Developing a national research and development centre in assistive technologies for independent living

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Abstract

Assistive technology (AT) plays a pivotal role in the lives of people who require assistance with one or more aspects of daily living. Ranging from simple devices such as an augmented fork to complex devices like a power wheelchair with integrated environmental control, AT is a broad term to describe a range of products and services that provide assistance. Historically used in the "disability sector", in recent years AT devices have merged into the ageing sector as more Australians develop an impairment through "age-related disability", creating a larger market for equipment that provides independence or restores lost/reduced functionality. Despite the national focus on ageing, Australia lacks a nationally coordinated and cohesive AT sector — most AT equipment and devices are imported and the sector struggles for local research, development, and commercialisation funding.

In an attempt to address this issue, a network of rehabilitation engineering and AT centres, universities, and industry players formed a collaboration to submit a Cooperative Research Centre (CRC) proposal to drive Australian AT products and services. The main focus was on developing Australian capacity within the sector and creating innovative products that met Australian needs, leading to import replacement. A secondary focus was on providing a national education program to provide ongoing AT training and development across multiple disciplines associated with both disability and ageing.

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What is known about the topic?

There is scant recognition of the vital role of assistive technology in assisting people with disabilities and those who are ageing to maintain an independent lifestyle. The assistive technology sector in Australia is small, fragmented, and at risk of being taken over by offshore multinational companies in their bid to acquire new product lines and enhance global market share.

What does this paper add?

This paper describes an Australian collaborative group CRC submission in the field of assistive technology, with commentary on why the bid was unsuccessful, and highlights recent successful partnerships and activity that resulted from the collaboration.

What are the implications for practitioners?

A model has been developed that has the potential to bring a coordinated focus to Australian capacity within assistive technology. Based on international experience, the model ensures that the outcomes are translated into commercial items that are useful and provide value for money for those who need them. The challenge remains in achieving the necessary public funding base.

IN 2003, almost 1.9 million Australians relied on equipment known as "assistive technologies" to live independently;[1] yet anecdotal evidence, and our own experience, suggests many do not have all the technology they require. In addition, the

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vast majority of Australia's technologies are imported, often resulting in suboptimal solutions and overextended support services. The term "assistive technology" (AT) has many published definitions, but a commonly accepted version is from US Public Law (PL 100-407), which describes AT as "... any item, piece of equipment or product system, whether acquired commercially off the shelf, modified, or customised, that is used to increase, maintain or improve functional capabilities of individuals with disabilities".[2] A broader definition has been provided recently by FAST (Foundation for Assistive Technology) in the United Kingdom, which describes AT as "... any product or service designed to enable independence for disabled and older people".[3]

The AT sector in Australia is small and fragmented, and dependent largely on imported products from overseas-based companies, especially in the areas of electronic communication aids, power wheelchair control systems and environmental control systems. As Australia's only independent testing facility for mechanical assistive and rehabilitation technology (eg, wheelchairs, shower chairs, etc), NovitaTech's accredited Testing Laboratory (www.novitatech.org.au/test) has seen a steady decline in Australian designed and fabricated products over the last 10 years. The knowledge and capacity base that Australia used to have in wheeled mobility is slowly being eroded as large multinational companies acquire local companies to complement existing product lines, shifting research and development (R&D) and manufacturing offshore. Several research studies and government inquiries have demonstrated the efficacy of AT devices in providing and maintaining independence, reducing hospital stays and nursing home admissions, and improving quality of life.[4,5] Unfortunately, there has been little financial support for a cohesive approach to its broad scale use in rehabilitation and community independence for people with disabilities and the ageing community. In recent years increasing attention has been applied to the economic benefits that sound AT practice offers.[6,7] More recently, international attention has been drawn to an Australian collaboration which is taking an economic standpoint perspective, to identify not only the costs of implementing AT solutions and the benefits of effective use, but also the costs of suboptimal AT provision and technology abandonment.[8,9] This international collaboration is linked to work in Europe assessing the longer term costs of AT provision.[10]

Despite this growing need, Australia lacks a cohesive approach to research and development (R&D) of AT. The authors estimate (based on reviewing national competitive granting reports) that about $280 000 per annum is provided from government grants or sources (less than 1×10^{-6} of gross domestic product [GDP]; 1.5c/person) to fund small projects, mostly less than $20 000 each. AT Research Centres (such as NovitaTech) contribute additional funds, bringing Australia's total spent on AT research and development to about $800 000 per annum. This compares poorly with the US (2.3×10^{-5} of GDP; $1.08/person) and European and Canadian (4×10^{-6} of GDP; 23c/person) expenditure.*

International review

In May 2003 one of us (DH) undertook a Churchill Fellowship[11] to investigate how leading rehabilitation engineering centres (RECs) around the world were applying R&D and universal design to assist people with a disability. This 8-week research project focused on identifying and understanding the processes used by specialist centres in the identification, initiation, funding and implementation of AT research projects. The project also investigated the dissemination of the outcomes of the research, the model of R&D operation, and the processes used for technology transfer or commercialisation.

Twelve RECs and AT facilities were visited in England (London, Oxford, and Cambridge), Can-

*National AT R&D expenditure is rarely reported (the report by the US Department of Commerce Technology Assessment, of the US Assistive Technology Industry, 2003, being the most comprehensive), so the figures presented are aggregate estimates.

ada (Toronto, Ontario), and the United States (Madison, Wisconsin; Rayleigh, North Carolina, and Atlanta, Georgia). The units varied from departments within hospitals, to academic institutions, to specialised RECs. Despite the breadth of centres and the different models of operation and funding systems that were evident across the three countries, a number of key themes were evident. These included: all centres were affiliated with or formally linked to a tertiary education institution; the common difficulty of securing funding in a niche yet highly competitive environment; an emphasis on technology transfer; the involvement of end-users (or clients) in each centre, and the extent to which they were consulted; the focus on information dissemination; and the number of collaborative links each centre established with other institutions and industry.

A focus of the Fellowship was how successful research, development, and technology transfer models operated within the rehabilitation engineering (RE) and AT fields. Two models were identified for their significant contribution to the field, and explored further: the Canadian provincial Ontario Rehabilitation Technology Consortium (ORTC) model and the United States National Institute on Disability and Rehabilitation Research (NIDRR) model.

Recognised internationally as a "model of excellence", the ORTC was established in 1992 at the request of the Ontario Ministry of Health and Long-Term Care, with a funding commitment of CA$15 million over 10 years. According to the ORTC Director, Dr Morris Milner, "It was understood that this [funding] came about because the Ontario government believed in the economic, health and social benefits of developing made-in-Ontario assistive products for people with disabilities".[12] With a commitment to source matching funds to support their research and other activities, the ORTC became, as their vision statement declared, "an engine of innovation" within the assistive device field, resulting in the formation of eight start-up companies to commercialise the reseacrch.[13] The ORTC succeeded in every area that the Ministry of Health and Long-Term Care intended, and received extra funding beyond its initial 10-year grant from the Ontario Ministry of Economic Development and Trade, with the expectation that it would seek to transform itself into a broader entity that would support both medical and assistive technologies.[14] The ORTC model then became the blue-print for the medical and assistive technologies sector as a whole in Canada, with the formation of The Health Technology Exchange (HTX – www.htx.ca) in 2004.

NIDRR was the only truly federally funded and coordinated approach to support research and development within the RE/AT field that was identified. NIDRR's core function is to generate, disseminate and promote new knowledge to improve the options available to people with a disability. Created in 1978, NIDRR sponsors rehabilitation research, funding about 300 projects annually through thirteen different project areas. Funding is typically for 3-year periods, after which another application must be made for continued support (although NIDRR-funded rehabilitation engineering research centers [RERCs] and rehabilitation research and training centers [RRTCs] are funded for 5 years). In terms of funding, NIDRR's total proposed fiscal year 2001 budget was US$141 milllion (US$100 million for research and US$41 million for technology requirements), which enabled it to support 344 projects.[15]

Both of these models provided a coordinated and focused approach to RE and AT research, development, result dissemination, and commercialisation. Key traits of the centres that operated within these models were that each had strong, visionary leadership; committed and dedicated multidisciplinary teams working towards clear goals; collaborative links with industry and other tertiary institutions; productive and efficient use of undergraduate and postgraduate students; the ability to learn quickly from what worked and what didn't; and a passion and desire to succeed within a small, niche field. Hobbs observed that neither the ORTC nor NIDRR model would exist without government support, and that this was not only a critical ingredient, but a critical instigator of both models.[16]

Building an Australian case

Bringing people together

Recognising the key features of the overseas models, and understanding the capacity and context of the Australian landscape, it was recommended that Australia should consider establishing an RE/AT network, similar to the Canadian ORTC model. In 2004, a state-based forum was called in Adelaide to discuss the potential for a national, multisite, collaborative research initiative in this sector. The focus for the forum was on developing Australian capacity within the sector and creating innovative products that met Australian contextual needs, leading to import replacement. A national education program to provide ongoing AT training and development across multiple disciplines associated with both disability and ageing underpinned the initiative. Participants representing end users, universities, government, industry groups and professionals unanimously agreed that work should begin to develop such an initiative. As the largest group specifically working in AT R&D in Australia, NovitaTech (the technology division of a South Australian disability charity) was tasked with facilitating the group in building a proposal. Further meetings and discussions were held around the country.[17]

Limitations of existing public funding schemes

Public funding for research in Australia is generally offered through the two national research programs — the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC). Both councils focus on substantial research projects that have principal researchers with significant track records, measured primarily in scholarly publications. In addition, projects are weighted for their "significance" — a measure of potential commercialisable return or the size of the population that they would impact. On both measures, research in AT has a low impact.

No mainstream research avenue exists in Australia to separately fund projects that target the needs of people with disabilities or the ageing, rather than compete with larger or broader population research. The Fellowship research indicated that this was also the case in the UK, but not in the US, where NIDRR distributes significant funding for disability-related research.[15] Recognition of the US government funding situation was made by Hobson in his keynote address at the inaugural Australian Conference on Technology for People With Disabilities in 1993, when he stated that,

> It's important to realize that the rapid development of RESNA [the professional body for AT researchers and practitioners in North America] and many of the technological advances that have occurred in North America would not have taken place without a long term public financial commitment to research and development.[18]

AT research in Australia is typically conducted through short-term projects (1–2 years) that are generally funded based on a related aspect of the research (eg, telecare) rather than the direct AT component. This has also led to projects funded by the ARC or NHMRC being ineligible for further funding after the initial pilot work when community-wide trials are required.[19] The former federal government (supported by many of the states) strongly emphasised support for commercialisation and industry development. Indeed, commercialisation became a major thrust of the Cooperative Research Centre (CRC) Program in the last decade. In Australia, while there are some substantial medical device manufacturers (such as Cochlear and ResMed), the Australian medical device industry consists largely of small-to-medium enterprises (SMEs), particularly companies with fewer than 10 employees.[20] In some cases, such firms have been acquired by larger firms (nationally and internationally) to complement their other products for the broad home health care market.

The CRC scheme[21] was deemed by collaborators in the project as the most likely avenue for funding of a national AT research and development centre. It is perhaps the one scheme in

Australia that seeks to build medium-term capacity (7-year funding) through strong partnerships between end-users, industry and university-based researchers.

CRC in technology for independent living

The Australian Government seeks expressions of interest to establish new CRCs every 2 years. This program has been operating since 1991 and now funds centres up to $50 million over 7 years (with government funding typically between $20–$42 million). Participants must at least match government support; the CRC must be a collaborative partnership between university researchers and industry, and since 2004 all CRCs are now required to be incorporated entities. The group worked over several months to submit a Stage 1 business case for a "CRC in Technology for Independent Living", with a total budget of $31 million over 7 years. The proposed CRC was seen as Australia's opportunity to establish, develop and grow a coordinated and focused approach to a range of AT equipment for people with a disability and Australia's rapidly ageing population.

The partners

NovitaTech was the lead industry partner for the bid. This required substantial time from the Director and a senior member of the Division's R&D group. Flinders University, having a strong focus on medical devices, agreed to contribute as the lead university partner, along with Queensland University of Technology and Monash University. Two senior academic staff and a research commercialisation officer from Flinders were heavily involved in the bid preparation. The final 10-page submission required over 800 person-hours of direct activity in its preparation.

The final bid comprised:

- Six key SMEs from the AT industry all of whom contributed either personnel, cash or facilities (totalling five full-time equivalent [FTE] positions and more than $0.5 million per year).
- Over ten national groups and associations representing end users and practising professionals from the ageing and disability sectors with particular interest in AT.
- Five Australian universities, two of whom each committed over $150 000 in cash and more than three FTE staff per annum.
- Five hospitals and rehabilitation engineering centres contributing time and facilities.
- Four international collaborators, some of whom offered their specialised facilities at reduced rates.

Proposed features of the CRC

The group drew heavily on the experience and success of the ORTC in forming its model of operation and approach to engaging end-users. End-users were actively involved in the project from the inception and the target group was broadened through the use of blogging and network meetings.

The group developed its product pipeline model to reflect the contribution from each of the partners:

- Needs identification and analysis — utilising the skill and networks of end-users and key centres of the aged care sector and consumer advice centres.
- Research, development and technical evaluation — based within the universities and other R&D partners, in collaboration with industry.
- Clinical evaluation and consumer review — drawing on the capacity of the hospital, rehabilitation and related centres, and using the networks of end-users.
- Commercialisation and manufacturing — facilitated through commercialisation partners, but primarily through SME operations involved in the process.
- Consumer uptake and community education — networks of both professionals and end-users provided a strong pathway to make end-users aware of the product availability and use.

The CRC represented the first time that researchers in AT from across Australia had singularly cooperated to develop joint projects to tackle the specific target areas of:

- Mobility;
- Communication (including the field of accessible telecommunication); and
- Habitat (including environmental control).

For many in industry, the bid process represented their first experience of close collaboration with universities, a large group of actively involved end-users and the opportunity for new product lines. End-users felt they had the opportunity to be involved at all stages in crafting technology solutions that met their needs.

The CRC program requires a strong educative component and the bid formulated a funded structure to not only educate researchers for the field, but also provide training and certification in AT practice for professionals working in the sector (including occupational therapists, physiotherapists, speech pathologists, and rehabilitation engineers), which is not available in Australia. The partnership with Independent Living Centres Australia Inc. included access to their databases of enquiries and issues from members of the public from around Australia, as well as national venues for workshops and an area to showcase new prototypes and products in each capital city.

Because of its strong community foundations, the CRC was able to demonstrate projects that addressed all of the government's National Research Priorities (at the time) under the goal of "Promoting and Maintaining Good Health", as well as two industry-related research priorities.[22] The CRC in Technology for Independent Living would have lifted Australia's contribution to funding R&D in AT to 1.8×10^{-5} of GDP or $0.30 ($0.13 being government-funded) per person.

Australia's population is among the most rapidly ageing in the world, and most levels of government are now forecasting unsustainable expenditure on health and aged care within 25 years. One study suggested one quarter of Australians will be aged 65 years or more by 2044–45, roughly double the 2005 proportion.[23] Policy development has already begun to build pathways to maintain people in the community and reduce these costs into the future. The CRC bid was proposed as an excellent foundation for contributing to this process and generating commercial returns to Australian businesses.

CRC adjudication outcome

Following review, the CRC Committee indicated they would not be seeking submission of a Stage 2 Business Case for the bid. Following receipt of the formal notification of the CRC outcome, a telephone debriefing with the Chair of the Committee highlighted key issues that stopped the bid.

The commercial gain from the proposed CRC was not significant enough to warrant funding as part of the program. The sector was judged to be too small (< $220 million), and had limited prospects of becoming a major exporter.

There was insufficient commitment from the "end-users". Many of the industry who would make the AT (which the group had understood as the end-user beneficiaries from a commercial perspective) illustrated commitment. However, the CRC Committee judged the end-users for their purpose as those responsible for funding the AT (primarily government schemes and aged care institutions). Although they had indicated support, none of the government and aged care funding schemes had been willing (or in many cases able) to contribute cash to the bid, which would have been a primary indication of commitment to the CRC Committee.

The collaborators did not have a significant track record of joint projects in the field. The collective capability was evident, but previous experience was lacking.

Current progress

The failure to rank public good was a serious omission. This point was highlighted by the Productivity Commission in their review of publicly funded research in March 2007.[24] We are also aware that in January 2008 the new Federal Government announced a review of the national innovation system, which included the CRC Program. The review panel consulted nationally and

released their Report to the Government detailing policy options on 31 July 2008.[25]

There was a surge of interest from others in the sector in the failed bid in the weeks and months that followed the announcement of the unsuccessful bid in June 2006. Despite failing to progress past Stage 1, many of the industry and other sector partners have been working to develop and progress some of the proposals contained within the larger project. A number of collaborative projects are now underway, though still funded through short- to medium-term grants, typically less than 3 years.

The CRC Committee's decision did highlight the critical importance of gaining commitment from AT funding bodies. Government AT funding bodies generally have no capacity, nor authority, to participate in research. The aged care sector has identified the imperative of embracing AT to help manage severe care staff shortages forecast as soon as 2010. Unfortunately, the response to date has focused on describing their needs and waiting for a vendor to supply such a solution. Only a few enlightened centres recognise the value of their engagement in the R&D process. At a national forum to discuss the state of research in the field in Canberra in late 2006, AT was used in the title of the forum, yet the majority of R&D discussed related to telehealth and telecare.[19]

The relationships and models developed during the CRC process were further extended by Flinders University to a broader research area. In December 2007 Flinders University and its South Australian-based partners were successful in a proposal to the Premier's Science and Research Fund[26] in South Australia to fund and initiate a Medical Device Partnering Program (MDPP). The MDPP is a collaboration between South Australian researchers, end-users and industry to develop cutting-edge medical devices and AT equipment and to bring them to market. The MDPP supports the development of products with an identified clinical need, sound technical solution and a viable market opportunity. Through its partners, the MDPP has strong links to both the ageing and disability sectors.

Collaborations of this type are not unique, and the convergence and collaboration between AT, disability and the ageing population is gathering momentum. In December 2006 a group of Canadian university researchers and private sector organisations developed a first-of-its-kind network to increase collaboration in research and development and improve Canada's competitiveness in the area of improving the life of seniors and people with disabilities. The Intelligent Computational Assistive Science and Technology network is a Canada-wide initiative that brings together scientists, engineers, clinicians, industry leaders, and representatives of organisations that serve people with disabilities, in a manner similar to that proposed by the planned CRC for Technology for Independent Living in Australia. In another Canadian initiative, iDAPT (Intelligent Design for Adaptation, Participation and Technology — http://www.torontorehab.com/research/idapt.htm) is a CA$36 million collaborative rehabilitation research initiative between the Toronto Rehabilitation Institute and the University of Toronto. Due to open in 2011, the building will be one of the world's most advanced rehabilitation research facilities where new therapies and assistive technologies will be developed for people recovering from, and living with, disabling injury, illness, or age-related conditions.[27]

Conclusions

Australia reflects many of the challenges of a modern western economy and lifestyle. Its population is rapidly ageing and government is struggling to meet the growing demand for health and aged care. Despite the increasing emphasis on healthy ageing and ageing in place, there is scant recognition of the key role that AT provides in assisting people to maintain an independent living lifestyle, or the capacity of Australian researchers and companies to meet the equipment and technology demands of an ageing population.

There is a clear need for techniques, technologies and systems that are appropriately matched

to the variety of climates, locations and support services that operate in Australia. Currently imported solutions only meet the needs of some end-users, and do little to develop capacity in the sector apart from product distribution.

A model has been developed that has the potential to bring a coordinated focus to this challenge, involve end-users, ensure that the outcomes are translated into commercial items that are both useful and provide value for money for those who need them, and provide ongoing training and skill development through a national education program for the sector. Funding remains a challenge.

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Competing interests

The authors declare that they have no competing interests.

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