Cambridge Centre for Housing & Planning Research

TAPPI Phase 2: Evaluation Report

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UNIVERSITY OF CAMBRIDGE

TAPPI

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- Co-Production and Engagement partners Co-production Works
- Evaluation and Shared Learning partners the Cambridge Centre for Housing and Planning Research (CCHPR) at University of Cambridge
- 6 locality 'testbeds': Bield Housing and Care; London Borough of Haringey; Platform Housing Group; Pobl Group; Southend Care; Wiltshire Council.

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TAPPI

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1. Executive Summary

The 2021 Technology for our Ageing Population: Panel for Innovation (TAPPI) report introduced 10 key principles for implementing technology services designed to improve the lives of older people in housing and care settings. Dr Gemma Burgess, Director of CCHPR, was one of the fourteen panel members who brought their knowledge of housing, the care sector, and assistive technologies to TAPPI. The second phase of TAPPI (TAPPI2) has sought to embed these principles in innovative technology pilots run by housing and care organisations in six testbeds across the UK.

The six testbeds, operated by Wiltshire Council, Bield Housing and Care, Pobl Group, Platform Housing Group, London Borough of Haringey, and Southend Care, have each delivered a technology service guided by the 10 TAPPI principles. This has enabled them to test the principles, to find out what works, and to share learning on what does not, such that the TAPPI principles can be as effective as possible in guiding organisations looking to use technology to improve outcomes for their service-users going forward.

The evaluation and shared learning partner for TAPPI2, the Cambridge Centre for Housing and Planning Research, has completed the evaluation of the project, and this report sets out the key findings and benefits realised. These are briefly summarised here:

1.1.Technologies

- **There is no one-size-fits-all solution:** The six testbeds used a wide variety of technologies in their projects, including: voice-controlled virtual assistants; GPS pendants; tablets; falls detectors; and a range of sensors. While a number of benefits and limitations were identified for each of the technologies installed, there is no one-size-fits-all solution, with individuals' diverse needs and preferences shaping the kinds of technologies which are appropriate for them.
- **Ease of use is crucial:** Technologies which are easy to use and which fit easily into a person's everyday routine tend to be favoured. Where technologies are seen as too complicated, they may not get used. Ensuring that a technology not only meets people's needs and aspirations, but also complements their level of digital literacy and desire to learn to use technologies, is essential.
- **Design of technologies must take into account diverse needs:** Some technologies can be difficult to use for people with some health conditions or disabilities. For instance, touch-screens, or sensitive buttons, may be difficult to use for people with shaky hands. In order to be beneficial, technologies need to account for the diverse needs of older or disabled people, and for their preferences. Indeed, technologies with an unappealing or clinical design may be off-putting.

1.2.Benefits realisation for individuals, families, and friends

- **Independence and control:** Improving independence was a key aim for several of the TAPPI2 testbeds' projects, and has been a notable benefit realised for many participants. This ranges from enabling people to carry out daily activities, such as making a cup of tea or turning on lights without assistance, to transformations in confidence, enabling people to feel able to go out on their own where this may not have previously been possible.
- **Health:** Several of the technologies trialled through TAPPI2 were preventative in nature, helping to monitor health indicators (such as how often a person uses the toilet, for example) to catch issues early and avoid a health crisis. Others enabled residents to keep track of their hydration, or provided reassurance about their health. Notably, the system of support – including responsive care teams – which underlies such technologies is essential to their functioning, and their impact therefore varies across institutional settings.
- **Safety:** An improved sense of safety is a key benefit of technologies used across the TAPPI2 testbeds. These improvements often come from people's sense that if they have a problem, such as a fall, technologies will support them in receiving appropriate care more quickly than if they were not using these technologies. Others have highlighted that sensors and video doorbells make them feel more secure in their homes. However, fears around online safety are a notable challenge which can reduce people's sense of safety if they lack confidence with the digital technologies they are using.
- **Social interaction:** Taking part in TAPPI2 has provided social benefits for some people. For instance, some TAPPI2 participants highlight that devices such as voice-activated virtual assistants provide a sense of company, which can reduce feelings of loneliness, while others note that the process of co-production has itself brought social benefits, by bringing neighbours together for regular chats. However, it is also notable that some participants were worried that technologies might reduce their opportunities for social interaction by reducing their need for in-person visits from onsite staff.
- **Peace of mind:** The use of technologies was highlighted as providing peace of mind for individuals and for their families. Indeed, some technologies which could remind people to take medications, or which tracked movement or falls, may reduce worries about relatives' wellbeing. This was highlighted as enabling more meaningful and enjoyable conversations between individuals and their families, beyond simply checking on their wellbeing.
- **Freedom:** For families and friends of people using technologies, improved freedom to go out for longer, or to not feel as much need to rush back to check on their loved

ones, was a notable benefit of TAPPI2, as technologies could provide reassurance remotely, or improve independence of service users.

1.3.Organisational settings

- **Resourcing:** Running a technology project takes a lot of time and energy, and it can be difficult to squeeze in the demands of a service such as those operated as part of TAPPI2 alongside other day-to-day responsibilities. Projects with a dedicated project manager typically found this easier to manage.
- **Organisational buy-in:** Projects which have had support from the very top of their organisation have typically been more successful, or have run more smoothly. Further, testbeds with high levels of organisational buy-in have been able to leverage the learning from TAPPI2 to feed into broader organisational strategies intended to benefit service users more broadly, beyond the remit of the TAPPI2 programme.
- **Procurement challenges:** Procuring technology for use in housing and care settings can present considerable challenges for organisations. It can be difficult to work out which suppliers can deliver a product which will best suit the needs of service users. In-house expertise, such as from dedicated IT teams, can be highly valuable in supporting the delivery of technology services at every stage of design and delivery.
- **Lead-in time:** Setting up a project using technologies in a housing or care setting can be a lengthy process, particularly where foundational requirements, such as good connectivity, are not already in place. Some testbeds would have benefited from additional lead-in time to prepare for their TAPPI2 projects.
- **Impacts for site staff:** Reactions to introducing new technologies from onsite staff have been varied. While some worried that the technologies might threaten their jobs, others were concerned that monitoring requirements would increase workloads. For some testbeds, data from sensors has been used to allocate resources more efficiently. However, the time commitments needed from onsite staff to support the delivery of technology projects need careful consideration.

1.4.Broader contexts

- **Digital exclusion:** Many older people are digitally excluded, either due to lacking a reliable internet connection, having a low level of digital skills, not having access to internet-enabled devices, or not feeling motivated to get online. This can create barriers to engagement and can limit people's ability to use some forms of technologies.
- **Building specifications:** Some buildings are not suitably designed or adapted for the needs of older people. Where this is the case, this can make some everyday activities difficult. Technologies may not be the best fix for issues which could be solved via

other forms of home adaptation, but may nonetheless provide a useful stop-gap for those whose housing circumstances are poorly suited to their needs.

- **Health needs:** Physical or mental health issues may make some activities difficult for people, and technologies may not always represent the most appropriate or effective intervention. However, technologies may usefully form part of a solution designed to respond to individuals' specific needs.

1.5.Recommendations

Technologies

- Technology services and the design of devices should be **tailored** to individuals' specific needs. Different people have very different needs and preferences, and have different ideas of what they want to get out of using technology. If people receive technology that they don't want or need, they are unlikely to use it. People should therefore have choice over the kinds of technology they engage with, and TEC services should be personalised.
- Technologies should be implemented as part of a **package of support**, rather than viewed as the only solution. Technologies can have a range of positive impacts, and can be transformative in helping people to achieve their personal goals. However, there are many things that technology cannot fix, including some of the issues which might be most important to people. For instance, physical home adaptations may be needed to enable people to confidently move around at home, and to be able to use their home as they wish, and where these adaptations are not in place, new technologies may not have the desired impact.
- Introducing a few new technologies **gradually** can enable people to get to grips with them before they learn to use any further devices. Where people have little experience of using technologies, introducing too many technologies at once can be overwhelming, and can mean that people don't get their full benefit.

Processes of implementing technology services

- Assigning a dedicated **project manager** is a key factor in the success of technology service projects. Implementing a successful TEC project requires adequate resourcing, and lessons from the TAPPI2 project highlight that where there is a project manager who can dedicate time to the TEC project, rather than squeezing it in alongside other responsibilities, the project is more likely to run smoothly.
- Organisational **buy-in**, and support from organisations' leaders and managers, is essential. The most successful TEC projects have support from the highest levels of their organisation. Understanding of the vision of what the technology pilot is aiming to achieve from the strategic levels of an organisation, as well as at operational levels,

means that projects will be better supported. It also means that success stories or learning from the pilot will be more likely to be scaled up and implemented more widely across the organisation.

- All staff should be brought on board to support technology projects. This may involve providing staff with information and **training** throughout the project. This will enable staff to support residents who are themselves using technologies.
- Co-production is an essential part of designing an effective technology service which meets people's needs and is effective in the long-run. Engaging tenants after key decisions have already been made can reduce tenants' sense of ownership over the project, and can prevent this from happening. The co-production process should therefore start **as early as possible**, prior to deciding on technologies, to ensure that people have a say on their services from the outset.

Operational context

- Suitable **building design** or home adaptations are important for wellbeing. Addressing any issues in building suitability prior to or alongside the implementation of technology projects should be carried out in order to support positive outcomes.
- Digital inclusion is key for many technology projects. Many people in the UK lack basic digital skills, and older people are especially likely to be digitally excluded. If a TEC project is using technologies which require tenants to actively engage with them, it is likely that **digital skills support** will be required, both for tenants and for staff. In order to be effective, TEC projects of this kind should provide ongoing digital skills support. Technology projects need to recognise that people have varied of levels of digital inclusion, and not everyone wants to be online.
- In order for technology projects such as TAPPI2 to have long-term impacts, ongoing support will be needed. Responsibilities for **maintenance** of technologies should be clearly set out from the start of a project.

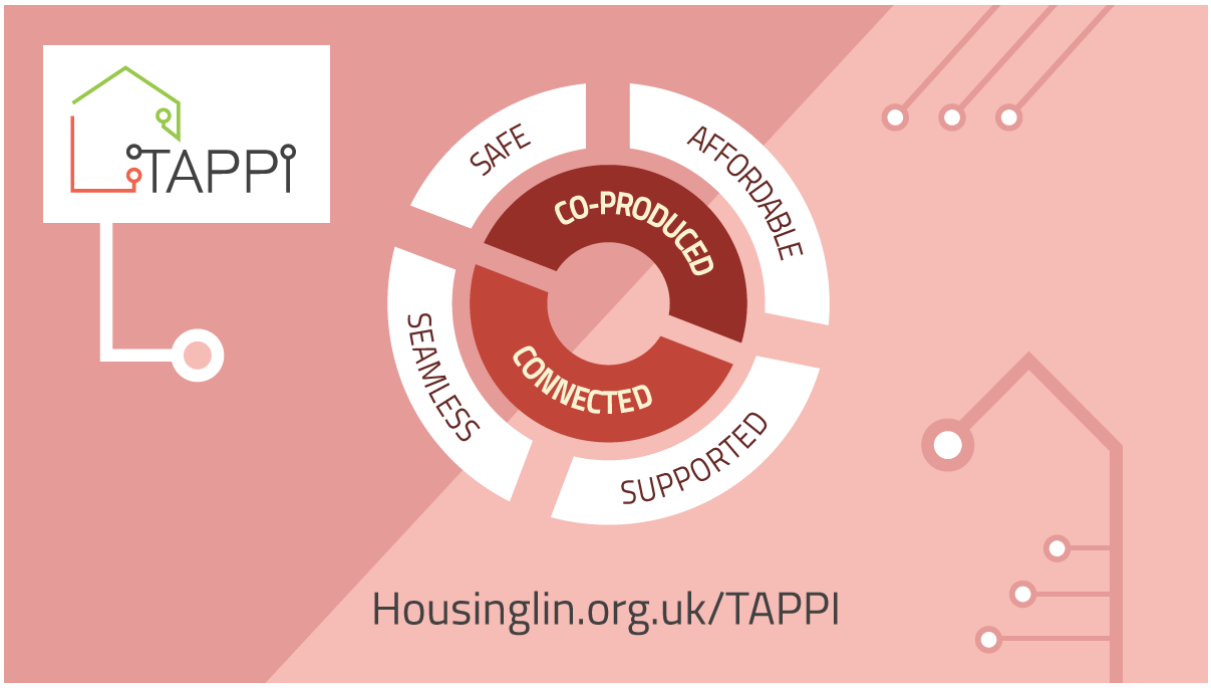
The TAPPI principles

- The TAPPI principles could be revised to make sure that each principle is **clear and easy to understand**. Simple descriptors for each principle would provide clarity on what is and what is not encompassed in implementing each one.
- Some TAPPI principles show a degree of overlap, and so could be **combined** to create a shorter, more accessible and memorable list.
- **Safety and privacy** are key concerns of many people using technologies. These could be incorporated into the TAPPI principles to adequately reflect these concerns, and to build safeguards against them into all technology enabled care services.
- Good connectivity should be seen as a foundation of any technology project. Internet connectivity is needed for many types of technology to perform at full functionality. Having **reliable internet connections** in place is therefore essential for TEC projects.

Thinking about this too late can result in delays, which can be frustrating for tenants. This could be captured in the TAPPI principles.

1.6. The revised TAPPI principles

The TAPPI2 evaluation was completed on schedule, a few months prior to the windup of the TAPPI2 project. Upon the conclusion of the TAPPI2 project, the TAPPI principles were revised to incorporate feedback from participants. These revised principles, which emphasise the need for technology projects to be co-produced, connected, safe, affordable, seamless, and supported, can be found here.



2. Introduction

2.1. The TAPPI2 project

In 2021, the Dunhill Medical Trust and Housing LIN launched the Technology for our Ageing Population: Panel for Innovation report. Dr Gemma Burgess, Director of CCHPR, was one of the fourteen panel members who brought their knowledge of housing, the care sector, and assistive technologies to TAPPI. The report introduced 10 key principles for implementing technology services designed to improve the lives of older people in housing and care settings. They highlight that technology services for older people ought to be:

1. **Adaptable** – able to adapt to changing user needs and technological advances
2. **Co-produced** – involving people to co-create solutions to inform how they want to live their lives
3. **Cost-effective** – offer value for money and benefit both to individuals but also to workforces in local housing and care economies
4. **Choice-led** – enabling access to more options that meet individual needs and wishes
5. **Interoperable** – ability to integrate and work across systems and platforms to meet individuals' diverse needs and aspirations
6. **Inclusive** – reduce digital, health, income inequalities to enable active involvement in home, local community or networks
7. **Outcome-focussed** – improve health and wellbeing to improve quality of life or maintain independence
8. **Person-centred** – Putting the person first to give control over own environment, care and support needs etc.
9. **Preventative** – focused on prevention rather than reactive models
10. **Quality-focussed** – in designing products, systems and services to ensure 'fit for purpose'

(TAPPI Principles from: Beech and Porteus, 2021)

2.2.The TAPPI2 testbeds

The second phase of TAPPI, known as TAPPI2, aimed to test the principles set out above across six testbed sites. Through testing the 10 principles at each site, TAPPI2 has enabled consideration of how technologies can be used effectively in housing and care settings to improve outcomes for older people. Each testbed has implemented their own technology pilot project, taking account of the 10 TAPPI principles. This has provided a valuable opportunity to learn how the principles work in practice and how they might best be adapted or implemented elsewhere. The testbed projects are still ongoing.

The six testbed projects are briefly introduced here:

Bield Housing and Care: As well as seeking to understand residents' levels of digital literacy and address digital exclusion, Bield is testing a range of technologies, working with tenants who are living independently to test devices aiming to improve wellbeing, and with tenants with identified support needs to test further technologies aiming to improve quality of life and enable people to live independently for as long as possible.

Pobl Group: Pobl is trialling a number of technologies in an extra care setting comprising 43 flats in Swansea. Residents are given choice over which technologies will best suit their needs.

Wiltshire Council: Wiltshire is trialling technologies in an extra care setting comprising 48 flats. An occupational therapist has assessed the needs of residents, with the aim of ensuring the technologies chosen to respond to individuals' needs. Intended outcomes of the project include reducing loneliness and preventing health issues.

Platform Housing Group: Technologies designed to respond to individuals' specific needs are being trialled in an independent living setting in Ledbury. Desired outcomes include improving digital connectivity, reducing isolation, and improving service engagement and satisfaction.

London Borough of Haringey: Technology is being used across extra care settings, sheltered housing, bespoke housing, and people's own homes across the London Borough of Haringey. The aim is to understand the needs of residents across these different housing models, to help people to age well, to help people remain independent, and to improve outcomes.

Southend Care: Technologies (including various sensors) are being trialled in supported living and extra care housing schemes, with the aim of preventing health problems, and

using technology to tailor levels of face-to-face support to individuals' needs to improve independence and wellbeing.

2.3. The evaluation

The Cambridge Centre for Housing and Planning Research (CCHPR) is the evaluation and shared learning partner for TAPPI2. CCHPR's role in TAPPI2 has been to collect evidence from across the testbeds at both individual and organisational levels as part of an evaluation of the programme. As well as supporting individual testbeds in their own evaluation activities, CCHPR has led the overall evaluation of the programme, collating learning from across the testbeds, with the aim of providing insight into the challenges and opportunities presented by the use of technologies in care and housing settings. This report reflects CCHPR's findings from this evaluation. At the time the evaluation was completed, the testbeds' projects were ongoing.

3. Methodology

CCHPR has produced a series of reports during the process of conducting the TAPPI2 evaluation. These include three interim reports. The first, produced in December 2022, set out testbeds' early understandings of the TAPPI principles and their aims and objectives for the project. The second report, produced in May 2023, presented preliminary findings from early interviews with residents across the six testbed sites. The third interim report, produced in July 2023, set out results from the first round of a survey conducted with residents at the testbed sites. As highlighted in these previous TAPPI2 evaluation reports, there are three key components which make up the evaluation methodology:

- **Interviews with testbed management staff:** Interviews were carried out with management staff at an early stage in the TAPPI2 project, and were then repeated in July-September 2023 to gauge how understandings of the TAPPI principles have evolved over the course of the project, and to capture the practical lessons learned from implementing the principles across the six testbed sites.

- **Surveys for residents/tenants:** Two rounds of an online survey were circulated to each of the testbed sites. This survey aimed to capture baseline information on residents' health, wellbeing, and attitudes to technology. While the majority of survey questions were asked across the six sites, some small adaptations were made to tailor the survey to some of the testbeds. The testbeds carried out this survey at an early stage of their projects, and have been asked to repeat this at a late stage. The results of the first round of the survey were presented in an earlier report. Some of the

testbeds have yet to complete the second round of the survey, and so while this data is not presented in this report, the testbeds are free to use the results for their own project evaluations where this is useful.

- **Interviews with residents/tenants:** CCHPR researchers have visited each of the testbeds twice to carry out semi-structured interviews with residents, both at an early stage in the TAPPI2 projects, and most recently in July-August 2023. These interviews were focused on various issues, including residents' views on technology, to what extent technologies met their needs and aspirations, and how included residents have felt in decision-making about the technologies they are using. These interviews have all been conducted in person, with the exception of a few residents from Haringey, who took part in online interviews having been unable to attend in-person interviews. The second research visit to each of the testbeds was used to gauge how residents' thoughts on the technologies they are using have changed over time.

- **Interviews with TAPPI Partners:** In order to maximise the capture of learning from across the TAPPI2 programme, CCHPR researchers also conducted interviews with other project partners, including representatives from the co-production team and the TSA. These conversations provided additional insights into key aspects of the TAPPI2 programme, particularly as the partners interviewed had some oversight across the six testbeds.

As part of the Evaluation and Shared Learning Partner role, CCHPR also provided support to testbeds in developing their own capacity for evaluation. This involved:

- Conversations with testbed staff at the outset of the TAPPI2 programme, and periodically throughout the process, where we encouraged them to get in touch with any questions they had about their own evaluations.
- An evaluation workshop, breaking down the process of evaluation into key stages, and setting out important considerations which the testbeds might want to take into account (held on 1st December 2022).
- The survey, which was distributed to all the testbeds, which they could use for their evaluations, and which also fed into the overall evaluation (with the results presented in the July 2023 interim report (see appendix)).
- A second evaluation workshop, to share evaluation findings and also to encourage shared learning among the testbeds.
- A standalone evaluation toolkit, drawing from several useful sources of information around how to conduct an evaluation of technology projects in housing and care settings. This toolkit was based on the first evaluation workshop.

4. Findings

4.1.The TAPPI2 technologies

The table below summarises the technologies which have been used across the TAPPI2 testbeds, highlighting some of the key advantages and disadvantages of different kinds of technologies.

Types of Technology	Advantages	Disadvantages	Testbeds trialling the technology
Voice-controlled virtual assistants (such as the Amazon Alexa)	Easy to use; readily available on the commercial market; can connect to many household items that might otherwise be difficult to use for those with health problems, and therefore boosts independence; useful for providing reminders (such as to take medication); may feel like 'company'.	May be set-up challenges; requires good connectivity; requires several other technologies (such as smart bulbs) to provide full benefits; can be difficult to use with speech issues.	Haringey; Wiltshire
Robotic vacuum cleaner	Easy to use for people with mobility issues, it provides a sense of independence by enabling people to do household tasks.	Some need to be controlled through a smart phone, which can be challenging for those with limited digital skills.	Haringey
GPS pendants (such as Oysta)	Boost confidence and independence by enabling people to go out for longer, or on their own; enhance a feeling of safety.	May send false alerts; they only work if they have a good, reliable service behind them.	Haringey; Southend; Platform; Wiltshire
Video doorbell	Can improve a sense of safety, prevent people from rushing to the door, and therefore reduce the risk of falls.	Requires good connectivity; demands extra fees for subscription to fully function; may require payment of a maintenance fee.	Haringey

Beacons	Can alert people with hearing impediments to things such as doorbells being rung, or fire alarms being triggered.	Only works if positioned in a highly visible location.	Haringey; Platform
Remotely controlled appliances (including lights, electrical sockets, doors, and curtains)	Easy to use; boosts independence by enabling people to carry out everyday tasks themselves, which might otherwise be difficult.	There may be set-up and maintenance challenges.	Haringey; Platform; Wiltshire
Sensors, including movement, heat, humidity, and mattress sensors, etc.	Can be useful for preventing health deterioration (e.g., by picking up on issues early); may provide peace of mind to tenants and families; data can be used to tailor care services to needs.	People may feel sensors are invading their privacy; some designs are less intrusive than others.	Bield; Southend; Haringey
Falls detectors	Improve a sense of safety and independence; could reduce time waiting for help in the event of a fall by alerting staff more quickly.	May require good connectivity; some designs are more user-friendly than others; sensitivity levels may cause issues, and an initial trial and error period, as well as regular check-ins and reassurance for users, will likely be needed.	Bield; Platform; Haringey; Wiltshire
Tip kettles	Easy to use; reduce the need for lifting; boost independence by enabling people to do some activities for themselves, which otherwise may be difficult.	Still needs someone to fill it, it is not big enough for people's preferences.	Platform; Wiltshire
Hydration cups	Enables people to keep track of how much they are drinking and provides data to	Some people prefer a larger sized cup (any cup, smart or not, needs to be designed	Wiltshire; Bield

	care providers to prevent dehydration.	around the user); automatic data collection may need supplementing with manual entries if connectivity in the building is not seamless	
Tablets	Can be used to take advantage of several online opportunities, including entertainment, socialising, financial wellbeing, and others.	Difficult to use for people with low levels of digital skills; it requires ongoing training and support; requires good connectivity; and there are risks of online harm.	Wiltshire; Platform; Haringey
Pain checker (PainChek)	Useful for non-verbal people to communicate how they feel; reduces reliance on subjective assumptions.		Southend
Care platforms (such as Amba, Miicare, and Anthropos)	provides an overview of data to inform care; useful for preventing health deterioration by enabling issues to be spotted early.	Need a designated staff to monitor the data; interoperability can present a challenge.	Southend, Bield, Platform
Magic tables and touch-screen notice boards	Can provide entertainment in a communal setting; can bring people together for socialisation; may make information more accessible.	Difficult for people with shaky hands; some users with low levels of digital literacy may view them as too complicated.	Platform; Pobl; Southend; Wiltshire
Wall-mounted call systems (such as Appello)	Enables communication between residents and staff within the building.	Complicated for some users; touch-screens can be difficult to use, especially for people with shaky hands	Wiltshire (provided by housing provider Housing 21); Platform

Communication app	Enables non-verbal people to communicate by typing; allows people to express themselves; can be set up with frequently used pre-set phrases	Requires prompts to use the app; may depend on which carer is present	Haringey

How technologies were chosen varied across the testbeds. Some testbeds used occupational therapists or TAPPI2 project managers, who spoke with residents about their needs and recommended particular technologies to meet their individual needs. Co-production occurred across most of the testbed sites in order to discuss which technologies people felt would be suitable for them and to involve residents in service design. An exception to this is Southend, where residents had less involvement in co-production.

4.2.Suitability of device design

The suitability of device design is a pivotal factor in determining the effectiveness of technology for older adults. A well-suited design not only addresses specific needs but also aligns with the preferences and abilities of older people. It should consider factors such as ease of use, adaptability to physical limitations, aesthetics that promote user acceptance, and compatibility with the broader context of people's living situations. The TAPPI2 project shows that devices with the right design, which are easy to use, contribute to enhancing quality of life for older adults by seamlessly integrating technology into their daily routines, fostering independence, and improving overall wellbeing, are typically well-received by users. For instance, a resident explains how sensor lighting is simple to use and prevents her from falling:

> *"I got a sensor light, which I find very, very useful. I've got one on the wall near the bedroom window. As I get out of bed in the night, it comes on. And then I've got one on my dressing table, and I've got one in the hall that shows me into the bathroom at night. I don't need to leave a bathroom light on during the night [anymore]."* – Resident, Platform

One of the key determinants of the success of technology for TAPPI2 participants is whether these devices meet their specific needs. Many older people have a diverse range of requirements, including health monitoring, communication support, entertainment, and assistance with daily tasks. Devices that address these needs directly are likely to be embraced. For instance, virtual voice assistants, such as Alexa, can help people grappling with cognitive decline to remember to take medications on time.

> *"Alexa is brilliant for me. [It] reminds me* of *my medication.* Sometimes *it could be four o'clock in the afternoon and I forgot to take my morning medication."* – Resident, Platform

Additionally, it assists individuals with mobility challenges by seamlessly controlling lights and switches through voice commands, enhancing their independence. One resident with limited mobility stated:

> *"Life has actually been easier since I had the Alexa. Because just having the lights switched on with that is just amazing. Because now I don't have to twist and turn to reach the light switch when I'm in bed if I'm on the opposite side, it's not so much [of a] pain."* – Resident, Wiltshire

The interviews with participants who have been using Alexa showed that the key to its success in meeting these specific needs lies in its simplicity and adaptability. Its voice-activated interface eliminates the need for complex button presses or touchscreen interactions, which can be challenging for those with cognitive or dexterity limitations. However, while many residents find voice-activated technologies helpful, some, like those with speech issues, might have trouble using it. For instance, one resident mentioned occasional difficulty in speaking clearly, which made her worry about Alexa understanding her.

Some electronic devices, such as tablets, are not typically designed with the specific health needs of older adults in mind. This is particularly true for those with poor eyesight, shaking hands, or arthritis, which can make working with certain devices, like touch-screen smartphones and tablets, difficult.

> *"I stopped using computers a bit because of my disease. Sometimes I make mistakes or take longer because Parkinson's also causes slowness in tasks and touch sensitivity issues, you lose the sense of urgency. This limitation restricts my possibilities."* – Resident, Haringey

However, it's crucial to recognise that even some devices targeted towards people with specific health needs may not fully meet the needs of these individuals. For instance, some residents have encountered challenges with certain buttons which have been designed to be easy to press, finding them overly sensitive and prone to accidental activation, and some have therefore requested that these were removed:

> *"The big red emergency button is a pain. Because every day somebody knocks on it by accident."* – Resident, Wiltshire

Similarly, one testbed encountered challenges with plug-in sensors meant to track residents' use of cookers and microwaves. The resident who used these sensors found the devices too bulky and space-consuming on her countertops. For individuals with shaky hands, this posed a significant problem:

> *"I had the sensors everywhere. The little square boxes that plug in [to electrical sockets], but they were so big that they were pushing [my appliances forward]. I need the room because my hands shake a lot, and the longer the day goes on, the more they shake… I just found it was getting difficult to get things out of my cooker and the microwave because the device was pushing them forward."*
> Resident, Southend

It is worth highlighting that since some of the technologies being tested in these testbeds are relatively recent, there is an ongoing process of discovering the most effective ways to design and customise specific devices to seamlessly integrate into individuals' lives while aligning with their preferences. An instructive example here is the experiences of some testbeds which have introduced hydration cups. While some residents liked their cups, and felt they were beneficial, other TAPPI2 participants found that they did not match their personal preferences. The cups are the standardised size commonly used in the care sector, as larger cups may pose challenges for people with reduced strength and dexterity. However, for some residents who drink a lot of liquids, this meant they had to frequently refill their cups to stay hydrated, which can be inconvenient.

Testbeds' experiences with this technology also highlight the need for interoperability and connectivity to be built into projects from the outset. Although these cups are designed to measure precise fluid intake, they are unable to record data in areas where they are not connected to wi-fi, and so, much like manual fluid monitoring, recordings are not made of fluids consumed outside of residents' homes. Many residents in supported housing or extra care settings enjoy coffee or water when socialising in communal areas, and this can present challenges for hydration tracking if there are any gaps in wi-fi connectivity in different parts of a building. Although manual data entry can be undertaken via a linked app if residents wish to use this function, in order to best support robust data collection and analysis, data from smart hydration cups should be supported by seamless connectivity across housing settings, and should connect to key care systems, including through offering training to relevant site staff and supporting residents to access their own data to promote independence.

While some residents chose to return their cups as they did not like their design, some residents with particular healthcare needs found the cup to be beneficial, and enjoyed using it throughout the day. This further highlights the need to match technologies up to the most appropriate settings, and to people's individual needs.

The market for technology created for older users is still in its early stages, and many businesses and developers are experimenting with various solutions. As a result, figuring out what best suits the unique requirements and preferences of older people can be a trial and error process. It is to be expected that there would be lessons to be learnt about how specific technologies can operate in practice and how they can be tailored to match individuals' requirements and preferences in a project like TAPPI2, where innovation is encouraged.

4.3.Benefits realisation for residents

Achieving benefits for tenants/residents is a key aim of the testbeds' TAPPI2 projects – and indeed for many organisations looking to implement technology enabled care (TEC) services. This section of the report therefore sets out some of the key observable outcomes for tenants/residents who have taken part in TAPPI2, taking into account key ways in which people have benefitted from using technologies, along with associated challenges and limitations.

4.3.1. Independence and control

Independence is widely recognised as a key benefit associated with the use of telecare technologies (TSA, N.D). Interviews conducted at an early stage in the TAPPI2 project highlighted that improving their level independence, or maintaining it over time, was a central hope for many residents when they decided to participate in TAPPI2. According to our survey of residents, reduction in the ability to live independently was among the four most prominent worries for residents. For some, the aim to improve independence was about regaining independence which was felt to have been diminished through health issues:

> *"[I hope] to enhance my independence and make me able to carry on doing everything else I can do. Sometimes my fingers are so damaged that even pressing the light [switch] is so painful. So now at least I could just tell Alexa to turn on the lights. So, anything that enhances my independence is fantastic."* – Resident, Haringey

Indeed, there is evidence that some TAPPI2 participants have noticed improvements to their independence as a result of using the technologies being trialled. Some of the activities which the technologies used at the TAPPI2 testbeds assist with include everyday activities

such as cleaning , meaning people with mobility issues are able to do this without relying on onsite staff:

> *"The [robotic vacuum] was to help me with my independence. I'm very, very independent. And so that made it easy. So I'm able to do it without having to rely on somebody else to do something else for me. And the [remotely controlled] curtain, which is the [technology] I'm dying from waiting for, because it's hard to get to and use close [my curtains]. Especially in the winter, when it gets dark quickly, I don't bother to even open it [because it's difficult]. So I leave it… And then the lighting, when my fingertips and everything swell, it's easy to just tell Alexa to do all the lighting and things like that… It has made a difference." – Resident, Haringey*

As this quote from one resident highlights, using a robotic vacuum to clean, or being able to turn on lights and open curtains remotely, can go some way towards instilling a feeling of improved independence by enabling her to complete everyday activities on her own.

For other TAPPI2 participants, the independence gained through using telecare technology has been more transformative. One Southend resident, who has a learning disability, had begun using a GPS pendant (Oysta) when he left his home:

> *"When I go out, I can call someone if I'm in trouble or something… It's safer, it is… I'm going to wear [my pendant] today, I'm going to go out and see my girlfriend… I love this [pendant]."* – Resident, Southend

The knowledge that he could press a button and instantly be in contact with his carers provides a sense of security for this resident, which has significantly improved his independence. As one member of staff who works closely with him noted, he will now happily go out for longer periods of time, and has begun to embrace his independence, as he no longer feels as though he needs to be home before it gets dark outside.

For others, an increased level of independence came from the confidence boost that using technologies had provided for them:

> *"These technologies help me live more independently, especially on the social side, because I suffer horrendously from anxiety. And I couldn't go out or do anything by myself. So it's been a really long, sort of hard struggle to get back into it. But with the help of things like technology, it's given me the confidence to try things."* – Resident, Wiltshire

Different technologies therefore have varying degrees of impact on people's sense of independence. Some technologies – such as the tip kettle or voice-activated lights – may have an impact on independence in their own right, by enabling people to carry out daily activities without assistance. However, the operation of some technologies – such as GPS pendants – is rooted in a broader service (e.g. involving carers or onsite staff responding to calls), and the reliability of these services are essential for ensuring that the devices themselves have the desired impact on independence. As one TAPPI testbed manager highlighted, preventative technologies are only as good as the people behind them, monitoring the data and driving their performance.

4.3.2. Health

The second survey of residents revealed that 85% of respondents reported experiencing physical illness, while 19% indicated that they thought they performed everyday activities either not very well or poorly. These findings underscore the significance of the TAPPI project's aim to enhance the health and well-being of older individuals through technological interventions. Some of the devices provided through the TAPPI2 project, such as tablets or camera doorbells, may not directly contribute to improving health, but instead offer indirect benefits. For instance, devices such as tip kettles and other similar appliances play a pivotal role in maintaining hydration, as one resident highlighted:

> *"On the weekends, I used to get het up because I couldn't get a drink or anything. Well, now, I've got that [new kettle] I know I can have a drink. So I know my health is going to be all right because I won't suffer from dehydration, and I can keep myself going."* – Resident, Wiltshire

Meanwhile, the camera doorbell contributes to fall prevention by eliminating the need for residents to rush to the door, reducing the risk of tripping and falling:

> *"The [camera doorbell] is very important because we had a fall. We live 40–45 steps away from the doors, and when people ring, they are impatient. Remember, we are on the main road, and so they (the drivers) park their vehicles quickly; they don't want to get a ticket. They expect us to answer within 10 seconds of those forty steps. It takes about 25–30–40 seconds. With this [camera doorbell], you're telling them you're coming down."* – Resident, Haringey

Some devices are preventative in nature, but can also provide reassurance to residents about their health on an ongoing basis, enabling them to feel a sense of improved control over their health. Certain devices, such as sensors or smart mattresses, excel in monitoring residents' health. One resident underscored the importance of data access:

> *"I'm not a doctor. The [onsite staff are] not doctors. But you see it in black and white, well, blue and green, and orange, or red if [your health has been] very bad. But sometimes it's a wake-up call to see how long I go sometimes without sleeping at all. And then how long I go after that… I know they say how [important] sleep patterns are for health. It's nice to have access to [the data from the mattress sensors]. I think it's great. I would recommend it to anybody."* – Resident, Southend

However, it is important to note that effective monitoring and data utilisation are integral to making these devices work optimally. These technologies can provide valuable insights into a person's wellbeing and daily routines. Nevertheless, the success of such monitoring hinges on having someone responsible for analysing and acting upon the data. In settings like retirement homes and independent living residences, where there might be no designated personnel to oversee this data, its potential value may remain untapped. On the other hand, in settings where trained professionals can actively monitor and utilise this data, such as care homes, these devices can significantly enhance the quality of care provided to residents. Therefore, the effectiveness of these technologies can vary depending on the setting and the availability of dedicated personnel to manage and act upon the collected data.

4.3.3. Safety

Many residents express reservations about using the internet, primarily driven by fears of making costly mistakes or falling victim to scams. Privacy concerns and worries about their digital vulnerability contribute to this apprehension. One resident's experience illustrates these concerns:

> *"One time my husband and I did have everything on a computer. Then someone within this building… went to her computer one day to do some work on it and she found that £5000 had been moved out [of her bank account]. And it was because she'd answered a [scam] phone call… and she lost all that money… I removed everything I had on my computer and I haven't gone near a computer since… It's so easily done, and people can be drawn in so easily. So I won't be drawn in because I won't do any [online activities]."*– Resident, Bield

These fears that many harbour concerning the internet caused this resident to completely disconnect from the internet.

On the other hand, some devices play a pivotal role in enhancing residents' safety through their preventative features or enabling them to more easily ask for help. Sensors designed to detect falls have had a unique preventative effect for some residents. Interestingly, this effect

is not solely derived from the sensors picking up data to predict potential issues but rather from their influence on the residents' self-awareness. One Bield Resident has embraced the sensors as a personal challenge, actively striving to avoid falls. Being aware of the presence of her sensors has made her more conscious of her movements, significantly reducing her risk of falling:

> *[Since getting the sensors], I find that I'm more particular in my movement. It's almost as if they're challenging me, you're being challenged. So I've only fallen once since I got it [installed]. Before, [some of my falls] were just trips, some were [due to] getting up too fast. But as I say, I've only had one bad fall [since getting the sensors] and that's been great. So I think that in itself being there [helps], and I know it's there. And I'm thinking 'go on, don't do anything stupid. Take your time.' It's a challenge. Stay on your feet for as long as you can."* – Resident, Bield

Residents who may be aware of the risks they face, such as falls, have adopted fall detectors and GPS pendants (such as Oysta devices) to get help in case of incidents. For instance, one resident who suffers from epilepsy expressed that they felt more confident as a result of using the GPS pendant:

> *"I feel safe. In other words, when I do go down, the alarm goes off… And people won't say 'what's wrong with him?'"* – Resident, Wiltshire

This technology therefore provides reassurance, as it ensures that assistance will be summoned promptly in the event of a fall.

Devices like camera doorbells provide an additional layer of security by allowing residents to see who is at the door and bolster residents' sense of safety by enabling them to monitor their surroundings. As one resident stated,

> *"I felt much safer because I knew that if someone was there, I could see them, and they moved. So, I feel much safer. It's not just having a doorbell for package deliveries; it's like having a burglar alarm because people don't know if you have it on record, so they're less likely to attempt anything. It provides a lot more security."* – Resident, Haringey

Residents' experiences demonstrated that technologies could become a crucial component of residents' safety measures, offering them peace of mind and reducing common safety concerns.

4.3.4.Social interaction

According to the first round of the survey, the majority of respondents were satisfied with the frequency with which they spoke to family and friends, while 31% would have preferred more contact. The survey also highlighted that over half of respondents said they were either 'often lonely' or 'lonely some of the time'.

The data suggests that individuals who are satisfied with the level of contact they have with their loved ones are less likely to feel lonely. Indeed, 90% of those who said that they hardly ever or never felt lonely said they spoke to their loved ones as often as they would like. Likewise, 70% of those who were often lonely were not satisfied with the frequency of their contact with family and friends. This highlights the importance of social connections in mitigating feelings of loneliness. The interviews held with residents highlight that TAPPI2 has had an impact on people's social interactions.

Unexpected benefits of technologies

While technologies like Alexa were initially given to some residents to provide practical reminders and smart lighting, some unexpected social benefits have emerged. Some individuals have found solace in these devices, often considering Alexa as more than just a digital assistant. They engage with Alexa as if it were a companion, using it as a means to combat loneliness.

> *"Alexa is like a person, [it] talks to you. If you're on your own, Alexa is good."* – Resident, Haringey

This unexpected benefit exemplifies how technology can bridge social gaps and become an integral part of one's daily life, extending beyond its intended purpose to provide a sense of connection.

Varied communication preferences

Some kinds of technology – such as those which can enable users to take part in video calls – have been identified as having potential benefits for users' wellbeing as a result of enabling increased levels of social interaction. Several interview participants mentioned that they use smartphones to speak to relatives or friends using video calls, and some were also making use of the technology provided by TAPPI2 for this purpose.

While devices like tablets and smartphones offer convenient ways to connect with family and friends, some residents still express a preference for the simplicity of a landline phone.

> *"I don't even use the [simple] mobile I have got- I use landline to call my family".* – Resident, Wiltshire

This preference highlights the importance of accommodating diverse communication preferences among older adults. Technology should not impose a one-size-fits-all approach but should provide options that align with individual comfort and familiarity, ensuring that no one is left feeling isolated due to unfamiliar or overly complex devices.

Social benefits beyond technologies

Participation in programs like TAPPI2 has revealed social benefits extending beyond the realm of technology itself. Involvement in co-production efforts has often enriched the lives of participants, bringing them closer to their communities and instilling a newfound sense of confidence and empowerment.

> *"It certainly pushed me into going down the local church, in fact, down the road at a coffee morning on a Wednesday on a Tuesday, and it pushed me into doing that. [I now] get on with it. Get on with life."* – Resident, Bield

This demonstrates that technology, when integrated into broader community engagement initiatives, can foster social connections, promote inclusion, and enhance the overall wellbeing of older adults.

The importance of social interactions

The rise of technology also underscores the significance of human interactions in the lives of older adults. There is growing concern that an overreliance on tech solutions may diminish the frequency of visits from caregivers.

For some of the residents in sheltered housing or extra care settings who were interviewed as part of the TAPPI2 evaluation, seeing their care provider is not only about monitoring their health issues or checking on their wellbeing, but also the only social interaction they may have in a week. Although one of the reasons for using technology in some care homes in the UK is indeed to reduce pressures on care staff time, this was not cited as a driving force behind involvement in TAPPI2 at most of the testbeds. For instance, at one testbed site, residents were given devices to use every morning to inform onsite staff about whether or not they are okay by pushing a button. While this button is intended to let staff know which visits they should prioritise, rather than to reduce the number of visits made, some residents do not use the button even if they are physically okay, as they worry that the staff will not visit. Indeed, they deem it important to have the chance to be visited by someone and have some social contact during the day.

> *"I don't press my buttons in the morning to say I'm okay, not okay, or whatever. So, I have a face-to-face meeting. And when they asked me what I*

wanted to do when all this [technology] went in, I said I wanted contact, face-to-face. And whoever's on duty will come and say, 'good morning, are you alright?'" – Resident, Platform

The fear of losing these familiar, friendly faces is a significant concern that leads to a reluctance to embrace technology.

"Everyone's got their individual needs, and I'm assessing them for what you know they need and what's important to them. But I think the overriding feeling I'm getting from each person is that they just don't want things taken away from them; they want to keep things as they are, like, keep on having the carers coming in, and that friendly face that some of them are scared that technology will take away, and they'll have something different… that's sort of their worry." – Staff, Wiltshire

It is essential, therefore, that people are reassured about the purpose of the technologies they are using, and that they are able to retain face-to-face interactions should they want to.

4.4.Benefits realisation for families and friends

4.4.1. Peace of mind

While some tenants taking part in TAPPI2 felt that technologies could offer enhanced peace of mind for themselves, peace of mind was most often brought up in interviews in relation to their families and friends. As one Bield resident highlighted, the sensors which she is using will ensure that somebody knows if she falls over, and this has reduced worry for her family, as they know that they will be informed if there is a problem:

"I sometimes fall… For my family, it's good for them to know there's something else other than them phoning or coming in, or getting things for me. If something goes wrong, they'll be told, or they'll be put in the picture as to what might be happening. I think it's the freedom of mind for everybody. And they don't need [to make] a phone call every morning to say 'are you okay? Do you need anything today?' I think it's merely peace of mind more than anything else." – Resident, Bield

Indeed, sensors which monitor movement or activity such as using a microwave or opening a fridge can be beneficial for reducing both families and for service users themselves. For families, such technologies can provide reassurance, and for older or vulnerable people, these technologies can reinforce a sense of independence, as they are not dealing with

constant check-ups from worried family members. Instead, as a staff member at one testbed highlighted, this can create time for more meaningful conversations with family members.

4.4.2. Freedom

The peace of mind which technologies can bring can have a significant impact on the everyday lives of families or friends of those using the technologies, particularly where they are the primary care giver for their relative.

For example, the mother of a young Haringey resident with Downs Syndrome who has been using a GPS pendant and an Alexa virtual assistant which provides him with reminders to complete activities essential to his health, said that this has had a positive impact for the family:

> *"He needs to drink two litres of water every day. Loads and loads of water. So the Alexa, we've got alarms on that now. So it reminds him to drink water? If I'm at work, then we know that those reminders are there… It gives me not loads of freedom, but a little bit of freedom. And I don't need to be rushing back from work. It just gives me a bit of peace of mind."* – Family, Haringey

The freedom which comes from not needing to rush home to ensure a loved one is ok is echoed by others, who cite a transformative effect of simple, commercially available technologies such as virtual assistants:

> *"We've had one client again who is the main carer for her Mum, and she mentioned that especially during the winter when it gets dark a lot quicker, she can be out [of the house] for longer, knowing that Mum can turn the lights on herself. If she's scared and it gets dark, she can just say 'Alexa, turn the lights on'. And if she needs to contact Mum, whereas before [her mother] wouldn't be able to pick up the landline as she's bedbound, now she can just communicate through the Alexa and say 'Mum, I'm running late."* – Staff, Haringey

It is clear, therefore, that the impact of technologies for families and friends of service users should be considered when designing a TEC service, as positive effects can extend to service users' community networks.

4.5.Challenges and opportunities for engagement

As discussed in section 4.3.4, engagement in the process of TAPPI2 has been enjoyable for many participants and has had social benefits in addition to any outcomes related directly to the technologies used. However, getting people engaged is not without its challenges.

Indeed, across several of the testbeds, there were issues with getting people involved in co-production. Some people felt that the co-production meetings were too long and tiring, while others simply did not think TAPPI2 was for them. As one Pobl tenant noted, a lack of interest in technology meant that some of her neighbours were not motivated to get involved:

> *"[I've been] trying to encourage people to get involved, but nobody's really interested. A lot of [the challenge in getting people engaged is] mentality. A lot of people my age, in fact, are [still] thinking of the olden days. And I think I'm, fortunately, at the age of 82, more forward thinking than a lot of people my age."* – Resident, Pobl

Several of the most highly engaged TAPPI2 participants – some of whom took on co-production champion roles – were already active members of their community when they got involved with TAPPI2. This includes people who have previous experience of representing other residents in a forum:

> *"I was in a big group, fighting for tenants in Glasgow once a month… And then this TAPPI came up, and I thought I'll give that a go."* – Resident, Bield

> *"I'm [a representative] for all the pensioners in Haringey… I organise events, I organise lectures, and I organise for the police to talk to them about fraud… I'm with the committee. So we try and organise and get knowledge to them."* – Resident, Haringey

Engaging people who are less involved in the local community, and who have little existing interest in technology, therefore appears to present the greatest challenge. As the TAPPI2 co-production partners stated, there are some important barriers to engagement in some settings. Indeed, where people have significant unmet needs – such as housing needs, for example – this can reduce people's motivation to engage, if they feel that technologies might not address their most pressing needs.

4.6.Long term viability

Residents and managers who have been participating in TAPPI2 raised two critical factors that long-term viability of technology adoption in housing and care settings hinges on. First, affordability plays a pivotal role, encompassing not only the initial device costs but also

ongoing expenses, including subscriptions and connectivity charges. As one resident expressed, affordability is a significant barrier to engagement with digital technologies:

> "*I haven't done anything with the tablet. I just can't afford to have an internet connection.*" – Resident, Wiltshire

This sentiment resonates with others who appreciate the value of technology but are burdened by financial constraints. A pertinent question arises regarding who should bear the burden of these costs—should it be the residents themselves or the organisations providing care or housing? There is a clear need for a sustainable and equitable approach to affordability, one that ensures technology remains accessible to those it seeks to benefit without imposing undue financial strain.

The second pillar of long-term viability revolves around maintenance and sustainability. Residents and stakeholders are rightfully concerned about the fate of devices should they break down and about where responsibility lies for addressing such issues. Additionally, there is uncertainty regarding who will assume responsibility for maintenance once the TAPPI2 project concludes.

In multi-organisational settings, where various entities oversee different facets of residents' housing and care experiences, there may be ambiguity surrounding the ownership of repair and maintenance for technology solutions. For instance, one resident expressed concern about building managers not being involved in TAPPI2 and questioned their role in fixing technologies received through the project once it concludes. Residents emphasise the need for a post-project plan:

> "*What's the follow-up plan? What's the long-term plan you're leaving me with so I can call somebody else to fix any problems with the technology?*" – Resident, Haringey

The engagement of building management is seen as crucial to ensure continuity of support for technology-related issues. Beyond the TAPPI2 testbeds, this underscores the critical importance of defining clear responsibilities for technology maintenance in housing and care settings. Ensuring that technologies continue to operate effectively in the long term is essential for delivering sustained positive outcomes and preventing disruptions that may erode the benefits technology aims to bring to older adults in these environments.

4.7.Digital exclusion

Digital exclusion is widely understood to disproportionately affect older people, with 67% of those in the UK who are entirely offline over 70 years old (Centre for Ageing Better, 2021). Older people's digital exclusion is rooted in several factors, which can include affordability, health issues which affect people's ability to use particular digital devices (e.g. touch screens), and levels of interest in getting online (Gallistl et al., 2020). Given that many residents using the services provided by the TAPPI2 testbeds are in this age group, digital exclusion is a key issue which has arisen over the course of the project. This section sets out some key considerations around digital exclusion along three different veins: connectivity and infrastructural barriers to getting online, digital skills, and confidence with technologies.

4.7.1. Connectivity and infrastructural barriers to getting online

Access to a secure, reliable internet connection is essential for any degree of digital inclusion. However, at the outset of the TAPPI2 project, many residents in testbeds based in sheltered or supported housing or extra care settings did not have access to broadband services in their own flats. This presented a considerable challenge to several testbeds, and caused delays to some of the pilots, since some devices could not be used to fulfil their full functionality until Wi-Fi was in place.

As a TSA representative highlighted, connectivity is a foundation which underpins any TEC scheme:

> "*If you don't get that right up front [that causes a problem]… We need to think about how to make [housing] more connected. If you get that right, it allows you to build services on top of that. If you don't, and you say 'let's just wait until we buy a new widget [before we think about connectivity], it will come unstuck.*" – TSA representative

Indeed, some testbeds highlighted that not having Wi-Fi installed prior to the onset of the TAPPI2 project meant that they couldn't proceed at the pace they had anticipated:

> *"So much of the technology that we would have liked to have put in and depends on good connectivity and Wi-Fi and we didn't have that. That's not something that we kind of provide as part of our service offer. And again, that's partly why things have taken so long."* – Staff, Pobl

As a result of this learning, some testbeds have resolved to roll out Wi-Fi provision as standard across their services. However, the challenge posed by connectivity issues varies across different settings. For example, where a building housing older tenants is owned by

one organisation, and managed by another, there are therefore additional challenges faced around who should pay for connectivity, and around securing the necessary permissions to install connectivity infrastructure. Further, some testbeds highlighted that consumer technology was not always interoperable with corporate broadband, and that this created considerable challenges for getting technologies to work effectively.

As previous research has highlighted, there is a clear relationship between housing circumstances and digital exclusion (Holmes and Burgess, 2022). Particular housing types can create a challenge for providing the necessary internet connectivity for telecare technologies. Indeed, connectivity of individual flats might vary within large buildings constructed using materials such as concrete (Holmes et al., 2022). For example, one Haringey resident who lived in a top-floor flat and had mobility issues experienced difficulty with the installation of her video-doorbell, since the Wi-Fi in her flat did not extend to the entrance of her building.

> *"[I thought] perhaps a doorbell with a video could be helpful because then I would not need to go downstairs [from my top-floor flat] to ask who was at the door. And then they started doing the [installation], you know, but the only problem is that in my [three-storey] block [of flats], I'm right at the top. The internet doesn't reach the door."* – Resident, Haringey

While this issue was fixed (using a Wi-Fi mesh system), this highlights the ways in which infrastructural challenges can present barriers to implementing TEC services, particularly in settings such as people's own homes, where organisations have little control over the Wi-Fi services in place.

4.7.2. Digital skills

In the UK, over one fifth of people lack the essential digital skills needed for everyday online activities (Lloyds' Bank, 2021). These basic skills include being able to turn on a computer, set up a password for an online account, or make an online purchase (ibid.). Indeed, while connectivity is an essential foundation for TEC services, digital skills are also a key factor which can shape people's experiences of such services. As section 4.1 indicates, not all of the technologies being trialled as part of TAPPI2 require digital skills. For instance, some testbeds are using technologies such as devices that track water consumption, and kettles which do not have to be lifted up, but rather can be tipped on their base to make it easier to make hot drinks. Others are using sensors (such as movement sensors attached to doors) which do not require active engagement from residents in their everyday use. However, other technologies which have been identified as potentially beneficial for residents across some of the testbeds aim to enable residents to engage with online opportunities, and therefore require some level of digital skills. These include tablets and virtual assistants, among others. Digital literacy is therefore an important consideration for TAPPI2.

Among the residents taking part in TAPPI2, there is a wide range of digital skills, with some people having considerable experience of using the internet, and others having previously had little interest in getting online. Among those who had limited experience of being online, some residents highlighted that they may forget how to use some technologies, and need to write down instructions such as how to operate devices such as tablets.

> *"When I'm learning something, I do have to write it down, with regards to which [step] comes next… On the iPad, I have to keep the [passcode] number written down for to get into the machine. You know, and all that sort of thing. So I haven't got a head for keeping stuff… and I think, you know, the older that you get, it's harder. It's a lot harder*." – Resident, Bield

This suggests there is a need for ongoing support with using digital technologies. Where people feel that their digital skills are lacking, having someone available who can provide support with getting online is a valuable resource, and time and patience are important here. Previous research highlights that digital exclusion exists along a continuum, with people experiencing varying levels of access to online opportunities, depending on their circumstances (Livingstone and Helsper, 2007), and so different people will have different support requirements. Some of the support offered with digital skills during TAPPI2 has included weekly drop-in sessions provided in Wiltshire by volunteers with AbilityNet, a digital inclusion charity (see abilitynet.org.uk). The skills training offered has been used to support people with activities such as using a tablet and doing online shopping.

Importantly, even those who may be considered to be internet users may require additional help with some online activities.

> *"I can order things online, but I'm not very good. I'm not right up to date, and I sometimes have to phone my daughter [to help me with online activities], and say 'what do I do here?'"*- Resident, Bield

Many of the TAPPI2 testbeds have offered digital skills support as part of their projects, and this will likely need to continue beyond the duration of the TAPPI2 project if technologies are to continue benefitting residents.

4.7.3. Confidence and motivation

Closely related to digital skills is the need to build confidence with using technologies. Indeed, a lack of confidence can prohibit individuals from taking full advantage of online opportunities (Ofcom, 2022). Given the wide range of experience among TAPPI2 participants when it comes to using technologies, it stands to reason that the confidence of those taking part varied considerably. Notably, while for some people, a lack of confidence in their digital

skills means that they are reliant on support from others with getting online (as discussed in section 4.7.2.), for others, this lack of confidence can put people off engaging with technologies in the first instance.

> *"I'm not clever enough for all that [using technologies]. I'm in my mid-eighties now and I'm just past all that. I can't take all that in because I was never educated that way. But if I need help, I know what to do – I've got [emergency help] buzzers."* – Resident, Bield

Notably, this resident – who enjoyed attending TAPPI2 meetings with her neighbours but had elected not to use any of the technologies provided through the project – attributes her lack of engagement in digital space to not being 'clever enough' to use technologies. Existing literature highlights that explanations which suggest using the internet is too hard for them are not uncommon among digitally excluded individuals: The Good Things Foundation highlights that thinking the internet is too complicated is a key motivational barrier to getting online (French et al., 2019). This quote is also instructive in highlighting the fact that the internet and digital technologies are positioned as unnecessary, since this resident has other kinds of support which she feels comfortable using, such as pull cords in her flat. Indeed, not recognising the benefits of using the internet, and therefore believing that the internet 'is not for me', is identified in existing literature as another notable motivational barrier (ibid.).

However, there is evidence that the TAPPI2 programme has helped some participants to build their confidence with using digital technologies. On CCHPR's first visit to interview Marie, a resident in Haringey, had a laptop which she had never used, and had a tablet which was still in its box. On our repeat visit, she highlighted that over a period of several months, she had been practicing using her tablet, with support from Haringey staff, and now felt able to try new things in the digital sphere on her own:

> *"I'd say I feel better with [technology] but I've got to get used to it. I've got to really think about it, because I can get on and find what I want. But if not, I can always try the tablet and do the best I can. And I might not have used all [the tablet's functions] at the moment, but it's given me the confidence to go and try on my own."* – Resident, Haringey

Indeed, while Marie's digital skills are still developing, and using her tablet still requires concentration, it is clear that she has now developed the confidence needed to explore the online opportunities that interest her.

While it is clear that motivation for getting online varies widely among those involved in TAPPI2, among those who did see the value of learning to use the internet, and of trialling technologies, a common theme emerged: Several people highlighted the fact that a broader societal shift toward digital space meant that they felt they had to become involved, so as not to be left behind.

> *"It's like a secret society really… there's no personal contacts anymore. I mean I can go to the manager here [to ask for help], but I like to do things myself. And that's when it's going to benefit me. That's why I need [the internet], I could buy a little computer then, second-hand, and get on with my life."* – Resident, Pobl

As this quote from this resident Pobl tenant, highlights, the shift to 'online first' services which has occurred across multiple sectors means that he feels he needs to get online in order to maintain his independence, since he doesn't want to rely on others to help him access information which he could find himself were he online. Other TAPPI2 participants echo this sentiment, saying 'I'm going to have to learn', or 'whether you like it or not, that is the way it's going… and you have to embrace technology going forward. It's going to be part of everyday life'.

However, it is also clear that some people simply do not want to be online, and do not intend to try new technologies.

> *"When you get old, the mind boggles… It's never occurred to me [to use the internet or digital devices] to be quite honest with you. I live my life as I like it. I've got my good friends here and things like that, we always communicate [in person and via landline phone]… As long as I can cook, eat my food and pay my bills [I don't need to get online]."* – Resident, Bield

This is not to say that being online is necessary for all types of telecare technologies. It is crucial, therefore, when assessing individuals' needs and considering how technology might play a part in care and support services, to consider both their current level of digital literacy as well as their desire to learn to use technologies.

4.8.Non-technological considerations

There are a number of contextual factors which shape people's experiences of using technology, and which vary considerably across different settings. This might be due to individuals' physical and mental health, the local built environment, or infrastructural factors, among others. Indeed, the contexts of people's lives impact the way in which technology fits

into their everyday routines and shapes their experiences of using technologies. Two key contextual considerations are discussed in this section: building specifications; and health needs.

4.8.1. Building specifications

The physical infrastructure and design of housing plays an important role in meeting people's needs. Some buildings housing older people are not designed to cater to the needs of residents, particularly where individuals have mobility issues:

> *"We've got a lot of this very kind of old sheltered housing that was built in its time, and it's probably reached the end of its life in terms of the design and the need for investment in it. They're not of the standard that we would be building older people's housing today; they have the standard of 30 years ago, in terms of the space and the layout, and all of that, and also all the other design features that we would expect in a modern old person's housing."* – Staff, Pobl

Indeed, one testbed is based in a building which was not originally designed to house older people. The building has very heavy doors, which can be difficult for many residents to use. While delays in the local testbed project had meant that technologies to make opening the doors easier were not in place at the time of the interviews, one resident highlighted that getting this technology would make life easier:

> *"It will be much easier [when I get an electric door]. Because the doors are so heavy. I could not do it. It's not getting out and in [the building that worries me], it's the doors [to my flat]… It's like Fort Knox when you try to come in. Honestly, I'm not joking, it is hard… You see, this place wasn't made to take invalids."* – Resident, Pobl

Poorly designed or inadequately adapted buildings can also create difficulties for wheelchair users. Indeed, one interview participant highlighted that she had been unable to access her kitchen and bathroom for several years because the doorways in her home are too narrow to accommodate her wheelchair. This has negative implications for her independence, and prevents her from doing many activities, including cooking, which she had previously enjoyed. She had received a tip kettle as part of TAPPI2, which was positioned at an accessible height in her living room. Indeed, she is not able to use a standard kettle, as she cannot reach the plugs or taps in her home, to the extent that she has been unable to wash her hands under running water for over four years. The new tip kettle is helping provide her with an improved sense of independence and control:

> *"[I can now make myself] something like a Pot Noodle or something for supper. But if need be, I could always do myself a cup of coffee or something, which is wonderful. [Being able to do that] gives you a feeling of [helping] a little towards your independence, to be perfectly honest, yes… I've lost complete control in many respects, and I need to get that back."* – Resident, Pobl

Evidently, while the tip kettle appears to be providing this resident with some level of improved independence, enabling her to do more for herself, this is in a context of living in a flat which does not meet her needs, and in which being unable to access her own kitchen has left her feeling as though she has lost control. Indeed, technologies may not be the most appropriate fix for this issue, as there is a clear need for physical home adaptations. However, this TAPPI2 participant has been waiting for these home adaptations for years already and is resigned to the fact that this may not happen in her lifetime:

> *"I want to get into that kitchen and want to get into cooking and what have you, [for] myself. And doing things. However, [the home adaptations are] in the future. You know, probably not in my time, the way things are going, but you never know."* – Resident, Pobl

As such, in the context of a system where necessary home adaptations may not be provided with any sense of urgency, it appears that technologies such as the tip-kettle can be helpful as a stop-gap solution, providing a much-needed boost to independence.

4.8.2. Health needs

Older adults, particularly those residing in extra care housing and retirement or sheltered housing schemes, have a diverse array of health needs and personal challenges. While technology holds the potential to offer solutions, it is important to recognise that it may not always be the most effective remedy. As one resident put it, some issues require the assistance of staff:

> *"I need to get someone to take me down. If something drops on the floor, I can't grab it; I have to wait until my carer comes."* – Resident, Wiltshire

For individuals grappling with significant health issues, their health-related concerns often take precedence. For example, one interviewee with mobility issues struggled with daily activities like dressing, expressed a willingness to explore technologies if they could offer assistance:

> *"I have real problems… If there was technology out there to help me, I would do it." – Resident, Wiltshire*

These voices underscore a critical point: while technology can be a valuable resource, it must align closely with the specific needs and challenges faced by older adults, particularly those with health-related concerns. Given that the most effective solutions to some challenges may not be of a technological nature, this highlights the importance of working with residents to determine what solutions would work best for them as well as considering a comprehensive package of solutions rather than a one-size-fits-all approach. Testbed staff stated this point clearly:

> *"I don't think it should just be one size fits all; it shouldn't just be [about] technology. [Services] should really be customised to that individual. So, for instance, someone might have a carer still going in, they might have some equipment, and then they might have a little gadget, that should just be a mixed bag; they definitely shouldn't just have technology to try and meet all [needs]." – Staff, Wiltshire.*

This approach embraces the diversity of residents' needs and underscores the importance of tailored, holistic solutions to enhance their overall wellbeing.

Co-production is a key aspect of the TAPPI2 project. Across the testbeds, co-production typically began with discussions about residents' needs and which technologies are appropriate to meet those needs. Starting these conversations early and focusing on individual needs is essential and enables both technical and non-technical solutions to be considered. Focusing on individuals' wishes and needs as opposed to starting with the technologies themselves enables projects to cover both highly technical and non-technical solutions. These findings also reinforce the point that in order to fully benefit residents and ensure a positive experience of using technology, it is necessary to consider non-technological issues and address the challenges that may arise.

Indeed, testbeds' experience showed that tailored technology solutions that directly address these needs tend to elicit more positive responses and hold greater potential for improving the lives of individuals in housing and care settings.

4.9.Organisational processes and culture

The TAPPI2 evaluation highlights several important ways in which organisational processes and culture work to shape the delivery of TEC projects. Some key factors which can help to ensure smooth implementation of these projects, as well as some important organisational issues which testbeds faced in their technology pilots, are set out here.

4.9.1. Resourcing

The TAPPI2 project highlights that effective project management is essential for the successful execution of projects, particularly those involving complex technologies and innovations. Testbed managers have underscored the importance of having a dedicated project manager, as implementing a technology pilot demands a substantial amount of time, energy, and focus. Attempting to juggle such responsibilities alongside other tasks can be challenging. Southend's perspective on having a dedicated project lead is particularly illuminating:

> *"You need that dedicated time and a dedicated person whose job it is to work on TAPPI, look at all the options, see what might work, and put it out there. When you're trying to do that on top of an already full-time job, it can be quite challenging." – Staff, Southend*

They emphasise the tangible benefits of having someone solely dedicated to the project. This dedicated individual can generate more evidence to support long-term goals, explore various options, and effectively communicate project updates.

However, there is a need not only for a project lead but also for adequate staffing to support the project more broadly. Therefore, while dedicated project management is crucial, it's equally important to have a team of professionals to drive the project forward effectively. In essence, resourcing is a multifaceted aspect of project implementation, encompassing both a dedicated lead and a supporting team.

4.9.2. Organisational buy-in

Experiences from TAPPI2 show that projects which have had support from the very top of their organization have typically been more successful or have run more smoothly. Indeed, testbeds with high levels of organisational buy-in have been able to leverage the learning from TAPPI2 to feed into broader organisational strategies intended to benefit service users more broadly, beyond the remit of the TAPPI2 programme.

For example, Bield, who have highlighted that senior staff have supported the project from the outset, have built the learning from TAPPI2 into their organisational strategy:

> *"[Taking part in TAPPI2 has] reevaluated all our thinking, to be honest, from our allocations process around how we use the newly developed TSA tools and the Virtual House to ensure we're getting the right tech for the person, to working with our adaptations team to ensure we can incorporate tech into our adaptations as a person's needs change. We've linked in with our tenant*

> *engagement team, and coproduced a coproduction strategy, [focusing on] how we work with tenants moving forward, and what that engagement looks like" –* Staff, Bield

It is clear, therefore, that when organisational buy-in is present, learning from a project such as TAPPI2 can be used to improve processes throughout the organisation. This means that the lessons from the project are not confined only to the team working directly on it, nor to improving similar TEC schemes going forward, but can reshape organisational practices more widely. Similarly, testbed staff highlighted that close collaboration with in-house communications teams can also be of significant benefit to technology projects. This can help to ensure effective and clear messaging, and to ensure that all stakeholders are kept up to date with progress and expected activity.

Buy-in from staff at all levels of the organisation is important for effective delivery of TEC projects. Testbed managers have highlighted that getting onsite staff on board has sometimes presented a challenge, as some onsite support and care staff have expressed concerns that technologies might add to their workloads or might replace their roles. Additionally, there are often varying levels of digital inclusion within a workforce, and supporting service users to use technologies may be challenging for some members of staff. Providing ongoing support for onsite staff is therefore essential for securing buy-in.

4.9.3. Procurement challenges

Procuring technology for use in housing and care settings can present considerable challenges for organisations. For example, some technology companies have minimum order requirements which can pose a challenge for organisations looking to run pilot projects with smaller numbers of devices. Further, as one testbed highlighted, 'the minute that our name got attached to TAPPI, we were kind of inundated with people trying to meet with us and sell [us] stuff'. Navigating the technology market and working out which suppliers have the product which will best suit the needs of service users, can be complex. Indeed, as testbed staff highlighted, the marketing of some products can be quite effective, even if the technologies being sold do little beyond an off-the-shelf solution which can be purchased 'on the high street'.

Expertise in technologies has therefore been highlighted as essential for ensuring a positive outcome from the procurement process. While the testbeds have all had support from the TSA as part of TAPPI2, it is clear that in-house expertise is also invaluable. Indeed, as Pobl staff highlighted, the organisation's IT team has helped to drive their project, and has brought expertise which has supported the success of their pilot:

> *"[The IT team] are having the conversations with the suppliers. You know, they understand all of that stuff around: Does X work with y? What are the implications of going with x rather than y? What are the data issues? What are the privacy issues?... All of that stuff is their world, around procuring, managing, and implementing technological solutions, albeit they hadn't done it in an assistive tech context in Pobl [before] so far. But they've brought a whole new world of expertise and insight that was just beyond our ability [as project managers]."* – Staff, Pobl

Indeed, while the evaluation has already made clear that project managers are a highly important part of resourcing a TEC project, it is evident that technological expertise is also essential during the procurement process.

4.9.4. Project lead-in time

Lead-in time significantly shapes the delivery of TEC projects. It serves as the foundational phase for planning, procuring technology, engaging residents, and ensuring a successful co-production process. Co-production, which ideally should have a pre-project phase, can face hurdles when there isn't sufficient lead-in time. Haringey TAPPI2 project staff underscore the importance of allowing sufficient time for co-production:

> *"Co-production requires time. And I think the kind of time we've had on the project has been quite limited as well. So, I guess, for co-production to work at its best, I think you need more time.*" – Staff, Haringey

Some onsite testbed staff highlighted that it is essential to set out expectations at the onset of projects, and to consider impacts on staff supporting the pilot in various capacities, including through dedicating time to project meetings. Testbed managers highlighted that effective project lead-in should consider not only the planning aspects but also synchronisation among partners and the availability of dedicated time and resources.

> *"It's about timing, and its lead-in is absolutely key… Across all of the testbeds, TAPPI has been in addition to our full time jobs. So the more lead-in you can provide, the better."* – Staff, Wiltshire

Lead-in time needs to be flexible and realistic, recognising the inherent uncertainties in innovative projects. Timelines should accommodate unexpected changes and challenges that may arise during the course of the project.

4.9.5. Impacts for site staff

There have been mixed reactions to technologies from some staff working in the day-to-day delivery of services within some testbed sites. Indeed, at some of the testbed sites, management staff reported that some care staff or onsite staff were wary of the technology being installed, and that they had expressed concern that these technologies might render their jobs at risk and feared that some aspects of their roles might be replaced with technologies.

Another concern raised by onsite staff was that technologies might add to their workload:

> *If there are any [technologies] that would be coming into play that [would mean] we then have to have more data to monitor, [that could] create more work and hindrance. Because if we have forgotten to monitor that device because we're dealing with an emergency… [that would make things harder] rather than easier – Onsite staff*

Additionally, some onsite staff themselves may have low levels of digital literacy, which can create challenges for supporting residents to use some technologies effectively. Notably, management staff highlighted that within the care sector as a whole, there is a high turnover of staff. Training staff to make the best use of technologies in housing and care settings may be challenging, as there is likely to be a need for continual retraining of new staff.

While some onsite staff are keen to see the technologies being trialled, care is being taken across some of the testbeds where the above challenges have become apparent to ensure that all partners involved in the delivery of initiatives using technologies in care settings are engaged and on board. This buy-in is likely to be important in ensuring that the TAPPI principles are embedded effectively across projects using technologies in all stages of planning, implementation, and use.

There are also important considerations around time commitments of onsite staff when implementing a technology service. Indeed, while managers at Southend had used data from sensors to adjust onsite staff schedules to ensure staffing resources are used most efficiently and effectively (e.g. in response to data showing that a resident may not need visits at a particular time of night), it is also notable that running a technology project requires considerable input of time from staff, as discussed in section 4.9.1. The impacts on onsite staff are therefore varied and should be carefully considered in the planning of any technology service.

5. Reflections on the TAPPI principles

5.1.Adaptable

The principle of adaptability is regarded as crucial by all testbeds involved in TAPPI2 project. They emphasise that adaptability extends to both the people involved in the project and the technology itself. Adaptation is seen as the key to overcoming obstacles that arise during technology implementation. It involves collaboration with various partners to surmount challenges faced at various points throughout the project and requires good communication between all partners and service users. Adaptability encompasses addressing the diverse needs of residents, including those with visual or hearing impairments, and adapting environments and messages accordingly to ensure everyone is able to benefit from the project. The ability to adapt is considered essential throughout the project's stages.

> "*I think for us, it's about not just being targeted at one particular group of individuals with one group of needs, so having technology that can adapt to different needs and circumstances, different client groups. It can grow and adapt with people's needs.*" – Staff, Pobl

The challenge of adaptability lies in ensuring that technology can keep pace with residents' changing needs and circumstances. Some assessments may be completed months before technology implementation, and it becomes necessary to revisit residents to determine if the selected technology remains suitable. A related challenge is the timeframe within which adaptability operates, especially concerning the healthcare system's ability to respond to evolving health needs. There is also the need for technology to adapt to different needs and circumstances, catering to various client groups, without requiring constant replacement.

5.2.Co-produced

Co-production has been acknowledged as vital for the TAPPI2 project. Suggestions have been made by those taking part in TAPPI2 for future co-production efforts to consider creating easy-to-read versions of materials or involving individuals from tenants' peer groups who can advocate on behalf of others. The interpretation of co-production implemented across the testbeds varies based on the different needs of service providers, suggesting that a more targeted approach might be beneficial. However, co-production is seen as a resource-intensive process, and there is a need for adequate time allocation to ensure its success.

> *"Co-production is great. And it's very achievable. But you just need to make sure you've got the right kind of people, the right kind of person carrying out*

their assessments, who's able to work in a co-productive manner. And you need the time necessarily allocated to it as well." – Staff, Haringey

However, implementing this principle has presented challenges for some testbeds in the TAPPI2 project. Engagement difficulties arise due to varying levels of motivation to use technology, as well as understanding of various technologies among tenants. Additionally, the challenges associated with co-production include the need for accessibility and engagement methods tailored to the specific needs of tenants, especially those with learning disabilities. The issue of trust and initial resistance to technology adoption must be addressed when seeking tenant involvement. Time constraints and resource limitations can hinder the effectiveness of co-production efforts, and there are considerable challenges in implementing it at scale owing to its time and resource-intensive nature. Additionally, there are concerns about the inclusivity of co-production, especially regarding tenants who cannot afford Wi-Fi or have safety concerns about online interactions.

5.3.Cost-effective

Cost-effectiveness is a critical consideration for the six testbeds. Testbed staff highlight that being accountable for funds and demonstrating appropriate expenditure is necessary to justify costs and reassure funders (or tenants if they will pay later for any products) that their money is being used efficiently. The principle of cost-effectiveness has enabled organisations to assess the scalability of technology adoption and explore partnerships with external entities for joint funding. While new technologies may initially be expensive, there is an expectation that prices will decrease as they become more widely used. Affordability and long-term sustainability are considered to be key aspects of cost-effectiveness, emphasising the importance of considering ongoing costs and funding sources.

"I think that [the 'cost-effective' TAPPI principle] should be more about affordability.... It's sort of similar to sustainability, long-term, when considering a piece of technology. At the minute, [tenants] have not paid for it because we are planning to allow them to keep devices... until the end of [their] tenancy. For instance, if [a tenant] wants to keep the device, she can, but she's going to have to pay the subscription. It's not expensive for what it is. But it's got to be affordable, rather than costly, for a cost-effective one-off purchase."- Staff, Platform

The challenges related to cost-effectiveness include the need for organisations to balance their budgets and demonstrate fiscal responsibility to tenants. There is a concern that tenants' willingness to use technology may vary, even if it is deemed cost-effective, which can lead to wasted resources if people do not use the technologies provided. The issue of

who bears the financial burden for technology adoption is complex, involving considerations of both housing providers and commissioners, health, and social care organisations. The affordability of technology for individual customers is another challenge, as people's circumstances may make it difficult or impossible to pay for ongoing costs associated with technology solutions.

5.4.Choice-led

The principle of being choice-led is understood to emphasise the importance of individual preferences and autonomy in technology adoption for older adults. Testbed staff suggest that this principle aligns with the idea of being person-centred and inclusive. The six testbed managers' views suggest that choice should be a central aspect of any technology initiative, allowing individuals to make decisions based on their own comfort levels and needs. They acknowledged that not everyone will be comfortable with or interested in the same technologies, and the choice should always be left to the individual.

However, providing choice can be challenging, especially when managing a diverse range of technologies and preferences. It requires a more complex approach than offering a one-size-fits-all solution. Testbeds' managers revealed that their organisations must navigate the balance between choice and complexity, ensuring that individuals receive the right information and guidance to make informed decisions about the technologies they want to use. Indeed, it is recognised that tenants should not be expected to have knowledge of the range of options available on the market:

> *"Choice isn't just about offering a menu of options; it's about treating people as individuals and giving them the knowledge and guidance to make informed decisions based on what's best for them."* - Staff, Bield

The main challenge associated with the choice-led principle is managing the complexity that arises when offering multiple technologies and options to individuals. It can be challenging to provide customised solutions while ensuring that the process remains manageable and affordable.

5.5.Interoperable

The experience of testbed managers highlighted that interoperability is necessary for seamless integration among various technology systems and platforms. For some testbeds, the relevance of this principle became much clearer over the course of the TAPPI2 project, once they had experience of implementing a technology pilot. Indeed, for those without pre-existing expertise in technologies, implementing this principle can seem complex.

Interoperability is seen as a fundamental aspect of providing efficient and effective services. Having technology solutions that can communicate and work together is highly valued. However, implementing interoperable systems presents a set of significant challenges. Carrying out work at the outset of a project to assess current levels of connectivity, compatibility of different technologies, and the levels of support needed, can support the goal of interoperability. Testbed managers highlighted that interoperability represented one of the most serious challenges faced throughout their TAPPI2 projects, particularly for testbeds using multiple technologies and platforms:

> "*Interoperability sounds idealistic. It'd be lovely, but it's not there yet. I think there's a lot of work to be done [to ensure the success of] interoperability because things just do not work well together [and across different platforms]… Those that work in care on the front line cannot always monitor and keep track of everything. It needs to be in one place.*" - Staff, Wiltshire

Attempting to use multiple technology systems or platforms, often sourced from different providers, can lead to complications stemming from variations in data formats and communication protocols. This technical complexity demands resource-intensive solutions and ongoing maintenance. Ensuring data security and privacy when multiple systems communicate is another concern. Furthermore, cooperation from technology vendors is essential but may be hindered by proprietary interests. Staff and user training to adapt to interoperable systems may be necessary. Navigating regulatory requirements, especially in sensitive domains like healthcare, adds extra layers of complexity.

5.6.Inclusive

This principle was recognised as important across all six testbeds. Testbed staff recognised that everyone should be given the opportunity to be included, and that this should involve raising awareness of their TAPPI2 projects among their service users, as well as among staff. Testbed staff highlighted that it was important that people should be enabled to engage at their own pace, and that efforts should be made to overcome broader inequalities to ensure everyone who wishes to take part is able to.

However, there are challenges associated with making a TEC project inclusive. There were concerns, for example, that technology schemes may not be inclusive given that many older people are digitally excluded, and therefore may not feel able to get involved or to have a go with some technologies. Further, Pobl staff highlighted that language barriers can be a particular issue when it comes to procuring inclusive technology.

> *"If you're looking at our older people, a lot of them are getting dementia, [and] their first language was Welsh as a child. So they're reverting back to speaking Welsh. Yet there's an awful lot of technology out there which will not pick up the Welsh language or doesn't understand it"* – Staff, Pobl

Building inclusivity into a project using technology in a housing and care setting is therefore not entirely in the control of project staff, as some technology simply does not support language requirements. Making such projects as inclusive as possible going forward will therefore require technology developers and suppliers to work with communities to understand their needs and to design technologies which meet them.

5.7.Outcome-focussed

Testbed staff highlight that making a project outcome-focussed requires clearly defined goals to be set out at the start of the project, as a guide against which progress can be tracked. These goals might be about reducing social isolation, for example, or enabling people to remain in their own homes for longer or improving health and wellbeing. The TAPPI2 testbeds have developed their projects with specific aims along these lines in mind and have been able to focus on outcomes in these areas, both expected and unexpected. Importantly, in a project such as TAPPI2 where innovation is encouraged, focusing on outcomes enables testbeds to recognise what does and does not work. Evaluation is considered an important part of this principle, as the evaluation process is essential for providing evidence as to whether and how pre-set outcomes have been achieved.

> *"I've been evaluating [outcomes] through four questions. How safe do you feel at home? How independent do you feel at home? How connected to other people [do you feel]? And how inspired are you to learn all about technology?... They've been good [because they] have been allowing me to monitor how people's feelings have changed over the year."* – Staff, Platform

However, measuring outcomes has presented a challenge for some testbeds owing to the timescale of TAPPI2, as some changes and outcomes may be operating on much longer timescales. Challenges also arise in deciding which outcomes to place emphasis on, and which to value as an organisation. As one testbed highlighted, a key question which must be addressed is 'outcomes for who?'. Indeed, desired outcomes for individuals and for the organisation as a whole may be very different.

5.8.Person-centred

This principle is understood to be about ensuring that individuals receive technologies which are right for them. Testbeds highlight that in order to ensure that technology services are person-centred, it is necessary to engage with residents and hear from them about what they want, and about what they hope to achieve through using technologies. This means delivering a bespoke service, in which people's needs are understood.

> *"[Often in health and social care] people [have to] fit into service rather than the service fitting to a person… That's because of the social care crisis, workforce crisis, et cetera. But to become truly person centred, TAPPI has allowed us to work more hands on with our tenants. It's allowed a dedicated resource to truly hear and understand what they want, and to work with them."* – Staff, Bield

Indeed, TAPPI2 testbeds emphasise that no technology can deliver a one-size-fits-all service. Even where technologies may appear to address some key needs of an individual, if that individual is not comfortable with the technology, they are unlikely to use it. As such, creating a person-centred service requires service providers to take into account not only the possibilities of technologies themselves for addressing individuals' needs, but also how people feel towards them.

5.9.Preventative

Ensuring that a service is preventative is widely understood to be about catching emerging health problems early so as to avoid deterioration of a person's health, or to avoid hospitalisation. It is also understood to encapsulate broader wellbeing, which can support these aims. This is about enabling people to live as independently as possible for as long as possible, and about preventing moments of crisis from occurring. Importantly, preventative devices need to be tailored to individuals' preferences, and to fit into their lives seamlessly.

> *"People don't want clinical [devices]. They don't. People never want to look old… We're never going to be preventative if we can't get the model and make of it right, because they won't use it until they fall in and realise they actually need it"* – Staff, Wiltshire

However, there are challenges associated with preventative technology services. One testbed highlighted that some preventative technologies – such as data platforms collecting information through sensors – are particularly expensive and resource intensive, as they require someone to monitor the data coming in in order for them to work effectively.

Further, some people find sensors collecting this data to be invasive of their privacy, and so these solutions will not work for everyone. Some testbeds highlighted the need to integrate preventative technologies with reactive ones, to create a system whereby people's risks are reduced, while ensuring that if people do have a fall, or an illness, they are able to get help quickly and effectively.

5.10.Quality-focused

Ensuring that a technology service is quality-focused is understood to be centred on the quality of technologies themselves. This is about ensuring that technologies do what they are intended to do, and that they are user-friendly, and of a design which people like and will use. This is not always a given, and testbeds have highlighted that they have sometimes spoken with suppliers to fix issues, or to work with them to help them better understand the needs of their client group.

> *"We won't shy away from difficult conversations… You've got to challenge if something's not right."* – Staff, Platform

Ensuring quality of technologies is imperative, not only to ensure that devices do not 'end up in a drawer, not being used', but also to ensure people's health and safety. Indeed, some technologies, such as falls detectors, have an important role to play in ensuring people get the help they need in a time-sensitive situation. There are challenges for testbeds which emerge around this principle, as it can be difficult to verify the quality of a device without expert knowledge.

5.11.Reflections on revising the TAPPI principles

Throughout the process of TAPPI2, testbeds and partner organisations have developed reflections on the TAPPI principles. These reflections could usefully inform revisions to the TAPPI principles, in order to ensure that they are best positioned to support organisations in delivering excellent technology services in housing and care settings.

Several suggestions have been made by testbeds. While there is no consensus around any single suggestion, these nonetheless provide important insight into how the experience of implementing a project guided by the TAPPI principles may affect views of which aspects of the principles work and what might be helpful to change. Some key reflections are presented here.

5.11.1. Overlapping principles

Several testbed managers highlighted what they perceived as a considerable degree of overlap between some of the TAPPI principles. Indeed, it was observed that it would not be

possible to deliver on some principles without also delivering on others. Principles where overlap was highlighted are:

- 'Outcome-focused' and 'preventative' – these principles are both thought to be around ensuring positive outcomes for service users and others.
- 'Person-centred', 'co-produced' and 'choice-led' – several testbed staff highlighted that these principles are understood to be centred on a personalised experience, and that working with residents is integral to delivering each of these principles.
- 'Interoperable' and 'adaptable' – one testbed manager suggested that these two principles, which both encompass ideas around adapting to changing needs and ensuring technologies can work together as these needs change, have an element of overlap.
- 'Cost-effective' and 'quality-focused' – while these are clearly distinct principles, key to ensuring cost-effectiveness is ensuring good value for money, and quality is an integral part of that.
- 'Inclusive' and 'choice-led' – These two principles are both focused on ensuring a diverse range of options are available in order to overcome barriers to engagement.

While some principles were identified by several testbed managers and TAPPI2 partners as overlapping with others, this is to be expected to some extent, given that the TAPPI principles are not stand-alone ideas, but are a cohesive set, intended to be delivered as a whole.

5.11.2. Clarity of principles

Some principles are more difficult to understand than others. 'Interoperable' was consistently identified as a principle which required further elaboration. This was particularly the case early in the TAPPI2 process, when testbeds had yet to implement their projects, and often did not have a full understanding of what was meant by interoperability and what it would entail. However, now that the testbeds' projects are underway, testbeds have emphasised the importance of this principle to the success of technology services. Setting out exactly what is meant by 'interoperability' and how organisations can work to build this into their services from the outset may therefore be helpful for an updated version of the TAPPI principles. TAPPI2 testbeds and partners emphasised the need to ensure that the TAPPI principles are accessible, and that the language used to describe them is easy to understand. It was suggested that the term 'seamless' may be easier to understand than 'interoperable'.

Similarly, as highlighted in TAPPI2 interim evaluation reports, understandings of each of the principles varied among the testbed staff at the outset of the project. While these understandings have become more aligned with one another over the course of the project, clearer descriptors to accompany each principle may be beneficial.

5.11.3. Additional factors to consider

Some important factors which underpin and shape technology services in housing and care settings are not currently explicitly included in the TAPPI principles. One key area, which some testbed staff and partners felt should be included in the principles is safety. Safety, including online safety and security and data protection, as well as broader physical safety concerns, could be added as a principle in its own right, or included under the heading of 'quality-focused'.

Another factor which has been identified as crucial for the delivery of TEC projects is connectivity. While this underpins the functioning of many technologies, and while its absence can cause considerable delays to the introduction of technology services, connectivity is not currently encapsulated within the TAPPI principles. Whether this is added as a principle in its own right, incorporated into an existing principle, or identified as a foundational requirement for implementing the TAPPI principles, connectivity is an important consideration going forward.

Sustainability has also been identified as an important factor in the success of technology projects. This might include maintenance of technologies as well as ongoing support with using technologies over time, in addition to cost-effectiveness and affordability.

Some testbed staff and TAPPI2 partners have suggested that 10 principles is too many, and that it might be useful to deliver a more succinct list of a few crucial overarching principles, with more detailed subsets of principles encapsulated under each of the key principle headings. Meanwhile, others have suggested that simply combining some of the overlapping principles would deliver a shorter set of principles, which would be easier to understand. However, others felt that all 10 of the principles are important and would be useful to retain.

Importantly, interviews with testbed staff and partners have also highlighted that there is a need to consider the target audience for the TAPPI principles. Indeed, a set of principles which is designed for service-users might look different to principles designed for technology suppliers, or for service providers. Specificity around who these principles apply to may also be useful. For instance, it may be helpful to state who projects should be cost-effective for, whether that be residents or service providers.

6. Conclusions and Recommendations

The TAPPI2 project represents a significant endeavour aimed at harnessing technology to enhance the lives of older adults in housing and care settings. Through a comprehensive evaluation of TAPPI2, numerous insights have emerged, highlighting both the opportunities and challenges associated with implementing Technology-Enabled Care (TEC) projects in these environments. This report has presented a synthesis of these findings, offering a holistic view of the key themes and reflections arising from the project's evaluation.

The experiences of six testbeds showed that suitability of device design plays a pivotal role in the effectiveness of technology for older adults. Well-designed devices not only cater to specific needs but also align with older individuals' preferences and capabilities. These devices should prioritise ease of use, adaptability to physical limitations, aesthetics that promote acceptance, and compatibility with the living situations of older adults. However, the success of device design is not one-size-fits-all. Learning and feedback from service-users about specific aspects of device designs which do and do not work for people with specific needs, is highly useful for informing design decisions going forward. Indeed, in a dynamic market for technology designed for older users, experimentation and learning are essential to tailor solutions effectively.

The outcomes of TAPPI2 for individuals who took part encompassed various dimensions including independence and control, health, safety, and social interaction. Independence is a central aspiration for many tenants and residents participating in TAPPI2. Technology has helped some regain a sense of independence that they felt had diminished due to health issues. Simple devices like tip kettles and voice-activated lights empower residents to perform daily activities without assistance. However, the reliability of services behind certain technologies, like GPS pendants, is critical in ensuring their impact on independence. As such, the suitability of such services may vary depending on the institutional setting, and the level of human resourcing which can be drawn upon to support the monitoring and use of information collected using technologies.

Technology provided through TAPPI2 also plays a crucial role in enhancing safety, both in preventing accidents and providing assistance in emergencies. Fall detectors, GPS devices, and camera doorbells offer peace of mind and reduce risks. However, privacy concerns and fears about digital vulnerabilities can deter some residents from using the internet.

Beyond their intended purposes, some technologies, like Alexa, have unexpectedly fostered social connections, combating loneliness. The diversity of communication preferences among older adults underscores the need for technology to provide options that align with individual comfort. The importance of human interactions should not be overlooked, as

technology should complement, not replace, face-to-face contact. The fear of losing social interactions with caregivers remains a significant concern, highlighting the importance of reassuring users about the purpose of technology while preserving in-person interactions.

There are also important outcomes for families and friends of those using TAPPI2 technologies, particularly with regards to peace of mind and freedom. Sensors and monitoring devices can provide reassurance that they will be informed in case of issues detected by technologies used by loved ones. This reduces worry and allows for more meaningful conversations between residents and their families. The peace of mind afforded by these devices means primary caregivers no longer need to rush home to check on their loved ones. This newfound freedom has a transformative effect on some individuals' daily lives, emphasising the positive impact of technology not only on residents but also on their families and friends.

Engagement in TEC projects, as demonstrated in TAPPI2, offers both rewarding experiences and unique challenges. While co-production has been enjoyable and socially beneficial for many participants, barriers to engagement exist. Some individuals lack interest in technology, making it challenging to motivate their involvement. Moreover, significant unmet needs for things such as housing adaptations, can diminish motivation when participants feel technology may not address their pressing issues. Engaging individuals less involved in the community or with limited interest in technology proved to be the greatest challenge.

The broader context in which technology pilots are operated is essential to consider and may have a considerable impact on outcomes. Indeed, digital exclusion remains a significant challenge, disproportionately affecting older adults. Bridging the digital divide requires addressing connectivity and infrastructural barriers, improving digital skills, and building residents' confidence and motivation in using technologies. Providing ongoing support for residents, regardless of their digital literacy level, is paramount to promoting inclusion and access to digital opportunities. Likewise, poorly designed or inadequately adapted buildings can hinder independence, emphasising the importance of physical home adaptations alongside technological solutions. And it is essential to recognise that while technology can be a valuable resource, it may not always be the most effective remedy for complex health-related challenges.

At the organisational level, effective project management, strong organisational buy-in, expertise in technology procurement, and dedicated resources are foundational to the successful execution of TEC projects. Testbed managers emphasise the importance of having a dedicated project manager, as juggling these responsibilities alongside other tasks can be challenging. Support from senior leadership has been a critical success factor for many testbeds, allowing them to leverage the learning from TAPPI2 to inform broader

organisational strategies. Navigating the technology market effectively requires technological expertise and clear procurement strategies.

Throughout the TAPPI2 project, testbeds and partner organisations have offered reflections on the existing TAPPI principles. These reflections provide valuable insights into how the experience of implementing a TAPPI-guided project may affect views on which aspects of the principles work and what might be helpful to change. Some testbeds highlighted considerable overlap between certain principles, suggesting potential consolidation or clarification. Additionally, there is a need to consider factors not explicitly included in the principles, such as safety and connectivity, as well as the target audience for these principles.

Overall, the TAPPI2 project represents a significant step forward in leveraging technology to enhance the lives of older adults in housing and care settings. The evaluation's findings underscore the need for tailored approaches to engagement, affordability, and maintenance, along with a relentless focus on addressing digital exclusion. The importance of considering non-technological factors and optimising organisational processes and culture cannot be overstated.

6.1.Recommendations

Technologies

- Technology services and the design of devices should be **tailored** to individuals' specific needs. Different people have very different needs and preferences and have different ideas of what they want to get out of using technology. If people receive technology that they don't want or need, they are unlikely to use it. People should therefore have choice over the kinds of technology they engage with, and TEC services should be personalised.
- Technologies should be implemented as part of a **package of support**, rather than viewed as the only solution. Technologies can have a range of positive impacts and can be transformative in helping people to achieve their personal goals. However, there are many things that technology cannot fix, including some of the issues which might be most important to people. For instance, physical home adaptations may be needed to enable people to confidently move around at home, and to be able to use their home as they wish, and where these adaptations are not in place, new technologies may not have the desired impact.
- Introducing a few new technologies **gradually** can enable people to get to grips with them before they learn to use any further devices. Where people have little experience of using technologies, introducing too many technologies at once can be overwhelming, and can mean that people don't get their full benefit.

Processes of implementing technology services

- Assigning a dedicated **project manager** is a key factor in the success of technology service projects. Implementing a successful TEC project requires adequate resourcing, and lessons from the TAPPI2 project highlight that where there is a project manager who can dedicate time to the TEC project, rather than squeezing it in alongside other responsibilities, the project is more likely to run smoothly.
- Organisational **buy-in**, and support from organisations' leaders and managers, is essential. The most successful TEC projects have support from the highest levels of their organisation. Understanding of the vision of what the technology pilot is aiming to achieve from the strategic levels of an organisation, as well as at operational levels, means that projects will be better supported. It also means that success stories from the pilot will be more likely to be scaled up and implemented more widely across the organisation.
- All staff should be brought on board to support technology projects. This may involve providing staff with information and **training** throughout the project. This will enable staff to support residents who are themselves using technologies.
- Co-production is an essential part of designing an effective technology service which meets people's needs and is effective in the long-run. Engaging tenants after key decisions have already been made can reduce tenants' sense of ownership over the project and can prevent this from happening. The co-production process should therefore start **as early as possible**, prior to deciding on technologies, to ensure that people have a say on their services from the outset.

Operational context

- Suitable **building design** or home adaptations are important for wellbeing. Addressing any issues in building suitability prior to or alongside the implementation of technology projects should be carried out in order to support positive outcomes.
- Digital inclusion is key for many technology projects. Many people in the UK lack basic digital skills, and older people are especially likely to be digitally excluded. If a TEC project is using technologies which require tenants to actively engage with them, it is likely that **digital skills support** will be required, both for tenants and for staff. In order to be effective, TEC projects of this kind should provide ongoing digital skills support. Technology projects need to recognise that people have varied of levels of digital inclusion, and not everyone wants to be online.
- In order for technology projects such as TAPPI2 to have long-term impacts, ongoing support will be needed. Responsibilities for **maintenance** of technologies should be clearly set out from the start of a project.

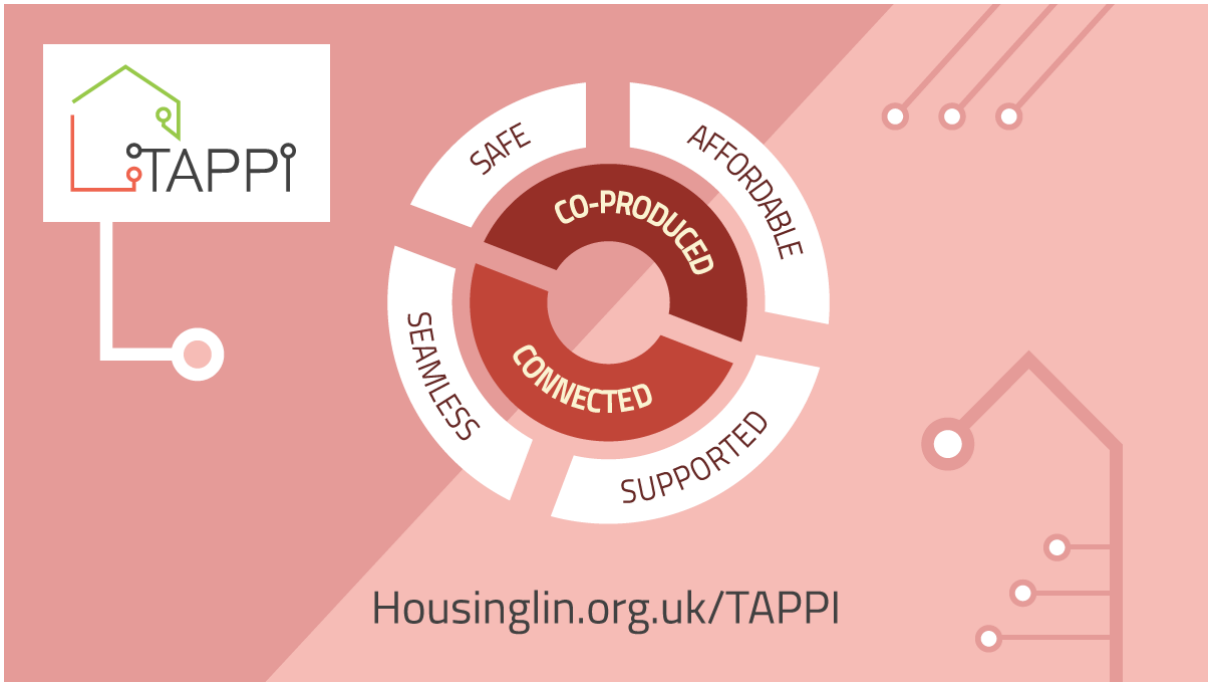
The TAPPI principles

- The TAPPI principles could be revised to make sure that each principle is **clear and easy to understand**. Simple descriptors for each principle would provide clarity on what is an what is not encompassed in implementing each one.
- Some TAPPI principles show a degree of overlap, and so could be **combined** to create a shorter, more accessible and memorable list.
- **Safety and privacy** are key concerns of many people using technologies. These could be incorporated into the TAPPI principles to adequately reflect these concerns, and to build safeguards against them into all technology enabled care services.
- Good connectivity should be seen as a foundation of any technology project. Internet connectivity is needed for many types of technology to perform at full functionality. Having **reliable internet connections** in place is therefore an important foundation for TEC projects. Thinking about this too late can result in delays, which can be frustrating for tenants. This could be captured in the TAPPI principles.

7. The revised TAPPI principles

After the conclusion of the TAPPI2 evaluation, the testbeds continued to implement their projects, and the TAPPI principles have now been revised to reflect the learning from across the six testbeds. The new principles were co-produced, and took into account feedback from all TAPPI2 participants.

The revised TAPPI principles, which emphasise the need for technology projects to be co-produced, connected, safe, affordable, seamless, and supported, can be accessed here.



8. References

Centre for Ageing Better (2021) *COVID-19 and the digital divide: supporting digital inclusion and skills during the pandemic and beyond.* [Online]. Available at: https://ageing-better.org.uk/sites/default/files/2021-07/COVID-19-and-the-digital-divide.pdf. Accessed on: 02/03/22.

French, T., Quinn, L., Yates, S. (2019) Digital Motivation: Exploring the reasons people are offline. The Good Things Foundation. Available at: https://www.goodthingsfoundation.org/wp-content/uploads/2019/02/digital_motivations_report.pdf Accessed on: 15.09.23.

Gallistl, V., Rohner, R., Seifert, A., Wanka, A. (2020) Configuring the Older Non-User: Between Research. Policy and Practice of Digital Exclusion. *Social Inclusion*. Vol.8. pp. 233. 10.17645/si.v8i2.2607.

Holmes, H., Burgess, G. (2022) Digital Exclusion and Poverty in the UK: How Structural Inequality Shapes Experiences of Getting Online. *Digital Geography and Society* DOI:/10.1016/j.diggeo.2022.100041

Holmes, H., Karampour, K., Burgess, G. (2022) Digital Poverty and Housing Inequality. Cambridge Centre for Housing and Planning Research and the British Academy. Available at: https://www.thebritishacademy.ac.uk/publications/digital-poverty-and-housing-inequality/ Accessed on: 27.09.2023.

Livingstone, S., Helsper, E. (2007) Gradations in digital inclusion: children, young people and the digital divide. *New Media and Society*. Vol. 9, 4, pp.671-696. DOI: https://doi.org/10.1177/1461444807080335

Lloyds Bank (2021) Essential Digital Skills Report 2021. [Online]. Available at: https://www.lloydsbank.com/assets/media/pdfs/banking_with_us/whats-happening/211109-lloyds-essential-digital-skills-report-2021.pdf Accessed on: 25/01/22.

Ofcom (2022) Digital exclusion A review of Ofcom's research on digital exclusion among adults in the UK. Ofcom. Available at: https://www.ofcom.org.uk/__data/assets/pdf_file/0022/234364/digital-exclusion-review-2022.pdf Accessed on: 15/09/2023.

TSA (N.D.) TEC Stories: How technology enabled care has transformed people's lives. A resource for social care directors and commissioners. TSA, Think Local Act Personal, and Adass. Available at: https://www.thinklocalactpersonal.org.uk/_assets/TEC-Stories-brochure.pdf Accessed on: 12.09.23.

9. Appendix

The July interim evaluation report presented the data from the survey conducted across the testbeds. Key information from the report is included below.

The survey which the July interim report is based upon set out a range of questions on health, wellbeing, and views on technologies. These were inspired by, drawn from, or adapted from established health and social care surveys, such as the Health Survey for England (NHS, 2022a), a survey conducted for the Ageing Society Grand Challenge (Gov.uk, 2018), an Age UK study of loneliness (Age UK, 2018), the Adult Social Care Outcomes Framework (NHS, 2022b), and the Digital Inclusion Evaluation Toolkit (Gov.uk, 2017). These resources have already proven useful for surveying similar themes with similar cohorts to TAPPI2, and so referring to these surveys was a helpful means of ensuring that the survey developed for TAPPI2 was appropriate, relevant, and easy to understand.

The survey was filled in by tenants or residents at each of the testbed sites. This was done at an early stage in the technology trials at each site in order to establish a baseline. Given that each of the testbeds is operating on slightly different timelines, in accordance with the progress of their own individual technology pilots, some carried out the survey more recently than others. Preliminary results from the first round of survey data are presented in this report.

Survey Results

The survey was completed by residents at each of the six testbed sites. The data presented here gives a brief overview of the responses from across the testbeds. We have compiled the data from across the testbeds here in order to present a simple outline of the baseline data across TAPPI. As the surveys were completed at a relatively early stage of each testbed's project, the survey data presented here provides a snapshot of people's health, wellbeing, and attitudes to technology before any impacts from TAPPI2 may have become apparent.

Demographic information

Among the participants, approximately 58% identified as female, while 42% identified as male. The age distribution revealed that 36% of the respondents were between 65 and 74 years old, while 26% fell within the age range of 75 to 84 years.

Only 6% of respondents were younger than 54 years old, with the majority being over 65 years old. Figure 1 shows this information in more detail.

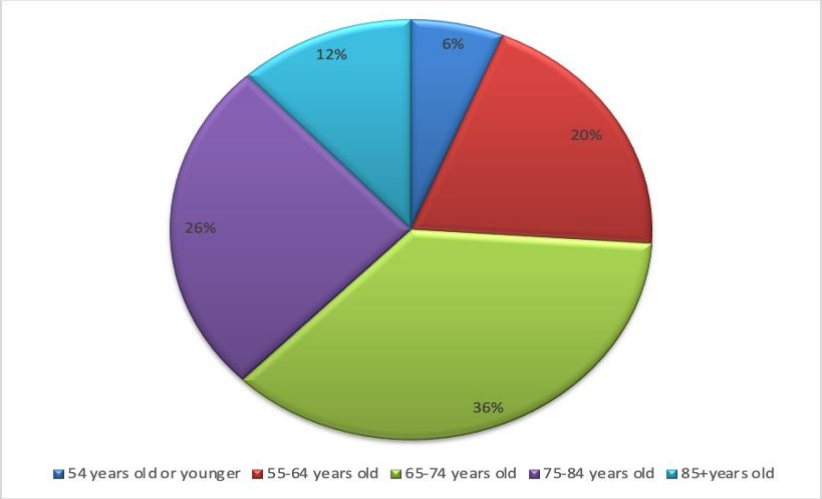


Figure 1. A pie chart showing the age categories of survey respondents.

Regarding ethnicity, a significant majority, 98% of the participants, identified as White, while the remaining 2% reported belonging to mixed ethnic backgrounds, specifically Asian and Black African.

Type of accommodation participants live in

As the below graph shows, 40% of participants live in independent homes, and 37% live in supported housing. This provides an opportunity to examine how the TAPPI principles work in practice across different housing settings.

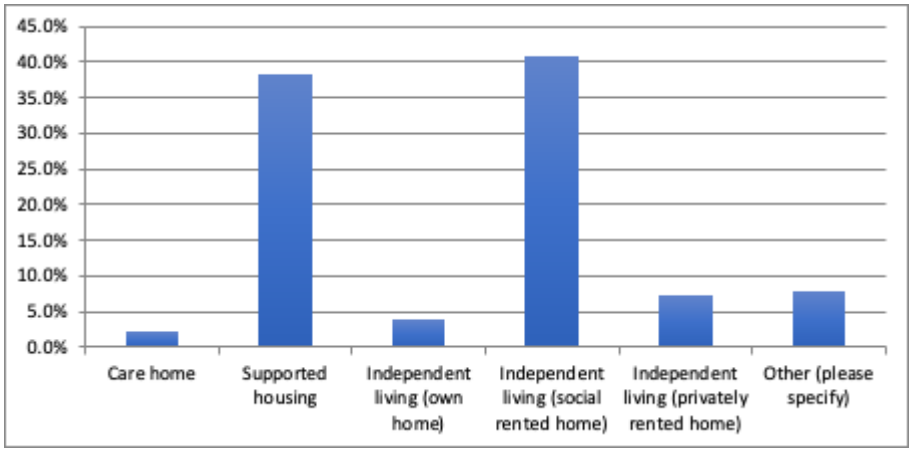


Figure 2. A bar chart showing survey respondents' answers to the question 'What type of accommodation do you live in?'. Respondents were asked to choose a category that best reflects their circumstances.

Health conditions

In assessing their overall health, respondents provided varying self-assessments. The majority of respondents, accounting for 46% of the total, described their health as "fair." Following closely behind, 23% of the respondents rated their health as "good," indicating a generally positive state of health. A smaller percentage, 21%, reported their health as "bad," suggesting some level of dissatisfaction or concerns. Lastly, only 3% expressed the most critical evaluation, rating their health as "very bad". Importantly, 75% of the respondents stated that they have long-standing physical illness. Also, 3% of people who completed the survey are disabled and just over 1% have long-standing mental illness. Please see Figure 3 for the full breakdown of results on this topic.

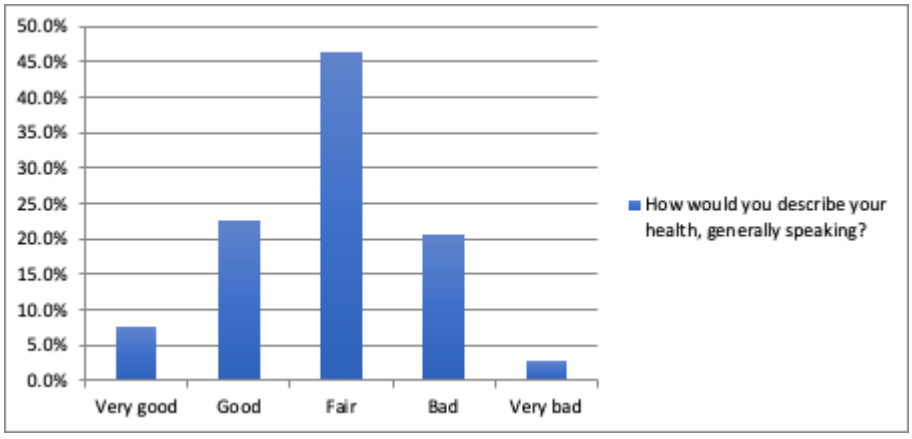


Figure 3. A bar chart indicating survey respondents' answers to the question 'How would you describe your health, generally speaking?'

Previous interim evaluation reports have highlighted the need for technologies to fit in with people's existing needs, including any health conditions. Health appears to have a notable impact on people's experiences of using technology, with people in better health more likely to use the internet more often than those in poor health, as indicated in the table below. Of the people who said their health was good, 43% used the internet several times a day, compared with just 22% of those who said their health was very bad.

		How people describe their health				
How often people use the internet		Very good	Good	Fair	Bad	Very bad
	Several times a day	64.0%	43.2%	37.5%	39.4%	22.2%
	Daily	24.0%	40.5%	36.8%	40.9%	11.1%
	Weekly	0.0%	1.4%	8.3%	9.1%	0.0%
	Monthly	0.0%	0.0%	0.7%	1.5%	0.0%
	Less than once a month	4.0%	4.1%	2.8%	4.5%	11.1%
	Never	8.0%	5.4%	13.9%	4.5%	55.6%
	Don't know	0.0%	5.4%	0.0%	0.0%	0.0%

Figure 4. A table indicating the relationship between how often survey respondents use the internet, and how they describe their health status.

Everyday activities

In the survey, participants were asked if they had had to reduce any of their regular activities in the past two weeks because of any long-standing physical or mental health issues or disabilities. It was found that 51% of the respondents answered in the affirmative. Figure 5 illustrates the different types of activities that these individuals had to reduce during this time period. Most respondents who had reduced their activities said that this had affected their plans for walking, shopping, and cleaning.

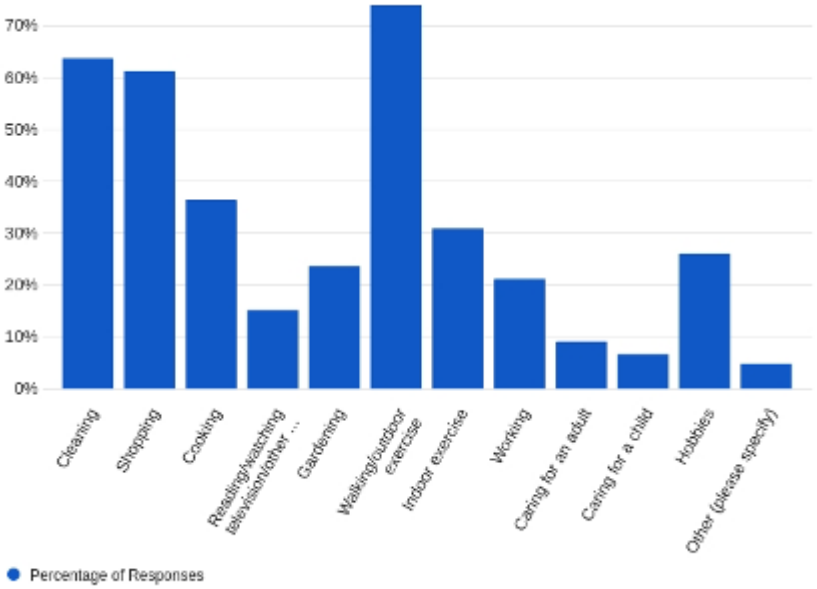


Figure 5. A bar chart indicating which kinds of activities respondents had had to reduce or skip altogether, if they had had to do so in the preceding two weeks as a result of a long standing physical or mental health issue or disability. Respondents were free to select as many answers as they wished for this question.

Wellbeing

The survey revealed that the issues which respondents most frequently said concerned them related to their physical health, with 66% expressing worry in this area. Following closely behind was the changing cost of living, which was a concern for 50% of the participants. Additionally, 40% expressed worry about experiencing a fall, and 29% were concerned about a reduced ability to live independently. These findings shed light on the significant concerns individuals have regarding their health, financial stability, and autonomy. Figure 6 shows this information in more detail. The extent to which such concerns can be addressed through technologies will be considered further in the more detailed analysis in the final evaluation report.

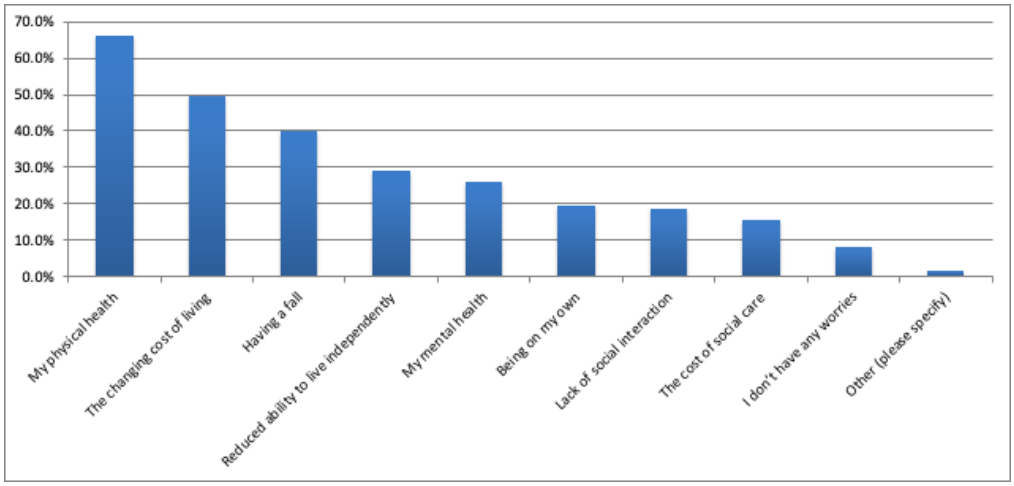


Figure 6. A bar chart showing the percentage of respondents who said they were worried about particular issues. Respondents were asked to choose the options they worry about the most and were free to select as many answers as they liked.

Communication with loved ones

More than 60% of respondents get in touch with their family and friends over the phone or see them for in-person visits, and 40% use online platforms to communicate with their family and friends. The below figure shows how often respondents talk to their family and friends. The majority of respondents spoke to family or friends at least once every few days or everyday, while around 17% spoke to loved ones at least once a week. Fewer than 15% of people spoke to their family and friends at least once a fortnight or less.

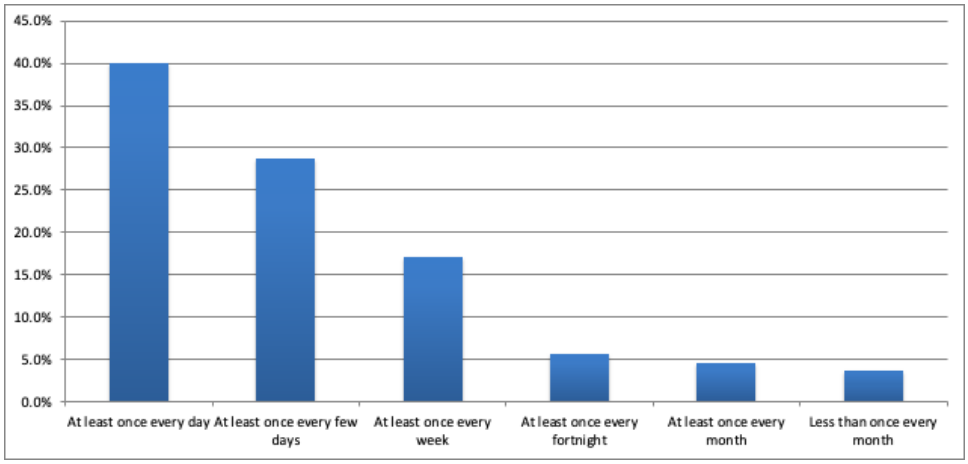


Figure 7. A bar chart showing respondents' answers to the question 'How often do you talk to your family and friends?'

When asked whether they communicate with their family and friends as often as they would like, 69% of the respondents answered affirmatively, while 31% expressed a desire for more frequent interactions. This suggests that while most people are satisfied with their level of

communication, a considerable portion of the participants feel a need for increased communication with their loved ones.

The survey sought to establish whether and to what extent respondents experienced loneliness. The results are displayed in the chart below. While a considerable portion of respondents reported that they are 'hardly ever or never lonely', over half said that they were either 'often lonely' or 'lonely some of the time'.

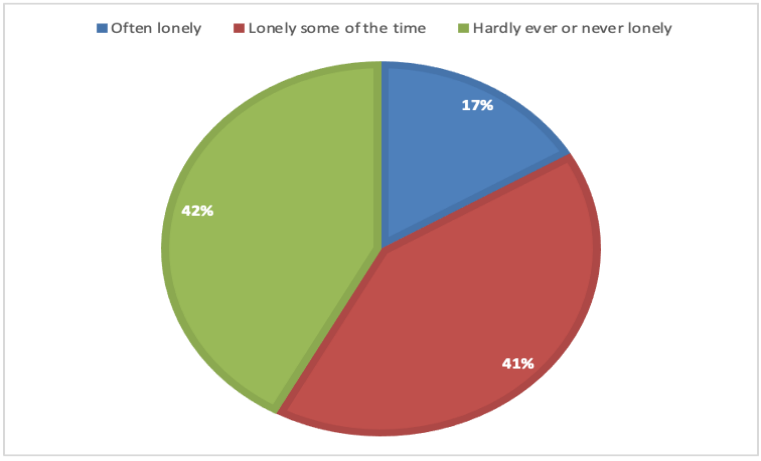


Figure 8. A pie chart indicating survey respondents' answers to the question 'How often do you feel lonely?'

Figure 9 provides evidence of a relationship between the frequency of communication with family and friends as desired and the level of loneliness experienced. The data suggests that individuals who are satisfied with the level of contact they have with their loved ones are less likely to feel lonely. Indeed, 90% of those who said that they hardly ever or never felt lonely said they spoke to their loved ones as often as they would like. Likewise, 70% of those who were often lonely were not satisfied with the frequency of their contact with family and friends. This highlights the importance of social connections in mitigating feelings of loneliness.

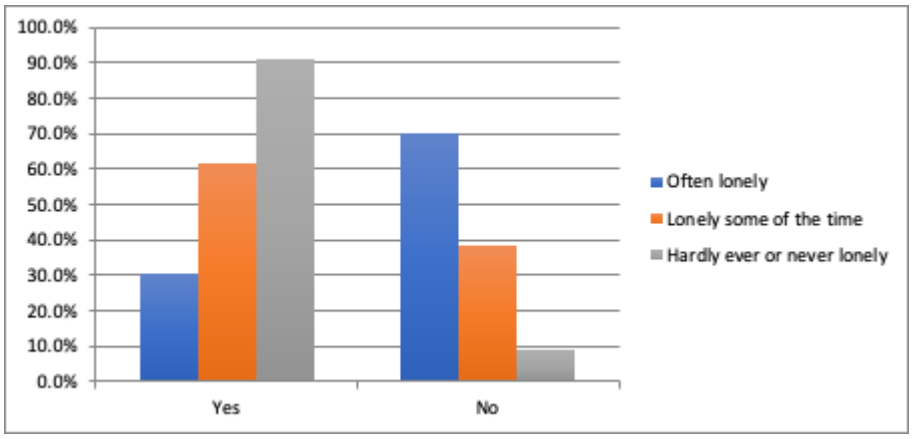


Figure 9. A bar chart showing the relationship between respondents' answers to the question 'Do you talk to your family and friends as often as you would like?', and the question 'How often do you feel lonely?'

3.7. Technology

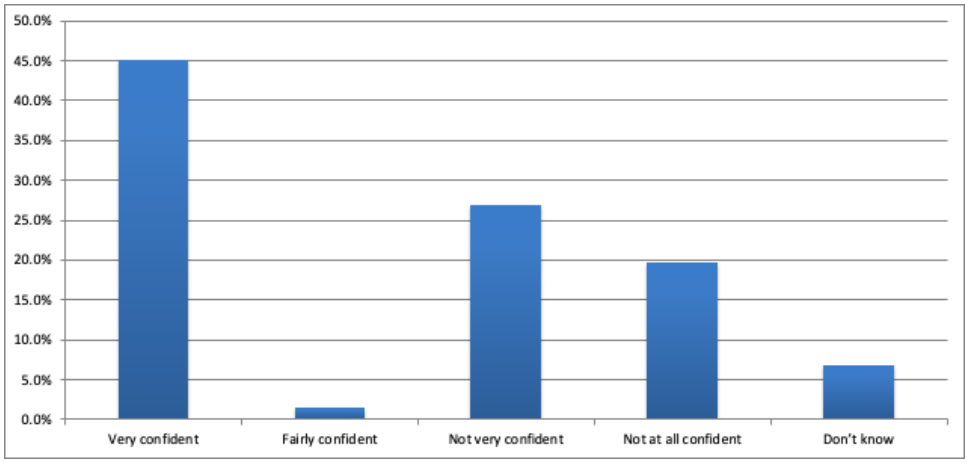


Figure 10. A bar chart showing survey respondents' answers to the question 'How often do you use the Internet?'

Of the respondents, 45% said that they were 'very confident' with using the internet, while a total of 46% said that they were either 'not very confident' or 'not at all confident'. However, there is considerable variation among residents of each testbed in this regard. Many of those who said that they were 'very confident' were Bield tenants.

Of course, much of the technology being trialled through the TAPPI projects across the testbeds does not require residents to have existing digital skills. However, many residents are using tablets, equipment with video-call technology, and internet-enabled devices such

as 'Alexas' as part of TAPPI2, and so an understanding of people's feelings towards the internet, and engagement with it, is important for underpinning the evaluation.

Appendix References

Beech, L., Porteus, J., (2021) The TAPPI Inquiry Report: Technology for our Ageing Population: Panel for Innovation - Phase 1. Housing LIN and the Dunhill Medical Trust. Available at: https://www.housinglin.org.uk/_assets/Resources/Housing/Support_materials/Reports/HLIN-TAPPI-Report.pdf Accessed on: 08/12/22.

Gov.uk (2018) Research: Ageing Society Grand Challenge: Saga Poll. Department for Business, Energy and Industrial Strategy. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/756416/ageing-society-views-older-people.csv/preview Accessed on: 12/12/22.

Gov.uk (2017) Digital Inclusion Evaluation Toolkit. Department for Digital, Culture, Media and Sport. Available at: https://www.gov.uk/government/publications/digital-inclusion-evaluation-toolkit Accessed on: 12/12/22.

NHS (2022a) Health Survey for England. NHS. Available at: https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england. Accessed on: 12/12/22.

NHS (2022b) Measures from the Adult Social Care Outcomes Framework. NHS digital. Available at: https://files.digital.nhs.uk/6E/D8BDCB/meas-from-asc-of-eng-2021-22-ASCOF-report.pdf Accessed on: 12/12/22.