instrument incorporates an indoor environmental quality (IEQ) system with POE questionnaire features and includes the BOSSA Time-Lapse, BOSSA Building Metrics, BOSSA Snap-Shot, and BOSSA Nova. It is envisaged that the BOSSA instrument will, over time, provide a database to support further IEQ research and assist designers in selecting building features (Candido, Dear et al. 2013).

IEQ refers to the quality of performance of indoor environments according to objective performance metrics. The measure is incorporated in a range of bespoke POE and building performance instruments (Centers for Disease Control and Prevention 2015).

The designers of the BOSSA instrument hope to address the absence of objective environmental measures in many POE instruments by including IEQ measurements. It is anticipated that this will assist in providing explanatory rather than simply descriptive information on a building's score (Candido, Dear et al. 2013).

BOSSA Time-Lapse involves an online questionnaire recording occupant views on technical and spatial features such as layout, furnishings, thermal comfort, air quality, lighting etc. BOSSA Building Metrics records basic information about a building's metrics, design and systems. The BOSSA Snap-Shot surveys building occupants for their subjective assessments of building features. This survey tool is designed for longitudinal application, with the survey administered repeatedly to small samples of building occupants over time (Candido, Dear et al. 2013).

- **MultiMap** is a survey and interview based instrument that primarily records the usability and physical properties of a building's technical condition. MultiMap was designed to evaluate the physical condition of buildings and has been further developed to measure usability and the extent to which a building meets the user requirements. The measurement of a building's potential to change or adapt in response to user requirements is also a feature of the MultiMap instrument, and is expressed in degrees of generality, flexibility and elasticity (Støre-Valen and Lohne 2016).

MultiMap principles were developed according to Norwegian building condition standards, using condition grades of between 0 (highest) and 3 (lowest). The instrument has been primarily used to assess education and health buildings, with 95 per cent of Norwegian hospital buildings undergoing a MultiMap evaluation (Støre-Valen and Lohne 2016).

Section 2: Instruments

6 Section overview

The section presents an in-depth review of 10 POE instruments, which were selected based on their perceived relevance to dwellings designed for people with disability with high physical support needs. Each tool is assessed in relation to the criteria described below.

For each instrument this review provides:

- 1 a detailed summary of the instrument
- 2 an evaluation of the instrument where available, including a description of instrument reliability and validity where available
- 3 an assessment of the applicability of the instrument to housing for people with disability with high physical support needs.

Factors considered in determining an instrument's applicability include, the instrument:

- focuses primarily on the built environment
- is suitable for entire house design rather than home modifications
- is suitable for use with a range of disability types (e.g. ABI, MS, intellectual disability, Huntington's Disease and spinal cord injury)
- can be completed by a proxy (e.g. significant other or staff member)
- is reliable
- is valid
- is concise (e.g. time required to administer)
- is sensitive (i.e. able to detect change over time)
- has clinical utility (e.g. user friendliness, language used)
- aligns with the domains of interest.

The evidence review applies a set of domains that form an aspirational vision for the Summer Foundation's apartment projects. The five domains comprise several components, and focus on a range of tenant outcomes supplied by the home.

- **social inclusion:** location, mix, opportunity for interaction
- **physical independence:** safety, accessibility, flexible use, understandable, low effort, customisable, encouraging skill development
- **home-like environment:** privacy, dignity, non-institutional aesthetic, personalisation, capacity for real-life opportunities
- **high amenity:** outlook and connection with the outdoors, environmental comfort, sufficient storage
- **affordability:** cost efficient specialisation, customisation and maintenance; smart investment.

7 Residential Environment Impact Scale (REIS)

The Residential Environment Impact Scale (REIS) evaluates the impact of the built environment in shared supported accommodation on occupants living with a disability. REIS is a non-standardised assessment tool consisting of semi-structured interview schedules and structured rating forms. The instrument measures resident participation and independence, as well as accessibility, impact, and interaction with objects in indoor and outdoor spaces in the home environment (Fisher, Forsyth et al. 2014).

Administering the REIS 4.0 instrument requires the therapist to conduct an independent visual evaluation of the physical home environment during a walk through, followed by observation of three chosen daily living activities performed by the resident (Fisher, Forsyth et al. 2014). A semi-structured group interview of the residents is also conducted. The interview comprises five categories, and includes '4 global questions, 19 overview open-ended questions, which are paired with supplemental probing questions, checklist forms, and a picture gallery' (Fisher, Kayhan et al. 2013: 9). If applicable, the therapist also interviews the resident coordinator or staff (Fisher, Kayhan et al. 2013).

The REIS 4.0 author's rationale for each interview category is provided below:

- **Space:** 'physical contexts that are bounded and arranged in ways that influence what people do within them' (Fisher, Forsyth et al. 2014: 2).
- **Objects:** 'naturally occurring or fabricated things with which people interact and whose properties influence what they do with them' (Fisher, Forsyth et al. 2014: 2). The presence of objects can also be noted during completion of the Walk Through Observation Guide or the Observation of Activities/Tasks' (Fisher, Kayhan et al. 2013: 9).
- **Occupational forms/tasks:** 'conventionalised sequences of action that are at once coherent, oriented to a purpose, sustained in collective knowledge, culturally recognisable, and named' (Fisher, Forsyth et al. 2014: 2).
- **Social groups:** 'collections of people who come together for various formal and informal purposes, and influence what we do' (Fisher, Forsyth et al. 2014: 2).

A short form of REIS identifies the impact of the built environment on independence, participation and quality of life from the assessor's perspective. The REIS short form uses a total of 17 of the full version's 24 items relating to physical space, resources, social support and opportunities to engage in meaningful activities, and adopts a four point scale from 4 (exceptional) to 1 (requiring major improvement). The short form REIS was designed to be used by practitioners familiar with the Model of Human Occupation (MOHO) upon which the principles of REIS are based (Fisher and Kayhan 2012).

Research was conducted in 2014 on the updated REIS 4.0 instrument to validate the instrument as psychometrically sound using a Rasch analysis (Fisher, Forsyth et al. 2014). The study included a review of feedback from 19 cases of practitioners conducting REIS evaluations.

Figure 2: REIS ratings description

SUMMARY OF REIS RATINGS

Rating Scale	4	Environment strongly supports people's sense of identity and competence by providing exceptional opportunities, resources & demands to engage in meaningful & culturally appropriate activities.
	3	Environment supports people's sense of identity & competence by providing opportunities, resources, demands & constraints to engage in meaningful culturally appropriate activities.
	2	Environment interferes with people's sense of identity & competence by providing limited opportunities, resources, demands & constraints to engage in meaningful culturally appropriate activities.
	1	Environment strongly interferes with people's sense of identity & competence by not providing opportunities, resources, demands & constraints to engage in meaningful culturally appropriate activities.

Everyday Space					Everyday Objects					Enabling Relationships				Structure of Activities					
Accessibility of space	Adequacy of space	Home-like qualities	Sensory space	Visual supports	Availability of objects	Adequacy of objects	Home-like qualities	Physical attributes of objects	Variety of objects	Availability of people	Enabling respect	Support and facilitation	Provision of information	Empowerment	Activity demands	Time demands	Appeal of activities	Routines	Decision-making
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

NOTE: This Summary of REIS Ratings form is auto-filled from the REIS Rating Form (pages 23 through 26).

Source: Fisher, Forsyth et al. 2014.

7.1 Examples of instrument use in relevant POE studies

The Residential Independence Pty Ltd (RIPL) Project One elected to use the REIS and REIS short form POE instruments for its evaluation of three apartments occupied by people with a disability, which are located in a mixed private and social housing residential apartment complex containing 59 apartments. The apartments are designed to allow full wheelchair access and feature home automation assistive technologies (Callaway et al. 2016). The three participants in the evaluation were all male and aged between 30 and 55 years.

The REIS instrument was adapted for use in this project's context, with features of REIS intended for use in a shared supported accommodation setting omitted (Tregloan et al. 2014). The four domains of REIS short form were conducted by observation, and a response form was administered jointly by an occupational therapist and architect with each participant (Callaway, Tregloan et al. 2016).

The three parts of REIS used in the RIPL study comprise:

- Part I: Walk Through Observation Guide
- Part III a: Space checklist
- Part III b: Objects checklist

The REIS instrument was used primarily to understand the interaction between the occupant and physical environment and apartment design features, while the Psychosocial Impact of Assistive Device Scale (PIADS) was utilised to evaluate the performance and suitability of home automation assistive technologies in the three apartments (Callaway, Tregloan et al. 2016).

Customised methodologies allowed researchers to define the range of movement, mobility and physical access in the apartments during performed daily living tasks. Digital recordings and photography of reach and mobility, guided by observational ratings via the REIS instrument enabled mapping and modelling of occupant experience. Researchers surveyed the metrics of the apartment and furnishings to help construct the virtual apartment map. Outdoor mobility was recorded using a GPS tracker installed on an occupant's mobility device or wheelchair.

The results showed that participants had a mixed degree of physical access, mobility and independence in the apartments, with the type of disability and level of physical limitation a significant explanatory factor for these differences. The limitations to this study were predominantly related to the scale of the study (small sample size, one housing model etc.), however concerns about the reliability and validity of the REIS instrument in this context were also raised by the researchers (Callaway, Tregloan et al. 2016).

There are no publicly accessible research papers on application of the REIS instrument in other disability housing evaluation projects.

A survey of previous REIS edition and the REIS short form users was conducted in 2012 and received generally positive feedback, however challenges were encountered in implementing the interview phase for clients with significant cognitive or communication challenges. The instruments include abstract questions, refer to abstract items, and were not designed for this demographic. Questions relating to decision-making in the home, adequacy of support staff and perceived reasons why certain activities were not available were only intended for people with mild to moderate intellectual disabilities (Fisher and Kayhan 2012).

Two survey respondents who had used both the REIS and REIS short form commented that the REIS was too long and that they preferred the short form instrument. The majority of respondents who utilised the REIS short form were from the UK, reflecting the fact that the REIS short form assumes advanced knowledge of the Model of Human Occupation (MOHO), an occupational therapy theoretical framework widely used in the UK (Fisher and Kayhan 2012). Anyone unfamiliar with MOHO may require additional training or prefer the structured and comprehensive format in the REIS long form.

Survey respondents nominated the use of photos or drawings as a useful addition to the REIS for people demonstrating a wider range of abilities (Fisher and Kayhan 2012). The evaluation of RIPL Project One is an example of how the instrument can be supplemented with photos and video (Callaway, Tregloan et al. 2016).

7.2 Applicability of instrument

The REIS was initially designed for use in shared supported accommodation. Following an update of the instrument and the creation of a short form version, REIS is now applicable to individuals living in specialist accommodation or considering moving into another type of residence. The instrument's authors advise that REIS is also now suitable for people with a disability including those with a history of substance abuse, homelessness, HIV/AIDS, mental illness, or behavioural disorders (Fisher, Kayhan et al. 2013). The updated version of the instrument (REIS 4.0) includes an optional photo gallery for individuals who respond better to pictures (Fisher, Forsyth et al. 2014).

An analysis of the degree to which the REIS 4.0 interview categories align with the evaluation criteria is provided below.

Table 2: REIS 4.0 interview question categories and correlating criteria

Interview category	Sub-category	Correlating domain components
Everyday spaces	Accessibility of space	Safety; accessibility; low effort
	Adequacy of space	Privacy
	Sensory space	Environmental comfort
	Visual supports	Understandable; low effort
	Home-like qualities	Non-institutional aesthetic; personalisation; dignity
Everyday objects	Availability of objects	Dignity; encouraging skill development; accessibility
	Adequacy of objects	Encouraging skill development; capacity for real life opportunities
	Home-like qualities	Non-institutional aesthetic; personalisation
	Physical attributes of objects	Customisable; understandable; flexible use; accessibility
	Variety of objects	Encouraging skill development
Enabling relationships	Availability of people	Capacity for real life opportunities; opportunity for interaction
	Enabling respect	Dignity
	Support and facilitation	Dignity; encouraging skill development
	Provision of information	n/a
	Empowerment	n/a
Structure of activities	Activity demands	Encouraging skill development
	Time demands	n/a
	Appeal of activities	Capacity for real life opportunities; opportunity for interaction
	Routines	Capacity for real life opportunities; opportunity for interaction
	Decision-making	Capacity for real life opportunities

Source: Fisher et al 2014.

The REIS instrument 4.0 is suitable for people with a variety of mild and moderate disabilities, and has been updated to include a REIS short form which is applicable to people evaluating their private home. In these respects, the instrument is appropriate for POE.

Some of the interview categories in the REIS 4.0 are not applicable to the evaluation of a private home or housing designed for people with disability with high physical support needs, and are more suited to shared supported accommodation – relationship with caregiver, for example (Fisher, Kayhan et al. 2013). The group interview is also not relevant to the scope of this review, due to the independent living environments envisaged

for housing designed for people with disability with high physical support needs. Questions better targeted to the evaluation of a private home are found in the streamlined REIS short form. While not a focus of this report, the instrument also evaluates the assistive technology or 'adaptive equipment, tools and aids' in the home (Fisher, Kayhan et al. 2013).

The REIS predominantly focuses on the resident's wellbeing, independent functioning, and participation in selected daily activities in the home environment. The REIS involves a walk through observation of the physical context in the home environment, and this may improve the ability of the instrument to describe barriers in the home and further explain their impact on the resident. However, the instrument does not offer a technical evaluation of the performance of home features (Fisher, Kayhan et al. 2013).

While the instrument forms the basis for a useful qualitative interview, the REIS is administered over a three hour period, and is therefore unrealistic to use in the POE of housing designed for people with disability with high physical support needs, given that tenant outcomes and impact of technology will also be measured. It is likely to be too much of a burden on participants. Finally, the instrument is not standardised, and in the absence of a baseline for each participant the scores will have diminished meaning.

8 Usability In My Home (UIMH)

The Usability in My Home (UIMH) instrument is a self-administered three factor analysis comprising activity aspects, personal and social aspects, and physical aspects. The instrument rates 16 of a total 23 items on a seven point scale based on positivity of response to each item, while the remaining seven items are open ended questions that further define the type of usability problems experienced. The 16 items underpin each of the three factors listed above; for example, six items contribute to the physical aspects factor (Fänge and Iwarsson 2005a).

A summary of the 23 items is as follows:

- activity aspects (including personal hygiene, cooking, washing clothes, doing the dishes)
- personal and social aspects (including perceived security, privacy, social contact, environmental flexibility, leisure, communication features)
- physical environment aspects (Fänge and Iwarsson 2005b).

An expert panel review established the validity of the instrument, and a test-retest reliability study, as well as application of the instrument in a range of recent studies have further optimised UIMH (Fänge and Iwarsson 2005a). Applications of the instrument have included homes designed or adapted for people with a disability or the elderly (Fänge and Iwarsson 2005a; 2005b).

8.1 Examples of instrument use in relevant POE studies

The UIMH instrument has been validated and shown to be reliable in number of studies (Fänge and Iwarsson 2005b; Fänge and Iwarsson 2007). While a number of studies have used the instrument in the evaluation of shared accommodation for older people, few studies used the UIMH instrument to evaluate housing for younger people with a disability.

A research-based strategy for managing housing adaptations was completed in 2014 and informs a significant housing adaptation and mobility device evaluation study currently underway (Ekstam, Carlsson et al. 2014). The current study, *Housing Adaptations and Mobility Devices—Evaluation of a New Practice Strategy*, is intended to record usability, activity, cost-effectiveness and quality of life years among elderly and disabled people with mobility devices or housing adaptations, and utilises the ADL Staircase and UIMH POE instruments, as well as the EQ-5D-5L health-related quality of life measure (Fänge 2017).

The study coincides with the further development of the psychometric properties of the UIMH instrument by the author of the instrument in Sweden, and while no translated English version currently exists, earlier editions of the instrument are available in English (personal correspondence with a project author 2017).

Previous studies involving the self-administered UIMH instrument include a 2005 longitudinal study investigating changes in activities of daily living and usability among people who have received housing adaptations. In this study, 131 participants between age 24 to 93 years (mean age 71) living in ordinary housing were assessed at baseline one month prior to adaptation, and at follow-ups of approximately three months and seven months post adaptation (Fänge and Iwarsson 2005b).

The majority of housing adaptations were located in bathrooms and included grab bars and changes to floor surface, while adaptations to doors and stairs were also popular. The estimated usability of these housing adaptations by participants is based on the self-assessed performance of daily activities in environments where adaptations are located (Fänge and Iwarsson 2005b). Changes in activity, personal and social aspects in UIMH were measured using the sign test statistical method.

In the case of this project, the UIMH instrument revealed no significant changes in activity aspects and personal and social aspects across the entire timeframe (from baseline to the final follow-up) however, positive changes in these aspects were recorded between stages (Fänge and Iwarsson 2005b). The authors state that ‘the results indicate that usability is a crucial outcome dimension in evaluation of housing adaptations’ as well as supporting previous study findings that ‘accessibility and usability are different but related concepts’ (Fänge and Iwarsson 2005b: 302).

A follow-up 2007 paper analysed the research strategy adopted in the preceding housing adaptation evaluations. Reflecting on the use of the UIMH instrument, the authors were positive about the instrument’s performance. The instrument was found to be easy to administer, with valid and reliable data collected after only one introductory lesson in most cases. UIMH directly targeted core outcomes of housing adaptations and ‘seemed to be responsive to changes over time’ in this longitudinal study (Fänge and Iwarsson 2007: 146).

8.2 Applicability of instrument

We were unable to access the instrument because the English version of the latest instrument is not yet available.

9 Housing Enabler

The Housing Enabler instrument assesses functional accessibility limitations and dependence on mobility devices, as well as physical environment barriers present or absent in a home. The majority of the instrument's measures correspond to official Swedish norms and guidelines, with the remainder based on the professional experience of occupational therapists (Fänge and Iwarsson 2005a).

A Housing Enabler assessor of functional or mobility device limitations assesses 15 items (13 functional, two mobility device) using a combination of interview and observational techniques. The physical environment assessment involves detailed observation of 188 items in the home and immediate outdoor areas as present or absent. Each item is awarded a performance score between one and four, which helps establish the scale of accessibility problems in a home. Typically, the instrument is administered before and after a housing adaptation (Fänge and Iwarsson 2005a).

The 188 environmental items are divided into the following categories:

- outdoor environment (33 items)
- entrances (49 items)
- indoor environment (100 items)
- communication (6 items).

The 15 functional and mobility limitation items are as follows: difficulty interpreting information; severe loss of sight; complete loss of sight; severe loss of hearing; poor balance; incoordination; limitations of stamina; difficulty in moving head; difficulty in reaching with arms; difficulty in handling and fingering; loss of upper extremity skills; difficulty in bending and kneeling etc; extremes of size and weight; reliance on walking aids; reliance on wheelchair (Fänge and Iwarsson 2005a).

The Housing Enabler has been refined, tested and developed over 17 years, and in a 2014 study sampling 106 cases of instrument use in Nordic countries, good inter-rater reliability was demonstrated (Helle, Nyrgen et al. 2010). A product of this refinement is the freely available reduced version of Housing Enabler, which is a valid screening instrument incorporating 61 of the original 188 items (Carlsson, Schilling et al. 2008; Iwarsson, Haak et al. 2012). The instrument is recommended for use in helping structure data collection processes if used in conjunction with UIMH or ADL staircase instruments (Fänge and Iwarsson 2007).

9.1 Examples of instrument use in relevant POE studies

The 2005 longitudinal study cited in the previous chapter (in relation to UIMH) (Fänge and Iwarsson 2005b) also used the Housing Enabler instrument, in addition to the UIMH and ADL staircase instruments (Fänge and Iwarsson 2005a). The Housing Enabler was used to record accessibility problems via a combination of interview and observation, and aimed to predict which design features cause the greatest accessibility problems for a specific client or group of people (Fänge and Iwarsson 2005a).

Of the 188 environmental barriers assessed by the Housing Enabler instrument in this project, 28 showed significant change in accessibility performance across the project's three stages (Fänge and Iwarsson 2005a). The authors noted that the Housing Enabler instrument is coarse due to the 'dichotomous' assessment process, which means that

subtle changes may not be detected by the instrument; these changes can often show up in usability evaluation instead (Fänge and Iwarsson 2005a: 56).

Substantial training for data collectors was found to be crucial to the Housing Enabler instrument's implementation in recording valid and reliable assessments. Hence, unforeseen personnel changes in the data collection team proved to be a challenge. Training courses were held by project leaders, and more experienced occupational therapists provided supervision throughout the project (Fänge and Iwarsson 2007).

The Housing Enabler's environmental component is structured on building design guidelines. Given that housing adaptations are intended to improve accessibility irrespective of design guidelines, the validity of the Housing Enabler for outcome assessment has been questioned (Fänge and Iwarsson 2007). However, a 2014 study testing the instrument's inter-reliability in 106 cases across four countries (Sweden, Denmark, Finland and Iceland) showed positive results, with sufficient reliability and validity demonstrated for application in practice and research in the Nordic context (Helle, Nyrgen et al. 2010).

A primary advantage of the instrument, according to researchers in the 2005 project, is the ability to better structure data collection underpinning the planning of a housing adaptation (Fänge and Iwarsson 2007).

9.2 Applicability of instrument

The Housing Enabler instrument is administered by trained therapists, guided by Swedish building standards, and is principally designed for before and after evaluations of home adaptations for older people and people with a disability (Fänge and Iwarsson 2005a). The applicability of the instrument to disabled people and private homes aligns with the POE scope.

Assessment of environmental items involves rating the location or absence of physical environment features of the home (e.g. grab bars are situated low on the shower wall) as well as their usability (e.g. use of grab bars requires two hands; visual pattern on stair surface camouflages edges of treads). The indoor environmental items are separated into general, stairs, kitchen/laundry/utility, hygiene area, other controls and operable hardware, and supplementary housing facilities. The outdoor environmental items are separated into general, parking, seating places, and other features. The entrance environmental items are separated into general, stairs, ramps, lifts, and sitting-out place/balcony (Iwarsson and Slaug 2014).

The instrument relates observations of performed functional mobility exercises of the participant to observations of the presence and usability of relevant home environment features. This allows a systematic exploration of the home environment's capacity to enable physical independence, and leads to confident explanations of where issues exist in the physical relationship between the person and their home environment.

Given that the Housing Enabler instrument is primarily designed to evaluate housing adaptations, the instrument is limited to addressing the physical independence domain. While improved *social inclusion, home-like environments, high amenity and affordability* might be flow-on effects of greater physical independence, this instrument does not directly evaluate any components of these domains of interest.

Moreover, the Housing Enabler instrument is guided by Swedish Building Standards, principally design for housing adaptations, and does not adequately align with the domains of interest. Due to these factors, it is not sufficiently relevant to this review.

10 A Way to Stay

A Way to Stay is a POE instrument developed by SCOPE Access for the planning, construction and assessment of home modifications by occupational therapists under the NDIS. The instrument consists of three parts:

- a personal questionnaire seeking an occupant's general thoughts and considerations on how the home and yard might affect their health and lifestyle
- an assessment tool and checklist for use by an occupational therapist in consultation with the occupant to record the home's features and identify their functional performance, which includes an OT assessment of the participant's ability to engage in everyday activities within the home
- a document formatting the first two parts with the option of including a builder's detailed quote or materials estimate.

Figure 3: A Way to Stay checklist example

Home environment		
	HOME LAYOUT	FUNCTIONAL PERFORMANCE
ACCESS TO HOME	Driveway/paths: Gradient, width, condition, overhead clearance above paths (awnings, power lines)	
	Fencing/gates: Condition, type of gate, lock mechanism	
	Front access: Number of steps, step height, tread length, condition, rails	
	Rear access: Number of steps, step height, tread length, condition, rails	
	Lighting: Illumination, sensor light, switch type & location	
ENTRANCE TO HOME	DOORS: Clear door opening, direction of door swing, weight and type of door, screen door	
	Door handles: Type of handle, lock mechanism, ease of operation	
	Steps: Threshold step, step height, condition, rails	

Source: SCOPE, a way to stay.

10.1 Examples of instrument use in relevant POE studies

No relevant published studies using A Way to Stay POE instrument currently exist.

10.2 Applicability of instrument

The A Way to Stay home evaluation instrument comprises a personal questionnaire section, occupational therapist assessment checklist, and a formatted document with optional building estimates.

The self-administered personal questionnaire invites the participant to identify when they feel unable, unsafe, or have difficulty in any areas of the home or in relation to specific home features. For example, the questionnaire asks participants how they feel about the use of their bathroom, and more specifically, in relation to the room size, ventilation, privacy, shower recess size, shower fixtures, and bath (SCOPE Access 2013). This

section incorporates most of the elements of the *physical independence and home-like environment* domains of interest.

The instrument authors advise that care-givers or parents can assist in administering the questionnaire, or complete it on behalf of the participant in the case of children and people limited by physical or intellectual disabilities.

The occupational therapist administered sections of the instrument comprise a personal and medical information section, environmental (social, economic, etc.) section, participant functional performance and capability section, and a home functional performance and layout section (SCOPE Access 2013).

The personal and medical information section records the participant's medical history and related weight, vision and hearing information. The environmental section records information about the participant's living arrangements, and social networks. This section most closely relates to the *social inclusion domain*, and may be useful once linked to the participant's home situation and home features.

The functional performance section records the capabilities of the participant, both in a general mobility sense and in relation to performing everyday living activities. Aspects of the functional performance section include extent of use of limbs, communication level, cognitive and perceptive capability, driving ability, employment situation, and ability to manage finances and domestic activities (SCOPE Access 2013).

This section incorporates elements of the *social inclusion* and *physical independence* domains of interest. The participant's ability to undertake daily living activities is a contributing factor in the participant's opportunity for interaction and independence. However, an exploration of the relationship between the functional performance of the participant and the home and home features would be more relevant to this review.

Finally, the occupational therapist assesses the 'functional performance and layout of the home'. This section is applied to areas of the home, yard and home features. For example, a comment is requested on home layout and functional performance for the kitchen, with specific information required on kitchen access, circulation space, storage space, and appliance use (SCOPE Access 2013).

Incorporated into this section is assessment of the participant's outlook and connection with the outdoors, accessibility, and the environmental comfort and storage capacity of the home. These form some of the components of the *high amenity* and *physical independence* domains of interest. However, a more holistic perspective, examining the relationship between the recorded functional performance of the home and home features, the personal capabilities of the participant, and the self-recorded feelings of usability and safety of the home would more effectively address evaluation requirements.

While a function of this instrument is the integration of builder's cost estimates for desired home adaptations, cost-efficiency or effectiveness is not sufficiently addressed to meet the *affordability* domain.

A limitation of the instrument in relation to the scope of this review is that feelings of home relating to *non-institutional aesthetic* and *personalisation* in the *home-like environment* domain have not been incorporated. The physical needs of the resident have been prioritised over their emotional needs, as the instrument is primarily designed for assessing home modification need and performance.

While the person, environment and functional performance section collects some data relevant to this review, this instrument focuses on evaluating the need for home modifications based on a significant number of demonstrated task performances, which may place an unreasonable burden on the participant.

11 Quality of Life (QoL) and Health-related Quality of Life (HRQoL)

The Quality of Life (QoL) is an outcome measure that can be used in the application of POE instruments. The quality of life outcomes for specific areas or groups can be measured by variations of QoL, including generic health-related quality of life (HRQoL) measures and the condition specific multiple sclerosis quality of life (MSQoL) (Wiesel, Laragy et al. 2014).

HRQoL forms the basis for measuring an assessment of the number and quality of life years returned on a health intervention. Various QoL and HRQoL measures have demonstrated good inter-rater reliability (Lin, Lin et al. 2013). However, no review of studies evaluating the outcomes of housing adaptations and design features in relation to these indicators exists. While not historically a common measurement indicator for POE, Chiatti and Iwarsson (2014) explore this measure in the design of a POE study of housing adaptations 'a research-based strategy for managing housing adaptations: study protocol for a quasi-experimental trial'. HRQoL was also recently utilised in Australia in an assessment of wellbeing outcomes of older and disabled people following home modifications (Carnemolla and Bridge 2016).

HRQoL is a multi-dimensional indicator, which incorporates physical, mental, emotional and social functioning domains, with interview results converted to utility scores (Carnemolla and Bridge 2016). HRQoL is able to qualify life years gained on a health or housing intervention with a health 'weighting'. This is to account for any loss of quality of life or health deterioration despite an overall gain in life years (Chiatti and Iwarsson 2014; Orrell, McKee et al. 2013).

QoL or HRQoL utility scores can typically be integrated with cost-effectiveness components of a POE (Carnemolla and Bridge 2016; Chiatti and Iwarsson 2014).

11.1 Applicability of instrument

The QoL and HRQoL instruments are designed to evaluate a person's quality of life by assessing their physical, mental, emotional and social functioning (Carnemolla and Bridge 2016). In the case of HRQoL, this is expressed in 'quality of life years' gained, and is typically applied to evaluate the effectiveness of a health-related intervention (Lin, Lin et al. 2013).

The instrument is applicable in some respects. The QoL or HRQoL instrument has previously been applied to housing interventions, in Australia and overseas (Carnemolla and Bridge 2016; Chiatti and Iwarsson 2014). Additionally, utility scores can be integrated with cost-effectiveness components of a POE to determine cost-utility ratios, potentially helping to address the affordability domain (Carnemolla and Bridge 2016; Chiatti and Iwarsson 2014).

QoL and HRQoL focus exclusively on outcome measurements, and there may be difficulty isolating which features of the home environment were primarily responsible for contributing to outcome changes after a housing intervention. For example, in relation to cost-effectiveness, the instrument could assist in determining the overall cost-effectiveness of an entire apartment design, but finding the cost-effectiveness of individual features would be much more challenging.

12 Client-Clinician Assessment Protocol (C-CAP)

C-CAP is a POE instrument designed to measure ADL performance and home environment impacts (Parts II–IV), as well as independence, difficulty and safety (Part I). The self-rating instrument, developed in the US, is applied at baseline and follow-up and comprises a structured interview process (Chiatti and Iwarsson 2014).

Part I of C-CAP, conducted by an occupational therapist, ascertains an occupant's ability and perceived independence, difficulty and safety in relation to 18 separate tasks on three rating scales. The C-CAP was designed for people in community living arrangements with a variety of type and severity of disabilities, and this is reflected in the instrument's 18 broad set of tasks: Feed self; dress upper body; dress lower body; grooming; bath/shower; transfer to toilet; get in/out of the house; walk indoors; walk a block; managing stairs; move in/out of bed; get on/off of chair; get in/out of car; prepare meals; do grocery shopping; do light housework; take medication; leisure and social activities (Pettersson, Fisher et al. 2007).

Part I of the instrument has been tested and verified on multiple evaluations of home environments for both the elderly and people over the age of 40 years with disabilities (Pettersson, Fisher et al. 2007). However, some studies utilising C-CAP have experienced a demonstrated lack of internal scale validity (Pettersson, Lilja et al. 2008).

The instrument's four parts can be administered alone or together and are not integrated to record a total score.

Figure 4: C-CAP rating scale categories

Level of Independence	Level of Difficulty	Level of Safety
4 = independent	5 = no difficulty	3 = feel safe
3 = use technical device or adaptation only	4 = a little difficulty	2 = feel somewhat safe
2 = use person help only	3 = moderate difficulty	1 = feel moderately or very unsafe
1 = use both person and device	2 = a lot of difficulty	
	1 = unable to do at all	

C-CAP = Client-Clinician Assessment Protocol.

Source: Pettersson et al 2007.

C-CAP has the potential to complement existing tools that measure people's functionality in daily living activities, principally in relation to the home environment (Pettersson, Fisher et al. 2007).

12.1 Examples of instrument use in relevant POE studies

A 2008 home modification study in Sweden utilised the C-CAP and comprised 73 subjects due to receive home modifications and 41 subjects waiting for assessment of their home modification applications. The exclusion criteria ensured that people who would not be able to understand, concentrate on and answer the questions in a valid and reliable manner in the data collection were not included in the study. The authors selected C-CAP for this study as it was the only instrument available at the time measuring self-rated independence, difficulty and safety in everyday life (Pettersson, Lilja et al. 2008).

This study confirmed findings from a previous study, which highlighted a lack of internal validity of the independence scale (C-CAP Part I) (Pettersson, Fisher et al. 2007);

Petersson, Lilja et al. 2008). The 2008 study also discovered that the independence scale comprised multiple constructs and therefore demonstrated a lack of unidimensionality. These weaknesses as well as perceived poor sensitivity to changes after a housing intervention have cast doubt on the applicability of the independence scale for conducting psychometrically sound clinical research (Petersson, Lilja et al. 2008). Many of the study's participants were already functioning at a moderately high level of independence.

The safety scale was able to detect significant changes in ability and task challenge estimations (Petersson, Lilja et al. 2008). No other publicly accessible research papers on application of the C-CAP instrument in relevant housing evaluation projects currently exist.

12.2 Applicability of instrument

Much like the REIS instrument, the C-CAP predominantly focuses on the resident's wellbeing, independent functioning, and participation in selected daily activities in the home environment. The C-CAP evaluates a participant's interaction with their home environment and awards a score for the difficulty, safety, efficiency, and level of importance assigned to functional mobility and daily living activities (Gitlin 2011). The instrument does not evaluate the physical home environment directly, but through its relationship to the occupant, and is designed for people with a disability who are residents of a community living or shared supported accommodation setting.

The occupational therapist administering the instrument first establishes a general understanding of the participant's daily routines, level of assistance received, and challenges faced. This is followed by a self-rated assessment of their capability and needs in relation to their functional mobility and daily living activities. Functional mobility refers to physical exertion scenarios, such as bending over to pick up clothing off the floor, climbing a flight of stairs, and maintaining balance while showering, while the activities of daily living refers to tasks such as putting on clothing, cooking and feeding, grocery shopping, washing the dishes, and managing finances.

The instrument measures the participant's readiness to change their behaviour or environment in order to improve their capacity to complete activities, and the person administering the instrument also identifies environmental constraints to the participant's function and performance of activities (Gitlin 2011).

The C-CAP meets a significant share of the *physical independence* domain, including *safety*, *accessibility*, and *low effort* components, while other domains of interest are only partially incorporated (*social inclusion*, *home-like environment*) or absent (*high amenity*, *affordability*).

The results produced by the instrument refer principally to the participant's capabilities and needs in the context of their environment, which would include many of the physical design features in the participant's home. However, home environmental features would only be indirectly evaluated, through their involvement in the subjective experience of the participant during functional mobility or daily living activity scenarios. As not all home features would be involved in the daily living and functional mobility scenarios, in the case of housing designed for people with disability with high physical support needs, many important home features would not be evaluated by this instrument.

This absence of technical evaluation of design features limits the explanatory capability of the instrument in relation to the performance of home features in daily living and functional mobility activities, and the instrument is therefore not applicable to housing designed for people with disability with high physical support needs.

13 Home Assessment of the Person–Environment Interaction (HoPE)

Home Assessment of the Person–Environment Interaction (HoPE) is a French language qualitative evaluation instrument, developed for individuals with motor disabilities by Rousseau et al. (2008) following a critical review of assessment tools related to home adaptations (Carignan et al. 2008). The HoPE instrument is designed to better understand home adaptation needs by examining the personal, environmental and interactive components of a home, and comprises six sections: general information, preliminary tests, nonhuman environment, human environment, synthesis, and potential (Carignan, Rousseau et al. 2008).

An assessor conducts the sections of the evaluation by observation, role-analysis and interviews. A description of each section is as follows:

- the general information section records medical and personal information within the home and includes any present working at home conditions
- preliminary tests assess physical attributes of the person relevant to living at home (e.g. balance)
- the nonhuman environment section assesses the physical attributes of the home; an assessor analyses interaction between the person and physical home attributes by observing performed daily activities in each room of the home
- human environment (e.g. spouse) interaction is evaluated during a role analysis, with participants' expectations a significant consideration in the assessment
- the synthesis section identifies and expands on interaction problems
- the potential section explores the capacity for adaptation and change in the person, and human and nonhuman environments (Carignan, Rousseau et al. 2008).

The HoPE instrument scores environmental items on a four point scale from '0—handicap situation' to '3—competence situation' based on the Model of Competence. HoPE has a high content validity, test-retest reliability and inter-rater reliability (Carignan, Rousseau et al. 2008).

13.1 Examples of instrument use in relevant POE studies

The HoPE instrument is designed specifically to evaluate housing adaptations for people with a disability, and is currently only available in French. While the authors of the HoPE instrument have conducted a study establishing the content validation process, no published relevant research papers utilising the instrument exist (Rousseau, Potvin et al. 2013). Further psychometric studies are currently underway and an English language version will likely be available at a later stage (Rousseau, Potvin et al. 2013) (Correspondence with the author 2017).

The content validation study engaged 20 occupational therapists using convenience and snowball sampling and five people with home adaptations in their own home for the expert consultation phase of the project. Meanwhile, four participants over the age of 18 years either currently, or soon to be, living at home and experiencing or anticipating accessibility issues participated in the pilot test phase. These participants had a range of disabilities including muscular dystrophy and rheumatoid arthritis, and all used wheelchairs or mobility devices (Rousseau, Potvin et al. 2013).

During the expert consultation phase of the project, the 20 occupational therapists were divided into seven groups and answered 15 open-ended questions relating to the instrument's guidelines, while the five past housing adaptation recipients were asked 10 open-ended questions regarding their experience in the housing adaptation process. Predominantly, both past housing adaptation recipients and occupational therapists' feedback suggested that HoPE content corresponds to the relevant impacts of housing adaptation, and sufficiently identifies the barriers in the home encountered by people with disabilities (Rousseau, Potvin et al. 2013). The authors incorporated the expert feedback into the updated version of HoPE.

The pilot test results suggested that all evaluation models of the instrument were relevant to the examiners, while minor changes were required to strengthen item relevance—changes included separating items (e.g. bath and shower) and adding sub-components (e.g. oven as a component of range) (Rousseau, Potvin et al. 2013). The pilot test also led to a restructure of the global score, with an improvement in the score's accurate representation of the 'handicap situation and decision-making regarding home modifications' (Rousseau, Potvin et al. 2013: 298). The test also reaffirmed the importance of understanding the 'person-human environment'. The role synthesis was able to identify miscalculations in expectations of competence, both externally (e.g. spousal) and internally (the participant), demonstrating how divergent expectations can lead to conflict and compromise during the adaptation process (Rousseau, Potvin et al. 2013).

13.2 Applicability of instrument

The HoPE instrument is designed to evaluate home adaptations and home adaptation needs specifically for people with motor disabilities (Carignan, Rousseau et al. 2008). This narrow client focus might limit its applicability, depending on the range of disabilities experienced by clients.

The instrument assesses the physical features of a home and their usability during performed daily living activities, the functional capabilities of the resident, the relationship of the resident to other residents in the home, and the potential for change in any facet of the environment or resident. This represents a comprehensive methodology for identifying barriers in the home and where changes are required.

It is not possible to estimate the HoPE's applicability without an English language version of the instrument, which will be available at a later stage (correspondence with the author).

14 Dimensions of Home Measure (DOHM)

The Dimensions of Home Measure (DOHM) is a self-report outcome measurement instrument for home modification evaluation. It comprises six dimensions: personal, social, temporal, physical, occupational and societal. Each of the six dimensions comprise several items, with each item rated on a five point scale.

The instrument was developed based on a literature review and qualitative study, tested in a pilot study involving 23 major home modification clients, and reviewed and validated by a panel of expert occupational therapists and academics (Aplin, Chien et al. 2016).

A 2016 study applied DOHM to a sample of 163 adults with disabilities and older adults who have or may need home modifications in the future (Aplin, Chien et al. 2016). The study's findings provided feedback for the continued optimisation of the instrument. Findings included that 'the current version of the DOHM could be claimed to demonstrate preliminary evidence of construct validity' and that 'ongoing investigation of the unidimensionality, targeting and appropriateness of the rating scales following revision of the DOHM will be required' (Aplin, Chien et al. 2016: 54).

14.1 Examples of instrument use in relevant POE studies

A 2016 study evaluating the instrument's validity recorded the results of 163 older adults and people with disabilities living in a community setting. Eligibility criteria for the study limited participation to people who had received modifications, were awaiting modifications or who received support services within their home. A significant proportion of the 163 study participants already had a modification in their home (83%), with the most common modifications involving grab rails, and a hand-held shower hose, followed by major bathroom modifications (Aplin, Chien et al. 2016). The age of study participants ranged from 31 to 95 years with an average age of 68.

Preliminary validity of the DOHM instrument was established by the study, however revision and further psychometric validation is required (Aplin, Chien et al. 2016). As a result of the study, the original five point Likert rating scale has been revised to exclude the neutral category rating 'unsure', which acted as an unintended catch-all or residual answer. The revised DOHM now includes a four point scale (strongly agree, agree, disagree and strongly disagree) (Aplin, Chien et al. 2016).

The subscales (dimensions) in the DOHM instrument were investigated for unidimensionality using Rasch analysis. The social (63.8%), occupational (56.6%) and temporal (54.4%) subscales demonstrated explained variance and show preliminary evidence of unidimensionality. However, the personal (42.4%) and physical (45.4%) subscales were not unidimensional. Upon a secondary and more targeted Rasch analysis of groups of items within each subscale, a higher unidimensionality was established. The authors have elected to revise rather than remove misfitting items for an updated DOHM, and this is expected to improve unidimensionality of subscales (Aplin, Chien et al. 2016).

A 2014 study of the impact of home modifications on experience of home for elderly and disabled people utilised the DOHM instrument in its earlier form, and found that modifications impacted all dimensions. The instrument was effective in showing negative physical dimension impacts, positive effects on everyday life tasks in the home (occupational dimension), enhanced ability for planning and future thinking (temporal dimension), marginal positive impact on the social dimension and relationships, and a new societal dimension also emerged (Aplin, Jonge et al. 2014).

No other publicly accessible research papers on application of the DOHM instrument in relevant housing evaluation projects currently exist.

14.2 Applicability of instrument

The DOHM instrument is limited to a questionnaire, which is administered by a therapist. No observation of performed daily living tasks or evaluation of technical performance of a home is involved. The instrument's dimensions relate to the domains of interest to varying degrees.

The personal dimension includes questions (statement prompts) relating to identity and the feeling of home, privacy, safety, freedom and independence, and this broadly aligns with the *home-like environment* domain and the safety component of the *physical independence* domain (Aplin, Jonge et al. 2015). Examples of statement prompts in the personal dimension include:

All the areas of my home reflect my style. (Aplin, Jonge et al. 2015: 2)

I worry about falling at home. (Aplin, Jonge et al. 2015: 1)

The social dimension includes questions relating to the impact of the home on relationships with family and friends, as well as the capacity of the resident to be involved in activities, and this broadly aligns with the *social inclusion* domain. Examples of statement prompts in the social dimension include:

I would like to do more social activities at home.

The relationships in my home are put under stress because it is difficult to care for me in this house. (Aplin, Jonge et al. 2015: 2)

The temporal dimension questions attempt to elucidate the resident's thoughts about the future, and the capacity of the home to support the resident's daily and weekly routine. This dimension most closely aligns with the *home-like environment* domain, as well as some components of the *physical independence* domain in a minor capacity. Examples of statement prompts in the social dimension include:

I know where everything is and how it works in my home.

With how things are at the moment, I am well set up for the future in my home. (Aplin, Jonge et al. 2015: 4)

The physical dimension of the DOHM instrument refers to the structure, services and facilities, as well as the ambience, location and space of the home, and broadly aligns with the *high amenity* domain. Examples of statement prompts in the physical dimension include:

I can easily keep warm enough in my home. (Aplin, Jonge et al. 2015: 5)

I enjoy the outlook of my home. (Aplin, Jonge et al. 2015: 4)

The flooring in my home is in good condition. (Aplin, Jonge et al. 2015: 4)

The occupational dimension of the instrument refers to the capacity of the home to encourage and support 'meaningful occupations', including leisure, rest, relaxation, domestic activities, self-care, caring and work (Aplin, Chien et al. 2016: 48). The dimension incorporates elements of most of the domains. Examples of statement prompts in the occupational dimension include:

I would like to do more household tasks at home (e.g. cleaning, laundry, managing household bills). (Aplin, Jonge et al. 2015: 3)

I enjoy the ambience of my home. (Aplin, Jonge et al. 2015: 4)

The societal dimension of the instrument refers to the 'political and economic conditions which affect the resources and control people have over their home' (Aplin, Chien et al. 2016: 48). Exploration of this dimension in the 2015 version of the instrument is limited to a 'cost of home modifications' statement prompt, which relates to the *affordability* domain:

The costs associated with the modification are a concern for me (e.g. initial installation costs, maintenance). (Aplin, Jonge et al. 2015: 5)

This statement relates to the *affordability* domain, however there is no scope for determining the total cost-effectiveness of a housing adaptation, apartment or individual design feature, due to the qualitative nature of the statement.

Overall, the instrument addresses issues relating to *social inclusion, home-like environment, high amenity*, and to a lesser extent, *physical independence and affordability*.

The DOHM instrument has been tested for reliability on 163 older adults and people with a disability in relation to their home modifications. The authors did not comment on the possible limitations of applying only a questionnaire for assessment. However, in administering the questionnaire to people with intellectual disabilities, the absence of a stated alternative method (e.g. observation of tasks) could prove to be a weakness. In addition to possible challenges administering the instrument to people with intellectual disabilities, this one-dimensional approach adopted may also limit its explanatory capability. For example, it is difficult to gauge the home environment's impact on a resident in the statement 'I worry about falling at home' in the absence of an observed performed task or technical evaluation of home features relevant to fall prevention (Aplin, Jonge et al. 2015: 1).

The DOHM was designed to be applied in relation to home modification, however the questionnaire adopts a whole of home approach to evaluation, and thus appears suitable for POE studies of entire homes or apartments, as well as home modifications. Most of the domains of interest are met by the DOHM instrument.

15 EVOLVE

The Evaluation of Older people's Living Environments (EVOLVE) instrument was developed to evaluate a range of building design features within 13 domains considered to be most important to the quality of life (QoL) of building occupants and users in extra care housing (ECH) schemes in the UK (Orrell, McKee et al. 2013). While the instrument is geared toward use for elderly occupants, a total of six domains relate to age neutral universal needs. The domains are as follows:

- universal domains: comfort and control, dignity, personal care, personal realisation, socialising within scheme, connecting with wider community
- domains related to support for older age impairments: accessibility, dementia support, physical support, sensory support, safety, security, working care [support for care staff].

Individual building design features are cross-classified based on their location in a building, for example living areas, communal areas and awarded a score, which contributes to the overall domain's score for QoL (Orrell, McKee et al. 2013).

15.1 Examples of instrument use in relevant POE studies

In a 2013 study involving 23 ECH schemes in the UK, the impact of building design on quality of life was evaluated using the EVOLVE instrument and Schedule for Evaluation of Individual Quality of Life—Direct Weighting (SEIQoL-DW). The SEIQoL-DW was utilised to measure quality of life of an ECH resident, and was supplemented by the CASP-19 quality of life scale for older people, which assessed the four domains of control, autonomy, self-realisation and pleasure. The EVOLVE instrument recorded building features and measured the building design's adequacy in meeting 13 user-related domains of interest to the project (e.g. comfort and control, dignity, personal care, personal realisation) (Orrell, McKee et al. 2013).

The measures of QoL in the study revealed high levels of satisfaction and perceived security among residents, while accessibility, safety and working care received negative results; partially the result of an institutional atmosphere present in some ECH schemes. The EVOLVE assessment of building design provided an insight into the relationship between the environment and resident quality of life, however residents identified relationships, independence and exercise as other significant contributory factors to quality of life. The authors observed that other outcome measures with more sensitivity to the physical environment, for example social activity, social wellbeing and loneliness, may have been more suitable than measuring global quality of life (Orrell, McKee et al. 2013).

The EVOLVE instrument performed well in describing ECH schemes and was sensitive to variation within and across scheme types. However, the authors describe difficulty in administering the SEIQoL-DW interview to older people. The time consuming nature of the interview (mean time 38 minutes) was a factor for many residents who suffer from impaired vision, poor manual dexterity, fatigue and confusion, and often impacted the ability of participants to complete the second and third stages of the instrument (Orrell, McKee et al. 2013).

The report stated that another limitation of instrument implementation in this study was a diminished statistical confidence in relationships between building design and quality of life due to the study's small sample size (Orrell, McKee et al. 2013).

15.2 Applicability of instrument

The EVOLVE instrument was developed to evaluate ECH schemes via a building design features questionnaire. The questionnaire links building design features to 13 quality of life domains. For example, 'there are shading devices for the windows' relates to the 'comfort and control' and 'sensory support' domains (Lewis, Torrington et al. 2010: 1).

The EVOLVE instrument comprises five parts, dedicated to the living unit, communal facilities, circulation, staff and services, and site and location. It is intended that the owner or manager of an ECH complete the survey with the consent of the housing occupants (Lewis, Torrington et al. 2010). The instrument is geared toward use for elderly occupants and occupants of ECH, and while these areas are not the focus of housing designed for people with disability with high physical support needs, many of the EVOLVE domains can be applied to the context.

The 13 EVOLVE domains align with the evaluation domains as follows:

- **comfort and control domain** relates to the *environmental comfort* domain component
- **dignity domain** aligns with the *privacy* and *dignity* components
- **personal care domain** does not relate to the domains of interest
- **personal realisation domain** relates to the *encouraging skill development* and *capacity for real-life opportunities* components
- **socialising within the scheme domain** relates to the *opportunity for interaction* component
- **connecting with the wider community domain** relates to the *opportunity for interaction, location, and capacity for real-life opportunities* components
- **accessibility domain** aligns with the *accessibility* component
- **dementia support domain** does not relate to the domains of interest
- **physical and sensory support domains** do not relate to the domains of interest
- **safety domain** aligns with the *safety* component
- **security domain** relates to the *safety* component
- **working care (support for care staff) domain** does not relate to the domains of interest.

While many of the domains of interest are not directly related to the EVOLVE domain titles, the questionnaire addresses part of this gap. For example, questions 20 and 21 in the communal facilities questionnaire ask whether the dining room windows have a view of the open sky or overlook outdoor spaces. These questions, and several others, address the component *outlook and connection with the outdoors* (Lewis, Torrington et al. 2010).

The living unit questionnaire also addresses this gap somewhat. The 'layout' section features questions such as 'the living unit is set back from the main travel route providing a space which can be personalised' and 'there is space around the entrance of the living unit for plants and flowers' (Lewis, Torrington et al. 2010: 10), which relate to the *personalisation component*.

Overall, the EVOLVE instrument is partially applicable to the context, with many of the instrument's domains and some of the questionnaire content aligning with domains of

interest. However, as the instrument is designed for use in an institutional environment for the elderly, much of the content and methodology is not entirely relevant.

While the instrument comprises a large number of questions and is time consuming relative to other POE instruments, little to no involvement is demanded of the occupants when administering the instrument, with much of the content requiring technical, objective observations of living unit and communal environment features (Lewis, Torrington et al. 2010). The absence of the occupant's perspective, or observation of the occupant's activity, limits the degree to which the instrument can be applied to the individual experience of the home—a key feature of the domains of interest.

16 Housing Quality Indicator (HQI)

The Housing Quality Indicator (HQI) is an instrument developed in the UK in 1998 to assess the quality of housing features across the three categories of location, design and performance (Sanni-Anibire, Hassanain et al. 2016). Ten quality indicators constitute the three categories, and a basic 'yes', 'no', 'n/a' method of scoring is recorded for questions regarding each of the quality indicators. The 10 quality indicators are as follows: location; site—visual impact, layout, landscaping; site—open space; site—routes and movement; unit size; unit layout; unit noise control, light quality, services and adaptability; accessibility within the unit; sustainability; building for life.

The instrument is a POE and building performance measurement instrument designed to assess the general quality of housing provision and is not specifically tailored for application to housing for people with a disability (Housing Corporation 2007).

16.1 Examples of instrument use in relevant POE studies

No published relevant studies using the HQI POE instrument currently exist.

16.2 Applicability of instrument

The HQI is designed to assess the general quality of housing provision and is not specifically tailored for application to housing for people with a disability, however many elements of the instrument are relevant to this context (Housing Corporation 2007).

Many of the 10 quality indicators relate to the domains of interest, however none are a perfect match. A range of domain components are incorporated into the quality indicators, however many are only partially satisfied, or feature in more than one quality indicator.

The first and tenth indicators (location; building for life) together incorporate the domain social inclusion. The location HQI indicator evaluates the dwelling's proximity to services, transport, recreational areas and satisfies *location* and *opportunity for interaction* components. The building for life HQI indicator involves questions regarding the tenure mix, proximity to parks and transport routes, neighbourhood and building character (Housing Corporation 2007). Examples of questions under these indicators are:

Is there an accommodation mix that reflects the needs of the local community?
(Housing Corporation 2007: 47)

Is there a secondary school within 1km? (Housing Corporation 2007: 11)

The second indicator (site—visual impact, layout, landscaping) evaluates the dwelling's visual character and site layout and incorporates the component *outlook* and *connection with the outdoors*. The visual character of the building relates to the overall aesthetic experienced by the resident, and may mean the resident perceives a home-like environment or non-institutional aesthetic—also components (Housing Corporation 2007). An example of a second indicator question is:

Do the buildings enhance the local environment? (Housing Corporation 2007: 13)

The third indicator (site—open space) evaluates the dwelling's provision of private and shared open space and the features located in these areas, and incorporates elements of the components *safety*, *opportunity for interaction*, *outlook* and *connection with outdoors*.

The *safety* component is represented by questions about surveillance, security systems, and the clear delineation between public and private spaces, while the other components feature in questions regarding provision of outdoor and shared space (Housing Corporation 2007). Third indicator questions include:

Are spaces that are to be shared by residents but not for the general public clearly defined? (Housing Corporation 2007: 17)

The fourth indicator (site—routes and movement) evaluates the dwelling's integration with, and the quality of, transport networks (e.g. car, pedestrian) as well as external accessibility to the dwelling. Components covered in this indicator are *accessibility* and *outlook and connection with outdoors* (Housing Corporation 2007). An example of a question under this indicator is:

Are road, place and building names and unit numbers clear, visible and legible and sited appropriately in relation to buildings? (Housing Corporation 2007: 22)

The fifth indicator (unit size) evaluates the overall size, number of rooms etc. of the dwelling, incorporating elements of the environmental comfort component (Housing Corporation 2007). This indicator evaluates the overall mix of dwellings in an apartment building, specifically assessing whether apartment buildings meet the required mix of dwelling types and sizes. Questions under this indicator include:

Study/separate work area is provided. (Housing Corporation 2007: 27)

The sixth indicator (unit layout) evaluates the layout and usability of a dwelling and incorporates much of the physical independence domain, as well as elements of the high amenity domain such as environmental comfort and sufficient storage (Housing Corporation 2007). An example question under this indicator is:

Living room is not an essential part of circulation. (Housing Corporation 2007: 33)

The seventh indicator (unit noise control, light quality, services and adaptability) evaluates the dwelling's environmental and amenity qualities as well as the provision of assistive devices in the home. This incorporates much of the high amenity domain, in particular environmental comfort (Housing Corporation 2007). An example of a seventh indicator question is:

Triple glazing to combat noise. (Housing Corporation 2007: 37)

The eighth indicator (accessibility within the unit) relates to accessibility within the building and dwelling, including interrogation of doorway widths, window height, lift and ramp provision (Housing Corporation 2007). This indicator incorporates many of the physical independence components. A final indicator (sustainability) does not incorporate any domains of interest.

The HQI POE instrument provides a comprehensive framework for assessing a dwelling or set of apartments against UK design and quality standards. The instrument focuses on the objective technical performance of elements of a home and does not sufficiently record the resident's subjective interactions with the home environment or feelings in relation to their home. This is a gap in the instrument's applicability, as a home evaluation in relation to a 'universal' person is less useful than an evaluation incorporating the individual's specific needs and capabilities.

Additionally, the HQI instrument only partially targets the domain components. Components not addressed include components of affordability such as cost-efficiency,

and components that focus on the capabilities and feelings of the individual, for example *personalisation*, *understandable*, and *encouraging skill development*. The survey is intended for completion by a registered social landlord (community housing provider) in the UK, and requires familiarity with the UK design and quality standards (Housing Corporation 2007).

The HQI instrument would be useful if a technical evaluation of housing features is required to complement subjective observations of the home by the resident or therapist. However, the instrument is not sufficient for requirements if used in isolation.

17 Alternative POE instruments

There exist a number of alternative POE instruments, which are briefly described below.

17.1 ADL Staircase

The Activities of Daily Living (ADL) staircase is a Swedish POE independence measurement instrument comprising five personal activities of daily living (PADL) and four instrumental activities of daily living (IADL). The professionally administered assessment is based on the ADL Katz index and involves both observation and interview.

Underpinning the PADL and IADL respectively are:

- feeding, transfer, using the toilet, dressing, and bathing activities
- cooking, shopping, cleaning, and transportation (Fänge and Iwarsson 2005b).

An independence scale is applied by rating each activity from total independence (0) to total dependence (10) with the number of activities in which the client is dependent corresponding to their number of the scale (Jakobsson 2008).

The ADL staircase has been shown to have acceptable construct validity and internal consistency, particularly when applied to 18–29 and 75–89 age groups. However, acceptable psychometric properties were not demonstrated for those aged 30–59 years. According to testers, the instrument is more suited for application on older people (Jakobsson 2008).

17.2 EQUAL

Environmental quality assessment for living (EQUAL) is an example of an environmental checklist instrument, which can be used as a resource for POE or building performance measurement. The instrument is primarily used to measure visual privacy, function-enhancing features, life-enriching features, degree of environmental control, personalisation, and dining and bathing experiences (Cutler and Kane 2007).

Although developed for extra care and nursing home environments, EQUAL is readily transferrable to independent living environments (Cutler and Kane 2007). A feature of the instrument is its capacity to link QoL and environmental data for occupants.

It is envisaged that EQUAL will be used in conjunction with other POE instruments and data acquisition methods, such as interviews or behavioural mapping (Cutler and Kane 2009).

17.3 POE studies using self-designed instruments

A number of researchers conducting POE studies relating to housing for the elderly and people with a disability have elected to create their own POE instruments, with many designed specifically for the purpose of the project (Cline 2006; Cutler and Kane 2009; Hutchings, Olsen et al. 2008). One reason provided by a researcher for creating their own instruments was that no measurement instruments were available that met the evaluation criteria of their project (Hutchings, Olsen et al. 2008).

A 2009 longitudinal study by Cutler and Kane (2009) of four nursing home Green Houses evaluated the behaviour and wellbeing outcomes of 40 nursing home residents. The study

used a mixed-methods design, and utilised behavioural mapping, checklist ratings of bedrooms and bathrooms, observational place-centred time scans, physical tracers, and questionnaires and interviews.

Behavioural mapping was conducted by observation of daily activities in different periods of the day (morning, afternoon and evening). This differed from the place-centred time scan, which also monitors behaviour, by occurring over a two-hour period (as opposed to 30 minutes). It also moved across spaces within the home monitoring an individual resident rather than a fixed space, as is the case for the time scan. Physical tracers mapped and modelled a resident's movement in their home and across shared spaces. Checklists and ratings systematically identified and recorded metrics and technical performance of features in the home.

A performance evaluation of the Green Houses was divided into technical, functional and behavioural performance. Technical performance referred to climate, lighting, noise, and security in the houses, and was evaluated via interviews and checklist ratings. Functional performance referred to the accessibility and usability of features in the home and was evaluated via checklist ratings, observational scans and interviews. Behavioural performance referred to the degree of privacy, dignity, meaning and interaction supported by the home, and was evaluated by observation, behavioural mapping and interviews (Cutler and Kane 2009).

The researchers made no comment on, or evaluation of the instruments created specifically for this project. However, results were recorded successfully and a series of recommendations for the revision of home design features were provided by the researchers (Cutler and Kane 2009).

The following are the researchers' post-POE recommendations for the revision of home design features relevant to housing designed for people with disability with high physical support needs:

Bedrooms and bathrooms

- provide locking doors for bathrooms (which would not interfere with the track installation into the bathrooms)
- place the shower so that bathrooms will not become entirely wet with shower use
- design and install storage on the bathroom wall large enough to store incontinence products
- increase the counter and storage space in bathrooms for elder's personal items, and install single lever faucet hardware
- replace the bathroom light switch with a motion activated switch
- increase the number of light switches and electrical outlets in bedrooms, and provide additional lighting and night lights in rooms
- replace all conventional toggle switches with pressure or rocker type switches
- equip the medication storage cabinet with internal light that turns on when cabinet is opened.

Shared space

- relocate air vents away from ceiling above dining chairs
- in each house, provide a room devoted to medical equipment storage

- enclose bookcase shelving in back of hearth for additional secure storage space (Cutler and Kane 2009).

During a 2006 study of kitchen design for people in wheelchairs, a range of instruments were created to better target the specificities of kitchen design and usability. The study sample comprised nine participants, both male and female, ranging in age from 28 to 58 years (Cline 2006).

The evaluation was centred on observing tasks performed by participants in the kitchen. Instruments created for the purpose of this study consisted of a pre-cooking assessment interview, a universal design evaluation form and decision tree, four cooking activity instruments (kitchen diagram, cooking activity menu, manual task matrix and cooking pattern behavioural map) and a post-cooking interview.

The pre-cooking assessment interview was designed to record information on the participant's household, food preparation patterns, cooking activities and appliance usage. An assessment of abilities relating to food preparation was also incorporated into the interview, with motion, strength and handedness assessed in reference to activities of daily living.

The universal design evaluation form and decision tree were completed by analysing a video recording of the cooking activity performance, and enabled the researcher to objectively classify ability in relation to each universal design feature while also evaluating each feature, collecting anthropometric data, and orienting participants to the kitchen. This analysis was supplemented by the cooking activity instruments, and post-cooking interview, which uncovered any additional hidden issues.

The study was exploratory in nature, however the author stated her confidence that the presence of a range of data gathering tools limited the possibility of bias and increased the study's validity and reliability (Cline 2006).

In another study, involving 45 older adults with developmental disabilities living in a community based nursing home, pre and post evaluations of modifications were conducted via purpose-built POE instruments. The evaluations included the use of both observational and interview questions, due to the varied intellectual and communication skills of the residents (Hutchings, Olsen et al. 2008).

The observational component of the evaluation consisted of a task/environmental assessment, where residents were asked to perform or simulate over 65 basic activities of daily living. During the interview component ('consumer interview'), residents described their performance of basic daily living activities and elaborated on any problems encountered. This task was conducted with direct care staff if the residents was unable to participate due to intellectual or communication issues.

The researchers described their difficulty in establishing reliability of the results in the interviews, and more generally in studies involving people with development disabilities. Subjects with intellectual disabilities may respond to what they perceive are the researchers expectations, with speech that can be unintelligible or difficult to interpret, or respond with inaccurate information, either in frustration with the process or in embarrassment at their own limitations (Hutchings, Olsen et al. 2008).

POE studies involving housing for people with a disability show considerable variation in the environment and subjects, as demonstrated by the studies described. This variation, and the fact that existing instruments may not adequately address the research question, has led some researchers to create their own POE instruments.

18 Conclusion

This report provides an investigation and review of a range of POE instruments for their applicability to dwellings designed for people with disability who have high physical support needs.

Very few POE studies have been undertaken specifically on housing for people with a disability¹; most focus on housing adaptations and home modifications for the elderly and older disabled people. Younger people with a disability have been infrequent participants in these studies.

Each instrument is designed for specific housing contexts (e.g. nursing homes, shared accommodation, home adaptations/modifications) or is intended to inform housing design. Instruments designed for individual homes are more readily applicable to the review context, but instruments that focus on shared homes also contain relevant elements.

No single POE instrument addresses all of the Summer Foundation's aspirational housing performance domains for people with disability who have high physical support needs. Instruments targeting home adaptations (Housing Enabler, A Way to Stay) are more likely to address the physical independence and high amenity domains. Instruments focusing on home adaptations (REIS and DOHM) are more likely to focus on the social inclusion and home-like environment domains.

Instruments delivering a technical evaluation of home feature presence and performance (HQI, EVOLVE) typically only indirectly relate to most of the domains of interest. This is because a first hand account or observation of individual experience of the home is necessary to sufficiently evaluate a resident's relationship to the built environment.

POE instruments demonstrate varying degrees of reliability, validity and internal consistency. Some have been shown to be reliable and valid (UIMH, Housing Enabler, HoPE), while others have been criticised for a lack of internal scale validity (C-CAP), or questions have been raised about their validity and reliability in certain contexts (REIS).

18.1 Recommendations

It is clear from the review of the evidence that no single POE tool is suited to the POE of dwellings for people with disability who have high physical support needs, and which aligns with the Summer Foundations aspirational housing performance domains. Consequently, it will be necessary to use a combination of existing POEs or their components, or to develop a new bespoke POE instrument.

The following recommendations set out key principles for the development of a framework for the POE of dwellings for people with disability who have high physical support needs.

- 1 The POE framework should combine technical evaluation of the performance or presence of home features with users' subjective experience of the home.

Many of the POE instruments reviewed provide either a technical evaluation of the performance or presence of home features (HQI, EVOLVE) or an account of the subjective experience of the home from the resident (C-CAP, DOHM), while some include varied combinations of both (A Way to Stay, REIS, Housing Enabler) or

¹ The RIPL Project One is an exception and a recent local example of such a study.

include observation (A Way to Stay, REIS, HoPE, C-CAP). This review recommends adopting an approach that uses both methods in conjunction to better target home performance and home requirements. This would enable cross-referencing of identified issues in the home between the objective evaluation of home feature technical performance and subjective resident account of interaction with home features.

The UIMH and HoPE instruments show promising applicability to housing designed for people with disability with high physical support needs, however neither instrument was available for in-depth review. The first English language version of the HoPE instrument will be available at a later date, while a psychometrically tested update of the UIMH instrument could become available in English in the near future.

- 2** The framework should ensure that POE instrument(s) are intelligible and suitable to users and are applicable to people with a range of disabilities.

Care should be taken to avoid POE instruments that use abstract questions, long questionnaires or physically arduous and lengthy daily task performance observations. Instruments that rely on these features should not be used, unless they can be replaced by alternative methods without compromising the instrument's reliability and validity.

- 3** As no existing instrument sufficiently meets all of the Summer Foundation's domains of interest, the framework should use a hybrid approach incorporating the most relevant elements of existing instruments.

POE instruments vary considerably in their coverage of domains of interest. This is summarised in Table 4. Note that Table 4 should only be interpreted in conjunction with the detailed observations on the POE instruments in section 2.

Table 3: Domains of interest

	Social inclusion	Physical independence	Home-like environment	High amenity	Affordability
REIS	✓	✓	✓	✓	x
UIMH	na	na	na	na	na
Housing Enabler	x	✓	x	x	x
A Way to Stay	✓	✓	✓	✓	x
QoL	na	na	na	na	✓
C-CAP	✓	✓	✓	x	x
HoPE	na	na	na	na	na
DOHM	✓	✓	✓	✓	x
EVOLVE	✓	✓	✓	✓	x
HQI	✓	✓	x	✓	x

- 4 The framework should consider using QoL/HRQoL scores in conjunction with housing intervention costs to derive a cost-utility ratio.

A QoL/HRQoL outcome-based approach to home evaluation for the purposes of providing a quantitative input to cost-effectiveness evaluation appears to have merit. QoL/HRQoL scores can be analysed in conjunction with housing intervention costs to derive a cost-utility ratio. This method more readily applies to cost-effectiveness evaluations of an *entire* home intervention, and determining the cost-effectiveness of *individual* home features using the QoL/HRQoL is more challenging. Nonetheless, QoL/HRQoL is the only POE instrument identified that offers possible integration with housing intervention cost-effectiveness.

- 5 The framework should adopt an iterative approach to evaluation of apartments with key stakeholders and tenants.

Very few POE instruments have been evaluated by independent sources for reliability and validity. Furthermore, instrument reliability and validity has not necessarily been tested in the context of housing for people with a disability, with elderly people typically the subjects in POE studies. Thus, it is important to consider the differences in capabilities of these groups and the degree to which this might compromise the efficacy of a POE instrument.

Consequently, it is recommended that the framework should adopt an iterative approach, which involves a trial POE with opportunity for feedback from tenants and people administering the instrument, or extensive pre-POE consultation and feedback. This will provide an opportunity for tenants and those administering the instrument to identify issues before significant resources are committed.

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Appendix 1: POE instruments summary

Table A 1: POE instruments summary

	REIS 4.0 and Short Form	UIMH	Housing Enabler	A Way to Stay	QoL/HRQoL	C-CAP	HoPE	DOHM	EVOLVE	HQI
<u>Built environment exclusive focus</u>	na	na	na	na	na	na	na	na	na	yes
<u>Suitable for which type/s of housing intervention</u>	Shared-accommodation; home adaptations	Home adaptations	Home adaptations	Home adaptations	na	Shared accommodation	Home adaptations	Home adaptations	Shared accommodation	Housing design
<u>Groups suitable for</u>	People with a disability	Elderly; people with a disability	Elderly; people with a disability	People with a disability	na	People with a disability	People with a disability	Elderly; people with a disability	Elderly	Any
<u>Suitable for people with a range of disability types</u>	Not suitable for people with significant intellectual disabilities	na	na	Yes	na	Yes - however, 2008 study criteria excluded some people with disabilities based on ability to understand, concentrate on and answer instrument's questions (Petersson et al 2008)	Designed for people with motor disabilities	na	Designed for older people in communal living environments	Yes
<u>Can be completed by a proxy (e.g. significant other or staff member)</u>	na	na	na	Yes	na	No	na	na	Yes (completed by a ECH manager)	Yes (completed by a community housing provider)
<u>Standardised</u>	No	na	Yes	No	na	Yes	Yes	Yes	Yes	Yes
<u>Reliable</u>	na	Yes- test-retest reliability study indicated moderate to very good agreement for each item to be rated, kw = .57-.88 (Fange and Iwarsson 2005a)	Yes - inter-reliability shown in 106 cases across four Nordic countries (Helle et al 2010)	na	na	na	Yes - high test-retest reliability and interrater reliability (Carignan et al 2008)	Ongoing investigation of the unidimensionality, targeting and appropriateness of the rating scales following revision of the DOHM will be required (Aplin et al 2016)	na	na
<u>Valid</u>	Yes - via Rasch analysis (Fisher 2014)	Yes - content validity established by means of an expert panel review. Construct validity also supported (Fange and Iwarsson 2005a)	Yes - validity shown in 106 cases across four Nordic countries (Helle et al 2010)	na	na	Internal scale validity has been questioned (Petersson et al 2008)	Yes - high content validity established by 20 OTs (Carignan et al 2008)	Preliminary evidence of construct validity, further psychometric validation required (Aplin et al 2016)	na	na
<u>Concise (30 questions or less)</u>	No - semi-structured group interview, four global questions, 19 overview open-ended questions, supplementary probing questions, checklist forms, and a picture gallery (Fisher et al 2013)	na	No - 188 items (Fange and Iwarsson 2005a)	No - 56 item checklist	na	No - for each of the 18 tasks the client is asked 3 questions concerning how they perceive their independence, difficulty and safety (Petersson et al 2008)	na	No - each of the six dimensions comprise several items with each item rated on a five-point scale, totalling 66 questions	No - 200+ checklist questions	No - 220+ checklist questions
<u>Sensitive (i.e. able to detect change over time)</u>	na	na	Moderate - subtle changes may not be detected by the instrument (Fange and Iwarsson 2005a)	na	na	Poor - Independence scale (Petersson et al 2008)	na	na	Yes, was sensitive to variation within and across ECH types (Orrell et al 2013)	na
<u>Clinical utility issues (e.g. user friendliness, language used)</u>	Length and abstract nature of survey raised by researchers as an issue for some users of the REIS Long Form (Fisher and Kayhan 2012)	Easy to administer (Fange and Iwarsson 2007)	Substantial training required for data collectors; instrument useful for structuring data collection underpinning housing adaptation planning (Fange and Iwarsson 2007)	Administered by occupational therapist and the subject or subject's proxy; Developed in Australia	na	People with more severe disabilities have been excluded from studies using this instrument (Petersson et al 2008)	Currently only french language (English avail. In near future)	Administered by occupational therapist and the subject or subject's proxy; Developed in Australia	Little to no involvement is demanded of the occupants when administering the instrument, with much of the content requiring technical, objective observations of living unit and communal environment features	Administered by community housing provider. No input required from tenant. Technical environmental assessment
<u>Data collection approaches</u>	Walk through observation; observation of ADL; tenant interviews; environmental checklist	Self-rated assessments	Observation of physical movements; environmental checklist	Self-rated assessments; environmental checklist	na	Self-rated assessments; observations of ADL	Observation; role-analysis; interviews	Self-rated assessments	Environmental checklist	Environmental checklist
<u>Alignment with the 5 domains of interest (compare Table 5)</u>	4 out of 5	na	1 out of 5	4 out of 5	na	3 out of 5	na	3 out of 5	4 out of 5	3 out of 5

Appendix 2: Research projects that may be relevant to the project objectives

Table A 2: Relevant research projects

Project	Centre	Institution	Year
SCOPE Access Home Modifications Case Study	SCOPE Access	-	2013
Person-Centred Approaches to Private Housing for People with Disability: Impediments, Difficulties and Opportunities	Disability policy and research working group	QUT/UniQld	2014
Report of Audit of Disability Research in Australia	Centre for Disability, Research and Policy	University of Sydney	2014
Addressing the housing needs of participants is critical to NDIS success	Centre for Applied Disability Research	-	2015
WA HACC Home Modifications and Assistive Technology Project	Independent Living Centre	Curtin University	2015
Building Occupants Survey System Australia (BOSSA)	Faculty of Architecture, Design & Planning	University of Sydney	2016
The housing careers of disability support pension recipients	-	University of Tasmania	2017
RIPL Project One	Monash Art Design and Architecture	Monash University	Current
Independent Supported Living (ISL) arrangements and outcomes for adults with intellectual disability (ID)	Centre for Applied Disability Research	Curtin University	Current
Individualised Supported Living Project (ISL)	Centre for Disability Studies	Curtin/Deakin	Current
Stepping On	Centre for Disability Studies	-	Current
NDIS Evaluation	NILS	Flinders University	Current
Evaluation of Housing Adaptations and Mobility Devices (FORMASEvid)	-	Lund University	Current

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