

The logo for Bridge8, featuring the word "bridge" in a blue sans-serif font and the number "8" in a stylized, multi-line orange font.

Report of the Industry Uptake of Enabling Technologies Foresight Workshop: Enabling Assistive Technologies

For the Department of Innovation,
Industry, Science and Research

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3 September 2011

National Enabling Technologies Strategy
Expert Forum

This report reflects the views of participants, including aged care and technology industry representatives, researchers, medical providers, industry associations and government policy officers and does not reflect government policies.

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Executive Summary

The Enabling Assistive Technologies for the Aged Foresight Workshop, undertaken in collaboration with Queensland Health, the Council for the Ageing (COTA), QUT Institute of Health and Biomedical Innovation (IHBI) and the Australian Academy of Technological Sciences and Engineering (ATSE) forms part of the foresighting program of the Expert Forum, established under the National Enabling Technologies Strategy (NETS). It is tasked with identifying new and converging enabling bio and nano technologies that may have implications for policy makers and regulators, including industry uptake and international activities that improve the understanding of the potential for enabling technologies to address major global and national problems and to understand and help resolve potential impediments to their uptake.

Foresighting is a collaborative and participative approach to explore drivers and decision points for change to understand possible scenarios for the future. In this way the broad range of stakeholders involved in the industry uptake of the emerging enabling technologies are able to identify issues and challenges that need to be addressed.

Aims of the Workshop

The workshop drew together a range of stakeholders (Attachment 1) to explore the potential contribution of new and emerging assistive enabling technologies to contribute to the goal of enabling older Australians to live more independently in their own homes with better health care and social support.

The Aged Care sector stands on the edge of a major shift due to several converging factors:

- Pressures on aged care funding and health system due to the demographic ageing of the population
- Recommendations of the Productivity Commission draft report, *Caring for Older Australians*, of which the final report is due soon
- Changes in aged care housing influenced by the Humanitas model, pioneered in Netherlands, which seeks to enable older people to live in their own homes/apartments rather than traditional nursing homes
- Developments in eHealth and telehealth, which will be accelerated by the government's roll out of the National Broadband Network that will enable augmented interactive video that networks homes and other services
- Developments in new nano and biotechnologies, including medical devices involving remote sensors, pervasive smart monitoring technologies in the home, regenerative medicine and biomechanical devices including robots, prostheses and cognitive assistive devices.

Key challenges for the uptake of enabling assistive technologies in aged care, as outlined in the Productivity Commission draft report 2010), *Caring for Older Australians*, and the ATSE report, *Smart Technology for Healthy Longevity*, (2010), and discussed at the workshop include:

- developing technology that is appropriate for clients, through attention to inclusive design, ergonomics, usability, efficacy, and regulatory compliance,
- supporting ageing-in-place trends and consumer demands, and facilitating self-care
- aligning with (or creating new) health service delivery models
- developing sound business plans
- recognising cultural, social, political, privacy and ethical issues

A new vision of ageing that places the older Australian at the centre of a system and provides the desired level of independence and quality of life informed the workshop, through using the foresighting technique of backcasting: establishing the desired vision of the future, and then working out how we got there by backtracking to the present.

The workshop considered the contribution of enabling bio and nano technologies via a framework that places the application of such technologies within a context that ranges from in vivo and personal technologies through to communications, the built environment and finally systemic and structural issues.

This framework was then used to scope the potential top three technologies across six themed areas. The workshop discussion highlighted the multidisciplinary and converging nature of the new assistive technologies as they include everything from biological and medical development, the development of devices, prostheses and robotics, software and processes for communication and building design.

Outcomes

The key outcomes from the workshop were the identification of a) the most significant enabling assistive technologies, b) the major issues and challenges, and c) the policy implications in achieving a new vision of aged care in Australia.

Most Significant Enabling Technologies

The most significant enabling assistive technologies were explored in six technology themes:

- *New medical devices and sensor technologies* included non-invasive medical devices. An example of this might include a wristwatch for personalised monitoring of signs like breathing and pulse, as well as pathology. Another category of potential technologies was around data visualisation and imaging.
- A National *Telehealth Service* was discussed which included client-controlled factors and a semantic information underlay.
- Potential *Regenerative Medicine* technologies included RNA therapies and nano-based therapies that cross blood-brain barrier, stem cells and induced pluripotent stem cells (iPS) technologies, organ 3-D printing capability and biomimetics or the use of smart materials and design inspired by nature
- *Smart homes and intelligent materials* included implantable monitoring devices, smart fabrics, assistive devices designed for low dexterity, data monitoring, smart grids and renewable energy.

- *Integrated health and social support services* included streamline care, and enablers such as funding, development, design, resources and program support, and education for carers, individual and professionals.
- There were a suite of other enabling technologies such as *biomechanical technologies* such as exoskeletons, *robotics* for monitoring and social engagement, and *neuro-prostheses*.

Issues and Challenges

The issues and challenges discussed by the six themed groups were as follows:

- In *New Medical Devices and Sensor Technologies*, appropriate design for ease of use and having training and support services available.
- In *Telehealth Services*, accessibility for a diverse population and across a multitude of stakeholders, as well as suitable funding structures. It was also seen as important for patients to understand the risks of participating and not participating in a national telehealth system.
- For *Regenerative Medicine*, research, commercialisation and the establishment of effective R&D partnerships. The ethical aspect of R&D and public awareness were also seen as critical.
- For *Smart Homes and Intelligent Materials*, design standards and integrated ICT systems. Flexible funding was again mentioned and importantly, the issue of community acceptance of ageing and the value of older people was raised.
- Community perceptions were echoed in the *Integrated Health and Social Support Services* group, as were funding issues, and access.
- For the range of technologies in *Biomechanical Technologies, Robotics and Neuro-Prostheses*, the focus was on education for users and researchers, technology development pathways, funding and the ethical issues.

Policy Implications

From the issues and challenges discussed, a number of recommendations were suggested which have implications for policy development. These were to:

- Develop a roadmap to identify technologies, functions, and regulations and to foster further collaboration.
- Initiate the preparation of a proposal for a specific CRC focused on the cross-disciplinary nature of applying new technologies to aged health care.
- Move from episodic incentives to person-centred, health outcome-based incentives, perhaps by performing an economic study to identify the role of assistive technologies within health.
- Address the parts of the current aged care funding system that don't allow for the appropriate use of assistive technologies such as funding shared care and telehealth services.
- Develop a framework for thinking through the ethical issues for assistive technologies
- Develop or adopt international standards for health language, universal design protocols and common specifications.
- Design specific education or services that facilitate the introduction of and familiarisation with enabling assistive technologies to better ensure appropriate adoption and use.
- Introduce strategies around valuing the contribution of older people in the community to alter the perceptions of ageing.

- Increase public awareness of ways in which new enabling technologies may improve health care and lifestyle.

Finally, the workshop recommended establishing a multi-disciplinary, cross-sector network that builds on these discussions and seeks to create ongoing opportunities for dialogue and collaborative partnerships.

1. Aims of the Workshop

The National Enabling Technologies Strategy (NETS) Expert Forum leads a program of work on identifying new and converging technologies to inform government policy and strategy, and to improve how science and technology are utilised by industry, government and society in general. The series of industry foresight workshops seeks to identify the application and uptake of future enabling technologies in addressing industry and market needs.

The aged care sector represents a major area of market opportunity due to a number of factors. The populations of Australia, Europe, the United States and parts of Asia are ageing, with growing demand for aged care health and support services and a reduced available pool of potential carers. Changing consumer values towards more independent living and increased levels of familiarity with information technologies may enable alternative models of care to be considered. Furthermore, the health care system has recognised the need to adapt to the treatment and management of increasingly common chronic diseases such as diabetes and cognitive degeneration rather than following existing paradigms for acute care treatment of the aged.

To explore the potential of enabling technologies in aged care, the NETS Expert Forum arranged an Enabling Assistive Technologies Foresight Workshop in Brisbane on 6 June 2011. The event was held in partnership with the Council on the Ageing (COTA), the Institute of Health and Biomedical Innovation (IHBI) at QUT, the Australian Academy of Technological Sciences and Engineering (ATSE) and Queensland Health. The aims of the workshop were to:

- Bring together researchers from universities and technology companies, aged care service providers, groups representing the interests of older Australians, and government agencies involved in policies and funding programs affecting the health and lifestyle of older Australians
- Develop a more effective interdisciplinary understanding of the range of factors affecting the aged care sector, and the potentially revolutionary role that enabling assistive technologies can play in this sector, especially when combined with new developments in eHealth, telehealth and telecare services
- Explore the challenges that need to be addressed to realise the opportunities that these developments present for meeting the challenges of an ageing society
- Develop a more active network among the key stakeholders across the sector, to promote an interdisciplinary approach to relevant programs and policies, and ensure that new technologies support the needs of older Australians

The key question explored in the workshop was **“how might the potential of bio and nano enabling technologies help older Australians live more independently in their own homes and neighbourhoods with better health care and social support.”**

2. Methodology

The foresight process for the Enabling Assistive Technologies for Aged Care workshop - including preparatory materials, the facilitated workshop and this report - was designed to:

- Provide a futures policy context, the new vision of ageing, for the uptake of enabling assistive technologies
- Enable participants to understand the contribution that the emerging bio and nano- technologies could make to a new vision of aged care in our society
- Identify the issues and challenges involved in capturing these opportunities.

A preferred scenario, a new vision of ageing supported by a range of enabling technologies, was given to participants to provide a context for examining the potential role of such technologies and the issues and challenges that would need to be faced and overcome to achieve this vision.

The agenda for the workshop is provided as Appendix 1 and the list of invited participants is shown in Appendix 2. The workshop was designed around three aspects:

1. A scenario or a future vision of aged care in 2023 (see Section 3). This was supported by an expert presentation by Glenn Bunney, the CEO of Sundale Aged Care and International Chair of LeadingAge¹. His presentation was followed by invited comments on the factors driving this new vision from Professor Keith McNeil, CEO Brisbane Metropolitan North District, Queensland Health and Ian Yates, CEO of COTA.
2. The potential contributions of bio and nano enabling technologies (see Section 4) as detailed in a presentation by Prof Greg Tegart (AM) of ATSE and background briefing materials from both ATSE and NETS which has been incorporated into this report. Additional knowledge was shared through small group discussions focused on the following technology topics:
 1. New medical devices and sensor technologies
 2. Telehealth-care services
 3. Regenerative medicine and intelligent materials
 4. Intelligent materials and intelligent homes
 5. Integrated health and social support services
 6. Bio-mechanical technologies, robotics and neuro-prostheses
3. The issues and challenges in achieving this potential future were then explored through small group discussions (Section 5) and mapping out a timeline to identify the priority issues (Section 6).

¹ LeadingAge is the International Association of Homes and Services for the Aged

3. Vision of Ageing

Focusing Question: **What is the new vision of ageing that will drive the uptake of enabling assistive technologies?**

The vision for ageing discussed at the workshop was developed in consultation with the Productivity Commission, reflected in its draft report 'Caring for Older Australians' (www.pc.gov.au, January 2011), the Department of Health and Ageing, NICTA (National Information Communication Technology Agency) and other key aged care stakeholders and researchers. The development of the vision was further supported by a keynote presentation from Glenn Bunney of LeadingAge, with further comments from Professor Keith McNeil of Queensland Health and Ian Yates of COTA.

The Productivity Commission Report and the presentation and video by Glenn Bunney of LeadingAge emphasised the following aims for the future of Australia's aged care system:

- Promote independence and wellness of older Australians and their contribution to society
- Ensure that all older Australians needing care and support have access to person-centred services that can change as their needs change
- Be consumer-directed, allowing older Australians to have control over their own lives
- Treat older Australians receiving care and support with dignity and respect
- Be easy to navigate—Australians need to know what care and support is available and how to access those services
- Provide assistance to informal carers to perform their caring role
- Ensure affordability for those requiring care and for society more generally, and
- Provide incentives to ensure the efficient use of resources devoted to caring.

Factors identified by Glenn Bunney that would influence these aims included changes in demographics, social and cultural preferences, trends in health issues and changes in health care provision.

Demographics

- The Australian population is ageing—by 2023, 20% of the population will be over 65, by 2050, the number of Australians aged over 85 and over is expected to be at 5.1% of the population, with 10% of the population accessing aged care services each year². Government funding for aged care homes was approximately \$7.1 billion in 2009-10, with around 900,000 older Australians received government-subsidised aged care in 2009-10.
- Reduced access to carers and family support will become an issue with the rise in one-person households and increased participation of women in the workforce².

² Caring for Older Australians, Productivity Commission

Social and Cultural Preferences

- Both the aged care providers and the Productivity Commission have identified a growing preference amongst older Australians for independent living arrangements and choice, rather than more institutionalised aged care facilities. Glen Bunney commented that as a result of these trends, Scandinavian countries have stopped building traditional aged care facilities. This trend is expected to increase with the ageing of the baby boomer population. Demand is therefore expected to decline for residential low care accommodation.
- However, residential care entrants are expected to enter at an older age and, associated with this, to enter with more intensive or extensive care needs.
- Expectations about being able to access a range of services (as illustrated in Figure 1 overleaf) are leading to consumer demand for more integrated models of health care and accommodation options, as is being pioneered in the Humanitas model now being adopted in Australia in such projects as the Benevolent Society of NSW's Apartments for Life project in Bondi, and a number of social housing projects being undertaken by State Housing authorities. Figure 1 illustrates the range of related services that come into play when a person has activity restrictions, which is concentrated among the aged, but also includes those managing a range of disabilities.



Figure 1: Services to be accessed by a person with activity restriction (eg aged care)

Source: G. Bunney

Health and Health Care

- An increased requirement for management of chronic conditions that require complex care such as diabetes, dementia, arthritis, visual and hearing impairment is expected with increased longevity in the aged population. Currently many of our health services within hospitals are focused on acute care; a focus on chronic care would require changes in the way health services are funded and provided.
- Specialist care needs will also increase, in areas such as wound management, dental care, incontinence and nursing, as well as palliative care.
- The role of connection to the community in preserving mental health is a further aspect guiding the type of care offered.
- Effective delivery and access to preventative health services and advice including diet, exercise and preventative medicines, is also important in improving health outcomes for older Australians. Furthermore, access to subsidies for preventative health measures like gym membership, and even perhaps new products and devices to maintain independent living have the potential to reduce future insurance claims³.

Health Care Provision and the Aged Care Industry

- Current industry structures and providers of aged care and health services may be affected by future changes in sources and level of funding and revenue models, as advocated by the Productivity Commission. One of the recommendations is that older Australians should have access to government-sponsored credit through the Australian Aged Care Home Credit scheme to allow them to meet cost of care and accommodation expenses without having to sell their home. The suggested reforms would enable older Australians to access easily understood information suitable for their region, to receive aged care services to address their individual needs and to choose how and where that care is provided, taking into account their capacity to contribute towards the cost of that care.
- Current uptake of information technologies for aged care services has been low. In terms of increasing the use of information technologies within the provision of eHealth services in aged care, policies have focused on electronic medication management and telehealth. The introduction of the National Broadband Network (NBN) offers broader opportunities for improving telehealth services through providing greater equity in terms of access to telehealth services, guaranteed minimum speeds and quality to ensure standards, and interconnection independent of geography, this linking disconnected health services. Greater awareness of these and other enabling technologies may change the rate of adoption within the sector.

The future scenario of aged care in Australia in 2023 developed by the Enabling Technology Policy section of DIISR draws on the aims and drivers described. The purpose of this future scenario was to provide a context for workshop participants, working across six topic areas, so that they could identify the top three potential technology developments that would contribute to this vision, and the issues and challenges that would be faced in realising this potential.

³ Smart Technology for Health Longevity, ATSE

Scenario: Future of Aged Care

Imagine it is the year 2023. The National Broadband Network has delivered high quality internet access, allowing high definition interactive video to homes across Australia. New funding models and integrated information services that flowed from the 2011 Productivity Commission report, Caring for Older Australians, allowed many more innovative approaches to supporting older Australians.

Australians over 65 years, who now comprise 20% of the population, expect to be able to live independently in their own homes or apartments in their neighbourhoods, with a supportive health and social support network, rather than seek this support through residential aged care facilities.

Homes now make extensive use of smart grid technologies and intelligent materials for managing energy consumption, security and alert systems, and appliances. These systems allow aged people to more easily manage the practicalities of living for longer in their own homes, including through remote support from their families or carers.

A network was established in 2011 to bring together researchers, technology companies, aged service providers and government policy and funding bodies to accelerate innovations in the provision of an integrated model of aged care that linked new developments in eHealth, telehealth-care, robotics and mechanical assistive technologies and new bio and nano medical applications to meet the needs of older Australians. This network is also linked into global developments in responding to the needs of older people.

This led to a rapid recognition in the marketplace of the growth potential of the assistive point-of-care sector, the turnover of which had grown to over \$40billion per year by 2020.

By 2023, new medical devices, bio-mechanical supportive technologies, regenerative medicines, sensor technologies and other novel applications are helping older Australians and their families manage their healthcare delivered through integrated eHealth and telehealth-care systems. Chronic illnesses are now managed from home on a daily basis so they don't escalate into acute health conditions requiring hospitalisation. Care-robots are now providing an important source of support to Alzheimer patients, although the incidence of the disease has been brought down due to improved screening technologies and medical interventions in the ageing process.

Older Australians have a much higher satisfaction in terms of quality of life than was common back in 2011 and carers in the aged care sector are reporting much higher work satisfaction in their improved ability to provide better care to their clients.

4. Enabling Assistive Technologies

Focusing Question: What might be the contribution of bio and nano enabling technologies to this new vision for ageing in Australia?

4.1 Definition

The Expert Forum of the National Enabling Technology Strategy is focused particularly on new forms of nano- and biotechnologies, and those enabled by ITC and cognitive science. Figure 2 illustrates the interplay between these enabling technologies:

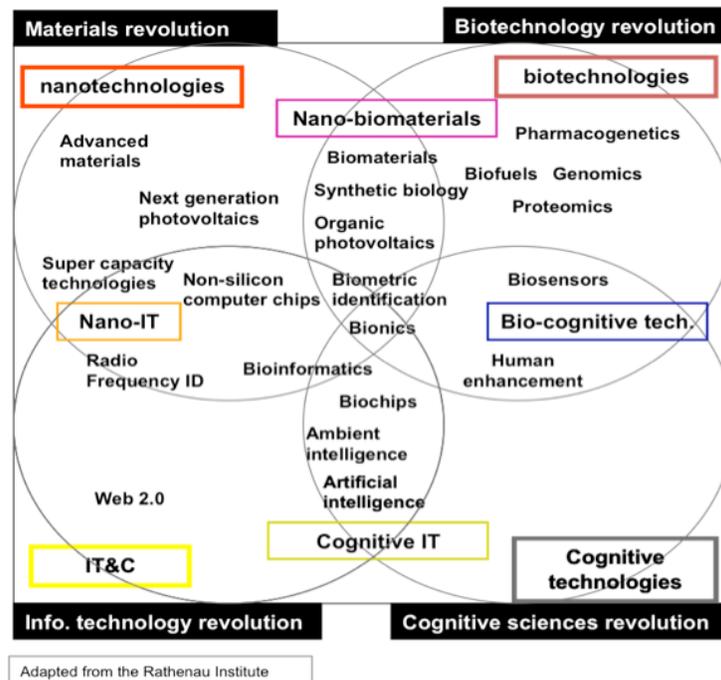


Figure 2: Enabling Technologies (courtesy of Dr Craig Cormick, NETS-DIISR)

Enabling technologies are defined by the NETS Expert Forum as having the following characteristics:

- Show high interdisciplinarity
- Are transformative in nature and have the potential to disrupt or create entire industries
- Have the potential for significant, systemic and long-lasting economic, social and political impacts
- Have the potential for development of new capabilities that address existing problems and/or open up new possibilities and markets, and therefore new risks impacting on regulation
- Create new opportunities for responses to global issues.

This definition embraces both the cross-disciplinary nature of enabling technologies and their place in a broader social context. The application and uptake of enabling assistive technologies for aged care in the next ten years are presented in the context of this definition. Convergence between enabling technologies is particularly significant. Many of the potential applications for an ageing population illustrative convergence arising from these technologies, with applications involving bio- and nano- technologies combined with ICT and cognitive science.

4.2 Overview of Enabling Assistive Technologies in Aged Care

To provide an overview of the ways in which bio- and nano-enabling technologies may contribute to health care and improved quality of life for the aged, Professor Greg Tegart presented three key areas of application and need as also outlined in the Smart Technology for Health and Longevity Report by ATSE. These three technology opportunity areas include security and safety, diagnosis and treatment, and assistive technologies for mobility.

Security and safety

Technology opportunities around security and safety were identified as elderly-friendly homes, prevention of falls, and communication and social interaction.

Improved security and safety is based on the notion that older people, or people needing assistance such as the chronically ill or disabled, require greater assistance and higher levels of safety, and that aged people living alone prefer higher levels of security. Elderly-friendly homes would incorporate technologies such as central locking, controlled access via smart cards or biometrics, remote surveillance and automatic lighting. Other monitoring systems might be linked to personal monitoring devices that detect movement or provide an easy method for the individual to call for help in an emergency. The ATSE report also mentions of the need for changes to the Building Code of Australia to allow for conversion of existing homes and construction of new ones to incorporate “housing for life” design including ease of access to bathroom and kitchen facilities and wireless communication technologies.

Falls are a major issue for older people, being the major cause of accidental injury, and injury-related deaths for people aged 65 and over, many of these leading to hospitalisation. Therefore prevention of falls is important for improving health outcomes and reducing hospitalisation costs. In addition to medication controls and training in balance exercises, fall prevention could be achieved by better environmental design to remove tripping hazards. Other more sophisticated technologies might include early warning of balance or vision problems using accelerometers and the introduction of assistive devices such as hip protectors.

Additionally, embedding communication and social interaction will provide access to health care and a broader social support circle. Although mobile phone ownership is high (90% of those aged over 70

have a mobile phone), improved capabilities in using the technologies will mean improved access to the internet and other mobile applications. Another possible application of communication technologies would be in using virtual animated agents (a visual of a talking head and shoulders) to provide reminders about appointments, medication and assist with memory training.

Diagnosis and treatment

Diagnosis and treatments could be supported by telehealth, alternative approaches to coping with degenerative disease and the use of nanomedicines. As foreshadowed in Section 3, telehealth systems will be important for health care in an older population as it will enable personal monitoring to be linked with wireless instrumentation and then to web-based services and databases. It also means greater access to a range of specialist services in remote health care. A range of diagnostic devices for blood pressure monitoring, pulse oximetry and electrocardiograms, as well as measurements of weight, body temperature and blood glucose could be linked to a central system for health management. Telehealth providers like TeleMedCare and aged and community care providers Feros Care are currently developing such systems.

In terms of treatments, novel approaches to degenerative diseases such as dementia or sensory loss (eg hearing, vision) will be important. This may include the application of rapid biomarkers to help understand the causes of Alzheimer's disease. The use of radio frequency identification devices could be used to help track and monitor patient movements for safety but also for monitoring of the progression of dementia. Sensory loss may be addressed through greater access to a new generation of hearing devices and implants, or the development of a bionic eye. Addressing diminishing vision will also help counter the effects of falls as discussed previously.

Finally the applications of nanomedicines could result in predictive "lab-on-a-chip" devices for detecting the onset of diseases, or DNA sequencing technology and its application to diagnosis and treatment. In addition to the application of stem cells and cell-based therapies for regenerative medicine, nanotechnologies could provide solutions to spinal cord injury, macular degeneration and diabetes.

Assistive Bio-mechanical Technologies

Reduced mobility is a major barrier to social interaction in the elderly. Assistive biomechanical technologies could aid mobility and include technologies such as biorobotics, brain/machine interaction and mobility systems.

Biorobotics includes the provision of robots for services such as domestic cleaning and household tasks, cognitive services including medication reminders and for companionship. Another area of application would be in rehabilitation to complement time-intensive and repetitive treatments currently delivered by physiotherapists.

In addition to brain/machine technologies previously discussed such as the bionic eye, applications could be around brain stimulation and regulation which have shown promise in the treatment of age-related diseases such as Parkinson's and Alzheimer's diseases. Other approaches could involve

neurofeedback to consciously control brainwave activity or to replace critical but damaged parts of the brain with chip devices.

Finally mobility can be aided by “way-finding” technologies include geo-referencing and route guidance on mobile platforms. Other solutions might be based in the provision of personalised transport such as wheelchairs and motorised scooters, or in the design of vehicles like cars and public transport to cope with the changing needs of an older and in some cases frailer section of the population.

The changing needs and expectations of older Australians, means exploring the potential of these technology applications – security and safety, diagnosis and treatment, and assistive biomechanical technologies – is important. The application and uptake of these technologies for sectors catering for an ageing population will have implications for costs, the way in which services are provided and quality of life.

4.3 Most Significant Technology Developments

The overview of enabling assistive technologies for aged care technologies led into a discussion of technologies in each of six areas – new medical devices and sensor technologies, telehealth-care services, regenerative medicine and intelligent materials, intelligent materials and intelligent homes, integrated health and social support services, and biomechanical technologies, robotics and neuro-prostheses.

After discussing the full range of developments of technologies and applications in each of these six topic areas, participants were asked to identify the top three developments for each topic that would support the scenario of the new vision of ageing, when considering how these technologies might help older Australians live more independently with better healthcare and social support.

Many of the groups noted that potential technological developments needed to be put into perspective. As well as understanding the technical or technological possibilities, it is important to be mindful that technologies are only tools and that they and their adoption and use, are strongly shaped by socio-economic and cultural factors. For example, in terms of new medicines, there may be barriers to implementation such as regulatory procedures for approval or public concerns over side effects. Three issues were identified that need to be considered: technical feasibility, commercialisation and customer use and acceptance.

Technological developments also need to be considered in the context of community expectations and practices. For example, genetic testing can inform people about their risks of disease, however such knowledge may not impact on behaviour i.e. people may not change their habits even with the possibility of reducing or delaying the onset of disease. Thus, uptake of new health technologies also requires community engagement and understanding of community expectations. These issues are further discussed in Section 5.

In total, six discrete top 3 developments were identified across the groups: Table 1 summarises the developments and the potential top three technology developments identified within each group are described in further detail in the sub-sections below.

Table 1: Summary of Most Significant Enabling Assistive Technologies for Aged Care

Category	Top Enabling Technologies
1. New medical devices and sensor technologies	<ul style="list-style-type: none"> • Non-invasive medical devices • Wrist watch for personalised monitoring of signs like breathing and pulse, as well as pathology • Data visualisation and imaging
2. Telehealth-care services	<ul style="list-style-type: none"> • National Telehealth Services (in the cloud) • Semantic information underlay • Client-controlled
3. Regenerative Medicine	<ul style="list-style-type: none"> • RNA therapies and nano-based therapies that cross blood-brain barrier • Stem cells and Induced pluripotent stem cells (iPS) technologies • Organ 3-D printing capability • Biomimetics or the use of smart materials and design inspired by nature
4. Smart homes and intelligent materials	<ul style="list-style-type: none"> • Implantable monitoring devices • Smart fabrics and intelligent materials • Assistive devices designed for low dexterity • Data monitoring – client controlled. • Smart grids able to withstand power interruptions • Sources of renewable energy.
5. Integrated health and social support services	<ul style="list-style-type: none"> • Integrated Healthcare – streamline care, sharing of documentation • Smart homes - voice and face activated • Uptake enablers such as funding, development, design, resources and program support, and education for carers, individual and professionals.
6. Bio-mechanical technologies, robotics and neuro-prostheses	<ul style="list-style-type: none"> • Neuro-prosthesis - Brain signals have an impact on sensors. • Robots - integrated information systems enabling monitoring, and social engagement • Biomechanics - eg walking-aid shoes; exoskeletons that help movement

4.3.1 New Medical Devices and Sensor Technologies

Advances in enabling technologies will impact the generation of novel sensing, diagnostics, medical devices and the development of data management for advanced data mining.

1. Non-invasive Devices
 - New non- and minimally-invasive devices will be an important development for those requiring frequent health monitoring and interventions. Such devices could include those used for testing of saliva, breath, skin cells, human waste or hair samples, or those used to assess touch, retina of the eye, or the way in which we hold things (repetitive behaviour) to better diagnose disease or degeneration.

2. Personal Monitoring
 - Regular monitoring of vital signs is critical for managing diabetes and other chronic conditions. In place of regular visits with health care professionals, a wristwatch device could be used to monitor vital signs (eg pulse, temperature) and provide point of care pathology assessment. The uptake of such a device could be expected to be high given that its appearance mirrors an item already established as socially 'normal'.

3. Visualisation
 - The development of new sensing devices such as those that allow for continuous monitoring must be accompanied by the development of new software for data collection and management. How the information is gathered, shared along the health care chain and visualised will be vital with large amount of data points and is a central concern of the development of eHealth data management systems. Additionally there may be algorithms that allow for these devices to be smarter, eg self-learning.

4.3.2 Telehealth Services

Telehealth services rely on the convergence of health services having access to broadband, electronic patient record systems and the ability for patients' records to be shared by various stakeholders in the system. Within Australia, the National Broadband Network could be a significant enabler for the development of telehealth infrastructure. The vision for the future of a National Telehealth Infrastructure Service is "an inclusive, standards-based interoperable service that provides a platform for clinical grade videoconferencing and telehealth" on agreed service and service levels in a usual way for multiple stakeholders and networks⁴.

The technology developments that would underpin such a vision for a national telehealth service from the workshop discussion included the following characteristics:

- National telehealth services in 'the cloud', where data could be aggregated daily (or more often), unobtrusively by scanner and triaged and monitored appropriately;
- The services would have a semantic information underlay to ease and standardise meaning; and

⁴ NICTA Telehealth Infrastructure Services, 7 July 2011, Report for the Northern Territory Department of Health

- The information would be client-controlled, with settings to allow physicians, clinicians, family and support services access as necessary, with crossover between physical and virtual systems.

4.3.3 Regenerative Medicine

Regenerative medicine is not one discipline, but covers a number of emerging and sometimes related fields. At its simplest it can be defined as a therapeutic intervention which ‘replaces or regenerates human cells, tissues or organs, to restore or establish normal function’.⁵ The following categories were identified in the discussion on regenerative medicine at the workshop:

1. RNA and other nano-scale therapies:
 - Use of RNA therapies for the treatment of diseases such as macular degeneration, osteoporosis, dementia
 - Genetic therapies which will progress approaches to personalised medicine
 - Therapies that cross the blood-brain barrier to target specifically dementia, Alzheimer’s and other brain degenerative diseases
2. Stem cells:
 - Being able to grow embryonic stem cell lines, donated by relatively younger donors (for allogeneic treatments) in larger numbers and distribute them widely. In the future, companies will be able to produce large amounts of cells, which could be shipped worldwide and used to treat many sorts of diseases.
 - Cellular reprogramming or induced pluripotent stem cells (iPS cells), whereby they are reprogrammed to behave like embryonic stem cells. iPS cells can be used to model and study disease, for example iPS cells from Downs Syndrome patients, who are predisposed to Alzheimers may be a model to study progression of neural cells. This will enable future developments such as large-scale growth of stem cells, personalised treatments, and technologies that help to understand disease progression as well as develop novel targets for drugs.
 - Intelligent materials will be used in conjunction with applications for stem cell: this may occur by methods that protect the cells (for example, encapsulating cells from a genetically non-matched donor, so that they are not rejected after transplantation) yet still allow functions such as the production of insulin (for example).
 - Organ printing technology to seed and grow cells onto a matrix in order to re-create three-dimensional networks of tissues and/or organs.
3. Biomimetics and the development of better materials:
 - Insect specific proteins that are rubbery and more resilient could have potential use in heart valves or spinal cord discs. It has been estimated such a development could be

⁵ Mason C, Dunnill P. A brief definition of regenerative medicine, *Regen Med*, 2008; 3:1-5, as quoted in the Department for Business Innovation and Skills report: *Taking Stock of Regenerative Medicine in the United Kingdom*, July 2011.

only six years away, and involves collaboration between engineers and biologists. Other applications involve water-channels used by cells to develop membranes for desalination.

The workshop group considering regenerative medicine discussed how personalised genomics could increase the lifespan by providing preventative applications regarding lifestyle choices or activity avoidance, and discussed how nanotechnology-based sensors injected into our body could specifically target diseased cells and therefore more effectively treat them *in vivo*. This approach is currently developed for cancer therapies.

In terms of the potential for novel technologies to directly arrest or reverse the ageing process itself, the general consensus was 'no'. Group members concluded that if the ageing process were caused by one molecule then it would be possible to develop anti-ageing therapies, using gene therapy for example. However, if the molecular mechanism of ageing is more complex; for example, although the enzyme telomerase catalyses telomere length, which is shortened in cell division, it is also involved in replication of cancer and stem cells. If therapies exist that extend our lives, then there exists the risk that they may also increase the chances of other diseases. Furthermore, the longer we live the longer we have to develop more degenerative diseases.

4.3.4 Smart Homes and Intelligent Materials

The impact of technologies on the development of new materials for medical devices and the homes of the elderly were considered in the following categories:

1. Smart Homes for the aged would feature embedded smart grid technologies that combine the monitoring of energy consumption by appliances, lighting, heating and air-conditioning, and could also link with security devices and health monitoring devices to enable independent living⁶.
 - Note also that the workshop group exploring Integrated Health and Social Support Services (Section 4.3.5), also identified the potential of voice- and face-activated technologies for interaction with family members and primary care providers such as careers, GPs and specialists.
2. Personal monitoring devices
 - As mentioned above, personal monitoring devices remove the need for regular, in person appointments with health care professionals. Such devices could become ubiquitous, embedded as smart materials or in household appliances such as television sets, refrigerators, stoves, etc or could include implantable monitoring devices that would enhance personal privacy.
3. Assistive devices for users with low dexterity.

⁶ As summarised from Smart Technology for Health and Longevity Report by ATSE in Section 4.2

- For users with low dexterity, smart devices with minimal requirement for maintenance/rebooting/battery changing would be useful; radio frequency identification tags (RFID tags) could be relevant in this context, since passive tags require no power. Elements of these applications could be extended out to exoskeletons (as discussed in Section 4.3.6). Other important considerations when considering assistive devices are ensuring universal design principles so that devices operate in similar ways or with a similar visual language, as well as the harmonisation of complementary technologies, so that devices can connect to each other.
4. Power for homes
 - Improving consistent and constant delivery of power to homes for the aged may involve smart grids, adoption of technologies that can withstand interruptions to power, and perhaps renewable energy. This is important as aged individuals requiring care and monitoring, but living independently will be vulnerable to power outages.
 5. Data monitoring
 - The control of data by clients is an important aspect of health and aged care (see Section 4.3.2). The regulation of who might be receiving and examining personal data for diagnosis is important to consider, and indeed might require specific training and the creation of a new workforce of people. Two issues were highlighted for particular consideration – (1) if you are connected, there is an expectation that the data are being monitored, and (2) data should be analysed for signals/patterns and identification of trends to support, for example, chronic disease management.

Other potential technologies raised in this group included design of the built environment (such as better floor covering to prevent falls) and telehealth services, especially enabled by the National Broadband Network, but also including voice recognition and “one contact” services with health providers. Initiatives like the Queensland Smart Home Initiative⁷ provide a way in which older people and other stakeholders in the community can activate and use assistive technologies, thereby seeing how a range of such technologies can be applied to the home environment.

4.3.5 Integrated Health and Social Support Services

To meet the vision of aged care, integrated health and social support services would be provided through the uptake of the full range of enabling assistive technologies, with attention paid to linkages between health care, aged care, housing and social support services. Technology would be a major facilitator but not an answer in itself. By 2023, consumer participation in the integration of health and social support services would be well advanced. The individual would not only be networked to health care systems, but to their social support networks and government services.

⁷ <http://www.qshi.org.au/>

We would have now recognized that ageing is not a health care issue, but a societal issue, and the potential technology developments are therefore framed as tools for community empowerment.

1. Integrated Healthcare
 - Integrated healthcare systems are those that streamline care, enabling sharing of documentation between hospitals, support services and aged care facilities, and allowing connections between rural, remote and city communities as foreshadowed in the discussion on telehealth services in Section 4.3.2. Ideally, the system would also allow services to be tailored as older peoples' needs change.

2. Organisational requirements
 - While planning for the integration of new technologies is one issue recognised, many other factors have been addressed. These include how to support the organisations that deliver such services, integrating funding, resources and program support, new technology and education and recreation. A national body to drive reform and the introduction of new standards, regulations and requirements have been prioritised.

4.3.6 Biomechanical Technologies, Robotics and Neuro-Prostheses

Biomechanics, robotics and prostheses for aged care applications all draw upon the use and uptake of new enabling technologies.

1. Robots
 - Different types of robots offer diverse characteristics: assistive robots such as robotic wheelchairs which aid in movement and physical independence; companion and social robots integrated with social support and family networks, especially for people with dementia and service robots will provide lifestyle support services and assist with other requirements. The incorporation of robots has also allowed the development of integrated information systems enabling better connectivity, monitoring, and social engagement.

2. Biomechanics
 - Entry of the elderly into managed care facilities is often a consequence of their physical inability to take care of their own body and home. Hence any technology that assists movement or monitors motion may be of value: such technologies may range from a simple walking-aid shoe, to a lightweight yet strong exoskeleton that helps movement and monitors motion. Other more advanced interfaces might involve internal biodegradable scaffolds for cell development, and interfaces between biomechanics and virtual reality that use brain wave signals for control.

3. Neuro-prostheses

- Neuro-prostheses are devices that help to restore neural pathways like cochlear implants, prosthetic limbs with neural controllers or implantable silicon parts for retinas or parts of the brain like the hippocampus. These prostheses make use of the way that brain signals can impact sensors, the rest of the brain, body, or wider interactions. The application of stem cell technologies as described in Section 4.3.3 may also have an important impact in this area.

This group made the important observation that technologies should be used to assist, rather than to eliminate the older person from an activity or interaction. We want aged people to be active, not just to replace functions that aged people have difficulty with.

5. Issues and Challenges

‘...as with many emerging technologies, there are steep technological, regulatory and strategic barriers to realising regenerative medicine’s significant potential’⁸

After considering the potential of the top technologies for realising the proposed new vision for aged care and quality of life, workshop participants, working in their six topical groups, were asked to discuss the issues and challenges that were faced in realising these potential developments in the context of the vision described in Section 3.

5.1 Overview

The identified issues and challenges were wide-ranging. Some related to the nature of the technology development such as research funding, commercialisation timelines and effectiveness and the cost of increasingly personalised medicines. The design of devices and systems was also identified as an important issue, especially in terms of ensuring compatibility and ease of use, and the workshop discussion highlighted the urgent need for there to be much better communication between researchers and end-use consumers.

Social issues were also raised, including cultural perceptions around ageing and how that might encourage or discourage the adoption of new technologies for consumers and the sector. Another

⁸ *ibid*, Ministerial Forward, page 3

important point noted was the current funding focus in the health care system was for acute care rather than prevention and management of chronic disease. Such a focus would become increasingly unsustainable with demographic ageing and increases in the costs of health care as foreshadowed in Glenn Bunney’s presentation (Section 3).

Structural barriers were also identified. Of particular note were the current low rate of housing stock renewal, incentives for health care services not necessarily being aligned with the provision of telehealth, and the provision of new types of health care skills in data mining, visualisation and monitoring.

5.2 Potential Issues and Challenges

The potential issues and challenges that might be faced in attaining the desired vision for aged care in the future were explored through sessions at the workshop, a group discussion to identify issues and challenges, and then a timeline construction to identify what actions would need to be taken in order for the vision to be achieved. A summary of the major issues and challenges for the six topic areas is included in Table 2.

Table 2: Summary of Major Issues and Challenges

Category	Issues and Challenges
1. New Medical Devices and Sensor Technologies	<ul style="list-style-type: none"> • Design: Ensuring that the design of devices and related products and services support ease and desirability of use • Support: Training personnel to interpret results from new medical devices and sensors and ensuring there are appropriate support services
2. Telehealth Services	<ul style="list-style-type: none"> • Accessibility: A national telehealth system needs to be accessible across diversity characteristics including language, age, education and economics. • Cross-disciplinarity: Different medical and social services will need to be able to share data and information, which means a common health language, dates, standards and nomenclature. • Multi-stakeholder: Implementation requires support of multiple stakeholders including physicians, other professionals, State governments, the AMA and industry associations and initiatives like the NBN. • Funding: Funding/payment dilemmas for shared care, as well as funding for telehealth consultants to set up specific patient systems. • Patient-Centred: Patients must know the risks of participating and not participating in a telehealth system.

Category	Issues and Challenges
3. Regenerative Medicine	<ul style="list-style-type: none"> • Commercialisation: Getting quality research funded and across the “valley of death” to domestic and international markets • Research: funding for research, inter-disciplinarity of funding for aged care • Partnerships: need to develop a culture of partnerships between researchers, commercial technology business and aged care providers. • Ethics: especially around the cost of personalised medicines, and extension of life versus cure. • Public awareness: important for the public to understand and appreciate the types of assistive technologies available for their potential needs.
4. Smart Homes and Intelligent Materials	<ul style="list-style-type: none"> • Design Standards: Devices need to be compatible across types in terms of standards, specifications, semantics and protocols. • Community acceptance of ageing: Perceptions of ageing in the community and medical sector need to become positive and older people need to be included in the research, design and evaluation of products and initiatives aimed at their well-being. • Funding: Need to ensure a sustainable funding system where prevention is valued and incentives support desired outcomes. The funding system needs to be more flexible so that consumers are able to choose services appropriate to them. • Data and ICT: Data collections systems need to be integrated and will require new tools to be developed to fully use the information for health outcomes and predictive modelling.
5. Integrated Health and Social Support Services	<ul style="list-style-type: none"> • Community acceptance of ageing: Perceptions of ageing and caring in the community and medical sector need to become positive. • Funding: Need to ensure a sustainable funding system that supports flexible and appropriate interventions, as well as providing alternative financing models for older clients • Access to Technology: Should be easier to access and data collections systems need to be integrated. • Access to Quality Care: Providing access to quality care in both urban and remote locations important.

Category	Issues and Challenges
6. Bio-mechanical Technologies, Robotics and Neuro-Prostheses	<ul style="list-style-type: none"> • Education: Require education for end users, for researchers, and for therapists in order to realise the potential of assistive technologies that are multidisciplinary • Technology Development: Develop a roadmap for goals in terms of technologies and incorporating factors such as regulation, education and collaborative opportunities. • Funding: move from episodic incentives to a person-centred system that also takes into account the role of assistive technologies within aged care. • Ethics: Need an ethical framework for assistive technologies for both research and for employing assistive technologies in the home and on people.

Actions required for addressing issues, or indicators of the desired vision across the next 12 years are included in Table 3. The policy implications from developing these timeline of required actions are further identified in Section 6.

Table 3: Timeline for Addressing Priority Issues

Category	By 2013	By 2018	By 2023
1. New Medical Devices and Sensor Technologies	<ul style="list-style-type: none"> • Gap analysis on funding models for in-home aged care. • New policy developed to allow funding of virtual appointments and to overseeing drug administration. • On-going whole-of-government approach involving relevant agencies for regulation and oversight. 	<ul style="list-style-type: none"> • Further research of devices and systems to allow in-home tests to replace in-person appointments. • Optional genetic profiling available to the public for a reasonable fee. 	<ul style="list-style-type: none"> • A demo store that showcases new devices and sensors where one can see, try out, and purchase these devices.

Category	By 2013	By 2018	By 2023
2. Telehealth Services	<ul style="list-style-type: none"> • Stage 1 – NT & WA Telehealth services completed (already in Indigenous areas) • Align wider telehealth delivery with NBN release test sites • Marketing and selling concept • Ensure reallocation of funds for rollout within Budget, and appropriate funding systems in place 	<ul style="list-style-type: none"> • Revise funding and payments of clinicians • Social engagement to ensure that eHealth is not seen as different from Health care • Evaluation & fine tuning of service 	<ul style="list-style-type: none"> • National rollout completed
3. Regenerative Medicine	<ul style="list-style-type: none"> • Coordination of research efforts • Better R&D incentives/grants to support innovation and clinical trials • A Translational Research Institute focused on Aged Care, to include companies and manufacturing • Regenerative medicine and biomaterials for scaffolds become available • Greater coverage in popular media from a marketing Strategy for public education about assistive technologies. 	<ul style="list-style-type: none"> • Institute for Aged and Innovation or a Translational Research Institute • Novel investment and/or taxation options so government funding not only input eg lotteries, health insurance, superannuation, individual investment funds and aged care providers all investment in future technology R&D. 	<ul style="list-style-type: none"> • Revaluation of regenerative medicine after ten years, both with regards to ethical and economic impacts in terms of affordability, access, and age limits.

Category	By 2013	By 2018	By 2023
4. Smart Homes and Intelligent Materials	<ul style="list-style-type: none"> • Redirection of health funding towards preventative measures arising from better housing design • Development or adoption of existing international Standards (for devices and housing). • Build community acceptance of technologies through detailed problem/needs analysis. • Establish long term funding mechanisms to support research into assistive technologies 	<ul style="list-style-type: none"> • Mandatory eHealth records • Community acceptance of ageing, responsibility for life long health lies with individuals. • Easy access to electronic systems for assessments and provision of services • Data collection systems providing data for modelling • Implementation of building codes – a ‘mentoring’ system to start with then mandatory standards 	<ul style="list-style-type: none"> • Predictive models and tools for data mining
5. Integrated Health and Social Support Services	<ul style="list-style-type: none"> • Flexibility in how funding is used by individuals • Adoption of integrated national strategies for action agendas in aged care • Application of population health to population needs • Expand on what is working in aged care • Cultural change and a revaluing of the ageing population 	<ul style="list-style-type: none"> • Cohesive voice and accountability • Communities getting involved in aged care and attracting new employees into workforce. • Harnessing data, eliminating barriers whilst protecting privacy • Streamline delivery of services • Preventive care resulting in longer periods of independence 	<ul style="list-style-type: none"> • Monitor and review aged care as a sector to ensure services are matching population needs

Category	By 2013	By 2018	By 2023
6. Bio-mechanical Technologies, Robotics and Neuro-Prostheses	<ul style="list-style-type: none"> Develop a detailed roadmap including - ethics, division of work between government, industry and university R&D for the development of these technologies Inform response to the Productivity Commission's report Caring for Older Australians, between the report's release and 2012-13 Budget 	<ul style="list-style-type: none"> Proof of concept in robotics and pilot communities put in place Education from community to community re "best practice" and link to NBN Foster commercialisation Ethical standards on place for assistive technologies 	<ul style="list-style-type: none"> Subsidies available for application of effective enabling assistive technologies Foresighting as standard strategy, not crisis driven

5.2.1 New Medical Devices and Sensor Technologies

The key issues and challenges raised by this group were the design of devices and training and services to support the use of such devices.

One of the key challenges for personalised technologies is ensuring cross-platform compatibility. Standard specifications in device design are needed as well as consistencies in manufacturing processes. Data standards, specifications and protocols that allow for devices to be used as modules with each other, and in ways that are simple for the consumer to understand, are also important.

Another important consideration for personal technologies is allowing for multi-purpose use of devices. For example, while a new personal monitoring technology may be used primarily to reduce the frequency of trips to the doctor, it may also have a crossover function that allows the user to better connect with family and friends.

To allow for optimum use of devices and sensor technologies, there needs to be a skilled workforce that understands how the devices work and how to interpret results. While simple and inexpensive tests are being developed, at this stage the technology still needs a person to interpret the results and explain to the patient. In-home tests offer potential for prevention and monitoring, but how the technology will advance, and whether there remains a role for a human interface either as in-person medical appointments or through telehealth is another factor that needs to be considered.

Finally, when thinking about the systems and structures that need to be in place to meet the vision for ageing offered in the 2023 scenario, it will be important to have a whole-of-government approach

involving agencies like the Department of Health and Ageing (DoHA), the Therapeutic Goods Administration (TGA) and the National Health and Medical Research Council (NHMRC) so that funding models, research and regulation are aligned and working in support of the larger vision.

5.2.2 Telehealth Services

In order to attain the vision for a National Telehealth Infrastructure Service, several key components will need to be addressed in its delivery. These include how the service meets the needs of patients and multiple stakeholders across different disciplines, and how it aligns with funding systems.

The current absence of a system for electronic health records in Australia does not enable mobility or continuous care from provider to provider. If such a system were to be developed, it would require the concurrent establishment of universal protocols and systems integration to ensure records can be carried throughout the system. This in turn would enable a design that ensures these records are accessible across diversity characteristics such as language, age, education and economics.

Another barrier is language. Different medical and social services will need to be able to share data and information, which means a common health language, dates, standards and nomenclature. The adoption of a common health language like “Snomed CT” (Systematised Nomenclature of Medicine – Clinical Terms) would allow for clarity on medical records.

The delivery of a National Telehealth Infrastructure service requires the support of multiple stakeholders including physicians, other professionals, state governments, the AMA and industry associations. It requires alignment with any proposed funding restructures for care and will also require funding for setting-up specific patient systems. Patients must also know the risks of participating and not participating in a telehealth system.

Furthermore, the implementation of the NBN and its uptake in the community will be a critical component. In addition to telehealth, it will present new opportunities in case management, data mapping, and integrated data systems. A further consideration is how data collected through telehealth systems might be used for predictive e-health modelling and decision-making for education, prevention, early intervention and accurate prognostics as discussed further by the Smart Homes and Intelligent Materials group (Section 5.2.4).

5.2.3 Regenerative Medicine

The Regenerative Medicine group identified issues and challenges around future research including funding and partnerships, commercialisation and ethical issues around research choices.

Firstly, one of the ethical issues raised was the cost of personalised medicines, as these may be seen as problematic by some sectors of the community, in that they are perceived to privilege the

wealthy. Certainly the increasingly targeted nature of cancer treatments (for example the breast cancer drug Herceptin) is an early indication of how medicine may be personalised to target specific genes.

The development pipeline for enabling technologies is also a concern as it was noted that there is not enough funding for research. If Australia is going to commercialise targeted cancer treatments and other similar medicines, then the government needs to support long-term funding for clinical trials as occurs in other advanced economies (for example, in Europe \$12-15 million grants are available to support clinical trials). However, it was suggested that a Centre of Excellence programme in this area could be an option to accelerate progress and uptake. Such a centre could take the form of an interdisciplinary Research Centre for the ageing. Intel has invested in such a model in Dublin, Ireland, that includes scientists, sociologist and nurses. It was also noted by participants that Cooperative Research Centre (CRC) guidelines regarding Intellectual Property (IP) are not attractive to SMEs (small and medium sized enterprises), which comprise the principal vehicle for commercialisation research in Australia.

Furthermore, participants strongly supported the need to develop a culture for partnerships between aged care providers and researchers. In Australia, aged care providers are not eligible to be an industry partner in a CRC or Centre without changes to Commonwealth regulations that limit how funds are currently distributed. Participants at the workshop expressed opinions that the Aged Care industry needs to become more appropriately regulated to enable innovation and more constructive partnerships between researchers and end-users. There is a strong feeling that although in Australia the quality of research was excellent, the small market size and lack of venture capital funds meant that commercialisation was not as successful as it might otherwise be. Other options may involve importing technologies from other markets like China, or finding ways to be less risk-adverse through innovative investment options such as superannuation schemes and stamp duty allocations.

One of the issues that arose during consideration of the timeline was the need for the public to understand and appreciate the types of assistive technologies that could become available. It was suggested that there is a real potential for nanotechnology to be perceived as a risk in Australia, like the issues around genetic modification. Companies in Europe are already choosing not to invest in products if they are called nano, leading to rebranding as 'sub-micron'. There fore a mix of popular media coverage and marketing or communications strategies about the potential of assistive technologies will be needed to educate potential users, the wider community and practitioners.

5.2.4 Smart Homes and Intelligent Materials

In thinking about Smart Homes and Intelligent Materials, many of the issues and challenges relate to broader issues around design, funding models and community perceptions as well as specific technology issues related to data and ICT.

The key challenge in the built environment is providing adequate and appropriate housing that meets the needs of an ageing population. The current rate of transforming adaptable housing is slow - only 2% of new housing stock is transformed each year by retrofitting existing housing stock with universal design principles, that allow wheelchair access into the house and within internal rooms, smart grid technologies, and more energy efficient and sustainable building materials. Universal housing design for these issues should be made mandatory for new homes and major renovations⁹. This group also supported the discussion in Section 5.2.1 about the need for standard specifications in device design and manufacturing to ensure shared standards, semantics and protocols.

The issue of creating housing appropriate for and/or modifiable to meet the needs of the elderly is especially important as the future of aged care is seen not to be institutional care (the question was posed “who can’t wait to get into a nursing home?”). The trend across Scandinavia is to stop building nursing homes and to bring remote monitoring into suitable housing as an alternative. Such an approach would also be appropriate for Australia.

Appropriate housing reflects the importance of changing perceptions of ageing in the community and medical sector towards a more positive image. Older people need to be included in the research, design and evaluation of products and initiatives aimed at their wellbeing.

In terms of health care, the current system has the wrong financial incentives for performance as it focuses on acute care rather than preventative care, and there is little incentive for rehabilitation. Medical practitioners are currently rewarded for making diagnoses, ordering tests and providing treatments rather than for delivering health outcomes. Legislative reform might be needed to look at new approaches like investing in age-enabled homes to reduce people waiting in hospitals for aged care facilities. Another approach may be to allow more flexibility in how health care dollars are spent by consumers. Individuals could choose how best to use the money: for example, some may use it for showering and cleaning assistance, others for taxis to the doctor and physical aids, still others for assistive technologies.

The final set of issues raised was around information and communication technologies. As discussed with regards to telehealth, the NBN will be a critical component of in-home aged care services. Data collections systems need to be integrated and will require new tools to be developed to fully use the information for predictive modelling and therefore early intervention and public health communications.

5.2.5 Integrated Health and Social Support Services

The broad base of scope for discussion around Integrated Health and Social Support Services lead to a wide-ranging discussion of potential issues and challenges that reflects the discussion of the other groups detailed to this point.

⁹ Replacement and retrofitting of housing stock were also discussed in the NETS Expert Forum Industry Uptake of Enabling Technologies Foresight Workshop: Building Products, 6 May 2011.

Firstly there was strong feedback about the need to change the culture around the elderly, so that growing old is seen as a positive experience and the community has an alternative view of older people, one that appreciates the mentoring and participation opportunities. Furthermore, society needs to acknowledge and value the roles of carers. The culture of the aged care sector as a whole needs to become far bolder to get the action that is required for improvement.

A sustainable funding system that supports flexible and appropriate interventions is required. Another aspect to funding is providing alternative financing models for older clients so that services can be specifically directed where support and care needs are required. Funding alternatives could include the use of superannuation to help finance care, or changes to stamp duty consideration for older clients when selling to downsize or to move to accommodation with higher levels of care.

Finally, it should become easier to access technologies. Proper implementation of eHealth, including data sharing and data collection systems is critical. This in turns will enable improvements in the quality of care provided across the country, including to remote locations.

5.2.6 Biomechanical Technologies, Robotics and Neuro-Prostheses

This group examined the issues related to the separate assistive technologies such as biomechanical technologies, robotics and neuro-prostheses to identify issues and challenges around education, funding and ethics. In addition to these, the overriding challenge was to develop a culture that actively supported collaborative opportunities across disciplines to ensure that the technology goals in support of the vision were met. It was suggested that a roadmap to identify end goals in terms of technologies and functions, and enabling factors in terms of regulation would be helpful to identify barriers and foster collaboration.

One of the biggest challenges identified was how technologies were adopted. Education and a lack of skilled personnel in appropriate areas is one aspect, especially given the multi-disciplinary nature of aged care. A greater understanding of enabling assistive technologies and when to recommend their use or application will be required. In NSW there is a program that supports assistive technologies through an assistive technology facilitator, who would assess client needs and describe or prescribe appropriate technologies. There are only two such facilitators in Australia, so perhaps expansion of this type of program would assist in better uptake. It was specifically noted that technology development needs to occur within a social context for it to be successful and that the culture around technology provision to older people needed to change.

The funding model for aged care was discussed, especially in terms of incentives. A move from episodic incentives to a person-centred system that also takes into account the role of assistive technologies within aged care would be desirable.

The research landscape was also discussed. In addition to the culture of collaboration and education aspects already identified, an ethical framework to guide research and for employing assistive technologies in the home is necessary. Investment in research and development is critical and mutual understanding between industry and universities would enhance this. An example is the Siemens-Monash collaboration with ongoing key performance indicators that must be met for funding to keep flowing to the university over a 5-year timeframe.

Addressing these complex issues of research technology development and uptake within a social context was another way in the idea of an overarching roadmap for identifying actions against issues and challenges was seen as important.

6. Policy Implications

Focusing Question: **What are the priorities that NETS and other agencies need to address to progress the uptake of relevant enabling technologies for aged care?**

Implications for policy can be drawn from the discussion on issues and challenges, and timeline of activities to meet the vision of the future for aged care as previously identified and discussed in Section 5. The areas for consideration include research and commercialisation, funding, ethical issues, design standards, skills and education, and community attitudes towards ageing and towards the uptake of assistive technologies. The workshop suggested a number of recommendations in these areas, but there was also broad support for the establishment of a multi-disciplinary network to support the range of stakeholders in achieving the desired vision for aged care.

Research & Commercialisation

The key recommendations in helping to further the impact of research and commercialisation for assistive technologies were to develop a roadmap and consider the establishment of a CRC.

- The development of a roadmap would identify technologies, functions, regulations and who is currently working on them, and what could be done to foster further collaboration and commercialisation challenges.
- Initiating the preparation of a proposal for a specific CRC focused on the cross-disciplinary nature of applying new technologies to aged health care would provide a focus for research and development in this area and encourage multi-stakeholder partnerships.

Funding

More flexible funding models need to be provided to ensure that the right outcomes are encouraged and that there is flexibility for people to address specific aged care needs.

- Move from episodic incentives to person-centred, health/outcome-based incentives, perhaps by performing an economic study to identify the role of assistive technologies within health.
- Address the parts of the current aged care funding system that don't allow for the appropriate use of assistive technologies such as funding shared care and telehealth services.

Ethical Issues

The way that assistive technologies are explored in research and introduced into homes requires an ethical framework.

- A framework for thinking through the ethical issues for assistive technologies - both for research and uptake could provide direction and information for stakeholders including researchers, companies and patients.

Design Standards

It is important that assistive technologies are easy to access, easy to use and compatible across a number of platforms, which means a common health language, dates, standards and nomenclature.

- Development or adoption of international standards for health language, universal design protocols and common specifications will assist in making these technologies accessible and easy to use appropriately.

Education

Education around assistive technologies - for end users and for researchers in terms of multidisciplinary training – is important so that technology developers, therapists and patients are all able to implement these technologies appropriately.

- Specific education or services that facilitate the introduction and familiarisation with enabling assistive technologies will better ensure appropriate adoption and use.

Community Attitudes

Community attitudes towards the adoption of enabling assistive technologies, and towards an ageing population both need to change.

- Strategies around valuing the contribution of older people in the community to alter the perceptions of ageing, and therefore perceptions of aged care solutions are needed.
- Increasing public awareness of ways in which new enabling technologies may improve health care and lifestyle should continue.

Network

The multidisciplinary nature of aged care services across ICT, health and medical care, housing and other services means that many stakeholders and agencies need to work together to fully implement the vision for aged care in the future.

- The workshop recommends establishing a multi-disciplinary, cross-sector network that builds on these discussions and seeks to create ongoing opportunities for dialogue and collaborative partnerships.

7. Conclusions

The key question explored in the workshop was **“how might the potential of bio and nano enabling technologies help older Australians live more independently in their own homes and neighbourhoods with better health care and social support.”**

To achieve the vision of a future that empowers older Australians to live independently, the workshops participants identified a range of insights into the type of relevant technologies and the issues that must be addressed. Some related to the nature of the technology development such as research funding, commercialisation timelines and effectiveness and the cost of increasingly personalised medicines. The design of devices and systems was also identified as an important issue, especially in terms of ensuring compatibility and ease of use, based on better consultation with end-use consumers.

Social issues were also raised, including cultural perceptions around ageing and how that might encourage or discourage the adoption of new technologies for consumers and the sector. The new vision of ageing, incorporating developments in telehealth and eHealth, provided the prospect for moving the current heavy investment in acute care beds among the aged to a model where better chronic disease management and falls prevention would make a major contribution to reducing the demand for acute health care beds from this age group.

Structural barriers identified included:

- Uptake of smart technologies in the home and universal design to allow older people to remain in their own homes as their demand for assistive technologies increased was negatively related to the current rate of housing stock renewal and potential cost of retrofitting existing housing stock
- Incentives for health care services not being sufficiently aligned with the provision of telehealth
- The provision of new types of health care skills required for data mining, visualisation and monitoring to support integrated eHealth and telehealth systems development.

To more effectively integrate research in new enabling assistive technologies and commercial development of these technologies within the social context of a new vision of ageing a number of issues were examined:

- Long term funding initiatives to develop research and directly assist in commercialisation of new technologies.
- Ongoing public awareness of enabling assistive technologies was seen as important, particularly for the aged care sector
- Thinking about new skills development to support revitalising the aged care sector and uptake of the new enabling technologies.

The adoption of such technologies would also required deeper thinking about appropriate ethical decision-making and changing structures to support new methods of health care provision such as telehealth. Finally participants considered that it was important to gain a better understanding and support for the research pipeline such as though the provision of a technology roadmap, encouraging collaboration and perhaps the establishment of a dedicated CRC. This process could be further aided by establishing a multi-disciplinary network to create ongoing opportunities for dialogue and collaborative partnerships and commercialisation, as mentioned above.

The vision of the future for aged care that allows the older Australian to live independently and to actively contribute to society as they desire is compelling. Enabling assistive technologies will play a role in achieving this future provided their uptake can be considered in the wider context of changes to structural and cultural issues and an appreciation for the multidisciplinary nature of the research, development and market adoption of these new technologies. One of the major challenges is the need to generate much greater market-pull across the whole range of new possibilities, including eHealth, telehealth, new medical devices and other new enabling assistive technologies. This requires creating awareness among older persons and their families, as well as aged care providers and government funding and policy agencies. The Government response to the Productivity Commission's final report on Caring for Older Australians is expected to take up some of these challenges.

Appendix 1: Workshop Agenda

Enabling Assistive Technologies Foresight Workshop 6 June 2011

COTA, DIISR, IHBI, ATSE

Venue: Institute of Health and Biotechnology Innovation (IHBI)

60 Musk Ave, Kelvin Grove Urban Village, Brisbane

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|-------|--|
| 9.00 | Morning coffee/tea on arrival |
| 9.30 | Alison Hemmings, DIISR: Welcome and aims of the National Enabling Technologies Strategy |
| 9.35 | Ron Johnston: Foresight and aims of Expert Forum
Kristin Alford: Aims of the workshop |
| 9.40 | The New Vision of Ageing in Society
Glenn Bunney from LeadingAge, with video 'Imagine – The Future of Ageing' |
| 10.00 | The drivers for this vision. Invited comment from: <ul style="list-style-type: none"> ▪ Keith McNeil, Qld Health ▪ Ian Yates, COTA |
| 10.15 | Discussion |
| 10.30 | The contribution of emerging bio- and nano- enabling assistive technologies to healthcare applications with significant social benefit for the aged
Greg Tegart, ATSE, author of 'Smart Technology for Healthy Longevity,' and leader of missions on this topic to Europe and Taiwan |
| 10.50 | Discussion |
| 11.15 | <i>Tea Break</i> |
| 11.30 | Outline of Future Scenario of Aged Care in Australia |

- 11.35 **Small Group Work: Identifying the Potential Top Three Developments**
1. What are some of the potential top three developments in the new enabling technologies and applications that support this vision?
 2. How do they help older Australians live more independently with better healthcare?
- Each table will focus on a particular topic, with discussion facilitated as follows:
1. New medical devices and sensor technologies (Anthony Lele, Invetech)
 2. Telehealth-care services (Gabriele Taylor, Feros Care)
 3. Regenerative medicine and intelligent materials (Dietmar Hutmacher, QUT)
 4. Intelligent materials and intelligent homes (Jeffrey Soar)
 5. Integrated health and social support services (Anne Livingstone, GCR)
 6. Bio-mechanical technologies, robotics and neuroprostheses (Janet Wiles, UQ)
- 12.10 Reports from each table - mapping developments and possibilities.
- 13.05 *Lunch*
- 13.50 **Small Group Work: Issues and Challenges**
- 14.35 Reports from each table - mapping issues and challenges in 2011
- 15.15 Discussion
- 16.00 **Priority issues** that we need to start to address to meet these challenges and capture the possible opportunities? How will this **change the way we work?**
- 16.30 Close
- Networking Event IHBI Atrium (adjacent to workshop room)**
Hosted by Global Community Resources (Anne Livingstone)
- 17.00 Wine, cheese and biscuits in the Atrium with the opportunity for members of the workshop to network with one another to pursue opportunities for collaboration.
- 18.30pm Close

Appendix 2: List of Invited Participants

Name	Grp	Organisation
Alan Petersen	2	Member, National Enabling Technologies Strategy Stakeholder Advisory Council and Professor of Sociology, Monash University
Ann Angel	1	Medical Device Partnering Program, Flinders University
Anne Livingstone	5	Global Community Resourcing
Anthony Lele	1	Invetech, Melbourne
Belinda Luscombe	6	Business Dev Manager, University of Southern Queensland
Branko Celler	4	Dean, Health and Science, University of Western Sydney
Bridget Munro	6	Director, Biomechanics Research Laboratory, Lecturer, Health Sciences, University of Wollongong
Cameron Marcuccio	6	Project Manager, Siemens Health Care
Chris Elvin	3	Senior Principal Research Scientist, CSIRO Livestock Industries
Chris Hatherley	6	Alzheimer's Australia
Christoph Barbe	3	Technical Director, CeramiSphere
Dianne Jackson-Matthews	4	Director of Regulatory Affairs, ERA Consulting
Dietmar Hutmacher	3	Professor, Faculty of Built Environment and Engineering, Queensland University of Technology
Dr Roslyn Yardin	6	Senior Industry Advisor, ICT, Health and Biotechnology, Austrade
Gabriele Taylor	2	Feros Care
George Margelis	2	Care Innovations, Intel, General Electrics
Glenn Bunney	2	Chair LeadingAge, CEO, Sundale Garden Village
Greg Tegart	4	Academy of Technology, Science and Engineering
Ian Yates	6	CEO, Council On The Aged (COTA) Australia
Ingrid Penberthy	5	Assistant Director, Aged Care Policy, Commonwealth Department Health & Ageing, Canberra
James Barrientos	4	Lifetec, Brisbane
Janelle Casey	4	National Manager, Manager Biotechnology, Health and ICT Teams, Austrade
Jason Hayes	1	Product Development Manager MiniFab Developers

Name	Grp	Organisation
Jayne Lucke	6	Research Fellow, Neuro-ethics, Centre for Clinical Research, University of Queensland
Jeff Fiebig	3	ACH Group, Adelaide, Foundation for Older Australians
Jeffrey Gow	2	Associate Professor, Health Economist, University of Southern Queensland
Jeffrey Soar	4	Director Collaboration for Ageing & Aged-care Informatics Research, University of Southern Queensland
Justin Gooding	1	Professor, School of Chemistry, University New South Wales
Keith McNeil	2	CEO Brisbane Metro North District, Queensland Health
Kylie Maidment	3	Research Manager, Medical Technology Association of Australia Ltd
Lanna Ramsay	4	CEO, OzCare
Lief Hanlen	2	National ICT Australia
Lisa Capamagian	1	Sales & Marketing Manager, Asia PacificTunstall
Luke Oborn	5	Manager Strategic Initiatives, Illawarra Retirement Trust
Majella Ryan	3	Executive Director, Home and Community Care and Community Mental Health, Queensland Department of Communities
Matt Murphy	3	Director, Research Policy and Support, Dept Health & Ageing, Canberra
Matthew Moore	5	Jymbilung Aged Care, Chair Qld Indigenous Healthcare Network
Michaela Richards	5	Department of Business and Innovation, Victoria
Pat Sparrow	5	CEO, Aged & Community Services Australia
Patrick Schaeffer	1	Head Supramolecular and Synthetic Biology Laboratory, James Cook University
Peter Gray	3	Director, Australian Institute for Bioengineering and Nanotechnology, University of Queensland
Peter Hobson	1	Manager, Sullivan & Nicolaidis Pathology
Peter Kambouris	2	ANA Alliance Board, Business Dev Manager, ICT Centre, CSIRO
Sarah Pearson	6	Director ANU Edge and Executive Officer Innovation & Advancement, Australian National University
Stefan Hajkowicz	5	Member, Expert Forum, National Enabling Technology Strategy and Principal Research Scientist, CSIRO
Stephen Rose	1	Associate Professor, University of Queensland Centre for

Name	Grp	Organisation
		Clinical Research, Royal Brisbane Hospital
Susan Feldman	2	Health and Ageing Research Unit, Monash University
To be confirmed	5	Thomson Adsett Architects, Brisbane
Vicki Wilkinson	4	Principal Advisor and Secretary, Social Policy Division, Treasury, Canberra
Wei Duan	1	Director Nanomedicine Program, Deakin University
Zoe Wang	5	Gerontology Nurse, Lecturer, Australian Catholic University

DIISR Support Staff

Alison Hemmings	Manager, National Enabling Technology Policy, Innovation Division
Barbara Lepani	Policy Officer, National Enabling Technology Policy, Innovation Division, Secretariat Expert Forum
Susan Hawes	Policy Officer, National Enabling Technology Policy, Innovation Division, Secretariat Stakeholder Advisory Council
Francoise Berlandier	Policy Officer, National Enabling Technology Policy, Innovation Division
Paul Stockwell	Policy Officer, Biotechnology Innovation Policy, Innovation Division
Michael West	Graduate, National Enabling Technology Policy, Innovation Division

Workshop Facilitators

Kristin Alford	Managing Director Bridge8; Member Expert Forum, National Enabling Technology Strategy
Ron Johnston	Executive Director Australian Centre for Innovation, University of Sydney; Chair Expert Forum, National Enabling Technology Strategy