## MaRS Market Insights

# **Towards an Accessible Future:** Ontario Innovators in Accessibility and Universal Design







#### Author

Hadi Salah, Industry Analyst, Life Sciences & Healthcare, MaRS Market Intelligence

Hyun-Duck Chung, Information Specialist, Life Sciences & Healthcare, MaRS Market Intelligence

To download the original report, please visit www.marsdd.com/news-insights/mars-reports/. For further information, please contact Hadi Salah at hsalah@marsdd.com.



An EnAbling Change Partnership project with the Government of Ontario

**Disclaimer:** The information provided in this report is presented in summary form, is general in nature, current only as of the date of publication and is provided for informational purposes only.

MaRS Discovery District, ©February 2013

## Executive summary

There are 4.4 million people with disabilities in Canada today - 14.3% of the population. People are living longer and having fewer children, resulting in an aging population that is expected to be a key factor in the doubling of the number of people with disabilities in the next two decades. The types of disabilities faced by Canadians are varied and can be physical, emotional, or cognitive. They can be visible or invisible, short-term or long-term, or episodic.

In 2005, Ontario was one of the first jurisdictions in the world to enact legislation (the Accessibility for Ontarians with Disabilities Act [AODA]) that set specific enforceable goals for accessibility, with mandatory reporting for all organizations (public and private). The goal of the AODA is to create an inclusive society where everyone can participate to his or her full potential, creating a level playing field for all Ontarians.

Why make Ontario more accessible? It's the right thing to do! Disability is part of the human condition: almost everyone will be temporarily or permanently affected by a disability at some point in life. A fully accessible Ontario ensures social inclusion at a time of need, and enriches the lives of all Ontarians through the implementation of Universal Design principles in the products and services we all consume.

It's also the smart thing to do. A more accessible Ontario will accelerate the growth of prosperity in the province: increased per capita GDP, creation of new intellectual property enhancing the province's global competitiveness, increased efficiency and productivity, \$1.5 billion in new tourism spending and up to \$9.6 billion in retail spending are some of the benefits. This is not surprising – the total disposable income of people with disabilities is \$25 billion in Canada, and up to \$220 billion in the US. The market for products and services specifically targeting people with disabilities (excluding vision aides and mobility devices) is estimated at \$8 billion annually in North America.

The real opportunity, however, lies in the emerging Universal Design movement. Well-designed products, services and environments using Universal Design principles not only serve the needs of people with disabilities, but are more broadly useful, and positively impact the wider population. It is estimated that the adoption of Universal Design principles across numerous market segments in the US and Ontario is a \$2 trillion business opportunity for startups, entrepreneurs, and innovators. The demand for innovations in this space has spurred the creation of startups and research institutes across the globe. Eleven startups and research institutes from Ontario's innovation ecosystem are profiled in this document: these innovators have developed first-in-class advances that solve complex challenges faced by people with disabilities in the areas of pain, mobility, agility, hearing, seeing and more.

It is a great time to jump onboard and create new accessibility innovations. Not only is the market opportunity tremendously attractive, but also the resources available to entrepreneurs and innovators in Ontario have never been better. Programs include access to mentors and advisors, education workshops, market intelligence, and access to capital. The Government of Ontario is also committed to providing all Ontarians the opportunity to participate in the social and cultural life of the province, be productive community members, and the beneficiaries of a growing economy – and ensuring a more accessible province by 2025.

# PART 1: Taking the lead: Making Ontario accessible

### Introduction

In 2006, Canada was home to approximately 4.4 million people with disabilities, which is approximately 14.3% of the overall population.<sup>1</sup> The number of people reporting having a disability is expected to double by 2036, to 8.7 million Canadians (approximately 20% of the population).<sup>2</sup> The percentage of people with disabilities varies across the country (Figure 1). In Ontario, 15.5% of the population (about 1.85 million individuals, or 1 in 7 people) reported having a disability in 2006 (Table 1).

#### Seniors at highest risk

The percentage of Ontarians with disabilities increases considerably with age, from less than 3.5% for children under 15 years old to 61.3% for the older adult (those 75 years and older), which is almost double the rate of disability for seniors aged 65 to 74 year old<sup>3</sup> (Figure 2). This tendency is directly correlated to a person's health: as overall health declines due to acute and chronic disease, disability rates increase. The incidence of chronic diseases (such as cardiovascular disease, diabetes and arthritis) increases with age.<sup>4</sup> In fact, the Ontario Ministry of Health and Long-Term Care estimates that 80% of those over

> the age of 45 (roughly 3.7 million Ontarians) were living with a chronic condition in 2003.<sup>5</sup> Furthermore, as our seniors continue to age, the likelihood of developing multiple chronic diseases increases, and with it, the likelihood of disability (Figure 3).

The world's population, and in particular Canada's, is aging. Canada's median age was 39.7 years in 2010 and is expected to increase to over 45 years by 2050. This contrasts with a median age of 26.2 years back in 1971.<sup>6</sup> The demographic shift, brought on by people living longer and having fewer children, is expected to be a key factor in the doubling of the number of people with disabilities by 2036.





Figure 1: Percentage of people with disabilities across Canada (2006). Source: Statistics Canada

Age group (years)	Percentage of Ontario population	Total number of people with a disability	People having a mild-to-moderateª disability	People having a severe or very severeª disability
Children (0-14)	4.5	82,820	49,960	32,860
Adults (15-64)	56.0	1,038,220	601,500	436,720
Seniors (65+)	39.5	732,540	430,060	302,480
Total	100.0	1,853,580	1,081,520	772,060

Table 1: Population with disabilities in Ontario, categorized by age group and severity of disability (2006). Source: Statistics Canada

a) The level of severity depends on the frequency and intensity of the limitations associated with the disability. For example, a person who has no difficulty walking and climbing stairs but cannot stand in line for more than twenty minutes would have a mild mobility-related disability. A person who can only move around in a wheelchair would have their mobility more severely limited, and one who is bedridden for a long term period would have a very severe mobility-related disability. The levels of severity for individual disabilities are combined to provide a measure of the overall level of severity.



#### Persons with Disabilities percentage of the total population

Figure 2: Population with a disability by age, Canada and Ontario, 2006. Source: Statistics Canada



#### Canadians with chronic conditions by age

Figure 3: The percentage of Canadians with no, one, or two or more chronic diseases in various age groups, 2010. Sources: Healthcare Quarterly and Statistics Canada

### Types of disabilities

Traditionally, societal attitudes towards people with disabilities fostered assumptions that people with disabilities were born with the disability, that it is physical in nature and that it lasts a lifetime. We now know better: disabilities are far more diverse. Disabilities can be physical, emotional or cognitive. They can be visible or invisible, short-term or long term, or even episodic. The impact of the disability can vary greatly, from being mild to severe. In general, one can conclude that no two individuals experience the same disability in the same way. In fact, the same individual may well experience a disability differently if it were to occur at different times during his or her life. For these reasons, the definition of "disability" is difficult to identify. The Accessibility for Ontarians with Disabilities Act, 2005 (AODA) adopts a broad definition for disability as: any degree of physical disability, infirmity, malformation or disfigurement that is caused by bodily injury, birth defect or illness; a condition of mental impairment or a developmental disability; a learning disability, or a dysfunction in one or more of the processes involved in understanding or using symbols or spoken language; or a mental disorder.

Simply put, a disability refers to the negative aspects of the interaction between individuals with a health condition (such as cerebral palsy, Down syndrome, depression, injury) and societal and environmental factors (such as negative attitudes of others, inaccessible transportation and public buildings, and limited social supports). Therefore, disabilities are not defined in terms of specific categories

### Types of disabilities common in Ontarians.

Type of disability	Description	Notes
Mobility disability	Difficulty walking up and down a flight of stairs, standing in one spot for 20 minutes or moving from one room to another	<ul> <li>Most common disability type among seniors</li> <li>Experienced more by women than men</li> </ul>
Agility disability	Difficulty bending down, dressing or undressing, getting in and out of bed, or grasping small objects	<ul> <li>Second most-common type of disability among seniors</li> <li>More common in women than men</li> </ul>
Pain disability	Constant pain or recurring periods of pain resulting in a notable reduction in the amount or kind of activities someone can do	<ul> <li>Third most-common type of disability among seniors</li> <li>Women more likely than men to report a pain disability</li> </ul>
Hearing disability	Difficulty hearing another person talking (either face to face or on the telephone)	<ul> <li>Becomes increasingly common with age</li> <li>Experienced by almost half of seniors aged 85 and over</li> <li>More common among men</li> </ul>
Seeing disability	Difficulty seeing the face of someone across the room, even when wearing glasses	<ul> <li>More likely to develop with age</li> <li>Slightly more common among women</li> </ul>
Memory disability	Frequent periods of confusion or difficulty remembering things	<ul><li>Increasingly common with age</li><li>Similar rates for men and women</li></ul>
Communication disability	Difficulty making oneself understood while speaking	<ul> <li>Common to also have another disability, such as with memory or mobility</li> <li>Experienced with slightly more frequency by men than women</li> </ul>
Learning disability	Difficulty learning new things; possibly diagnosed with a condition such as attention deficit disorder or dyslexia	<ul> <li>Not as common as other disabilities</li> <li>Higher rates among seniors aged 85 years and over</li> <li>Equal rates for men and women</li> </ul>
Emotional disability	Difficulty taking on day-to-day tasks because of conditions such as depression or anxiety	<ul> <li>Living independently in the community decreases the likelihood of emotional disabilities (compared to younger adults)</li> <li>Similar rates for men and women</li> </ul>

Table 2: Types of disabilities common in Ontarians. Source: HRSDC's Federal Disability Report, 2011

of individuals, but rather as the interactions between people and the societies they inhabit.<sup>9</sup>

The types of disabilities faced by Ontarians are varied, as summarized in Table 2. Lack of mobility, reduced agility, and pain were the three most reported disabilities among all people with disabilities in Ontario and Canada<sup>10</sup> (Figure 4). It is important to note that most people in Ontario and Canada who have disabilities have more than one disability. This is especially true for seniors. In fact, among seniors with disabilities, less than two in ten have only one disability; the remaining eight in ten have two or more disabilities. Multiple disabilities can be caused by a common condition. For example, a person who has arthritis might develop pain, mobility and agility disabilities."



#### Percentage of people with disabilities experiencing various disabilities

Figure 4: Percentage of people with disabilities experiencing various disabilities in Ontario and Canada, 2006. Source: Statistics Canada

### Making Ontario accessible

To address the needs of people with disabilities, the government of Ontario passed the *Accessibility for Ontarians with Disabilities Act* (AODA) in 2005. The goal behind the AODA is to create an inclusive society where everyone can participate to his or her full potential, creating a level playing field for all Ontarians. At the core of the AODA legislation are five accessibility standards that set out the requirements for identifying, removing and preventing barriers in key areas of daily living and are to be implemented in stages, in order to make Ontario fully accessible by 2025. The standards were developed with the involvement of people with disabilities, the Ontario government, the broader public sector, and the private and not-for-profit sectors. The five standards to the AODA are summarized in Table 3. The AODA also includes compliance and enforcement initiatives – making Ontario one of the first jurisdictions in the world to take a proactive approach to accessibility, in contrast to reactive complaintsbased approaches.

The benefits of Ontario's approach to accessibility are multi-faceted and create an opportunity for a new generation of innovations, businesses and entrepreneurs to make Ontario accessible to all, described in the following sections.

Standard	Description
Accessible Customer Service Enacted in 2008	<ul> <li>Requires businesses and organizations to carry out simple steps to provide accessible customer service</li> <li>Deals with accessible customer service policies, procedures and practices; service animals; support persons; customer feedback; and staff training</li> <li>Applies to all provincially-regulated businesses or organizations in Ontario with one or more employees</li> </ul>
Accessible Information & Communications Enacted in 2011	<ul> <li>Addresses how businesses and organizations create, provide and receive information and communications in ways that are accessible for people with disabilities.</li> <li>Includes information being provided in person, through print, a website or other means</li> <li>Provides organizations with the flexibility to work with people with disabilities to decide on the most appropriate accessible format or communication support</li> </ul>
Accessible Employment Enacted in 2011	<ul> <li>Requires organizations to establish processes that provide for accessibility across the employment lifecycle, from recruitment to career development</li> <li>Seeks to break down barriers for qualified persons to ensure everyone can participate in Ontario's economy</li> <li>Does not require/mandate employers to hire people with disabilities</li> </ul>
Accessible Transportation Enacted in 2011	<ul> <li>Applies to public transportation service providers, as well as municipalities, universities, colleges, hospitals and schools</li> <li>Applies to conventional transportation services as well as specialized transportation services</li> <li>Enables easier travel for everyone</li> </ul>
Accessible Design of Public Spaces Enacted in 2013	<ul> <li>Addresses elements, structures or sites that make it easier for people with disabilities to move through and use the environment.</li> <li>For example: <ul> <li>Sidewalks that are free of barriers</li> <li>Accessible pedestrian signals at intersections</li> <li>Curb ramps</li> <li>Accessible parking spaces</li> <li>Accessible public spaces also include recreational elements like trails, outdoor eating areas and outdoor play spaces that can be enjoyed by people of all abilities.</li> </ul> </li> </ul>

### The five standards of the Accessibility for Ontarians with Disabilities Act (AODA)

Table 3: The five standards of the Accessibility for Ontarians with Disabilities Act (AODA) (Source: Ministry of Economic Development, Trade, and Employment, Ontario)

### **Ontario: A global leader**

With the introduction of the AODA in 2005, coupled with the aim to embed accessibility into all aspects of life and business in the province, Ontario became the first jurisdiction in Canada and a world leader in implementing proactive, enforceable, compliance-based accessibility legislation.

Many countries and regions around the world recognize the importance of equality for people with disabilities, in order to empower people with disabilities to participate fully in society - dating back to the United Nation's adoption of the Universal Declaration of Human Rights. The concept of inclusivity for people with disabilities evolved over the years, with many nations collaborating and supporting the UN's Convention on the Rights of Persons with Disabilities (2006). In addition to global collaborative efforts, nations across the world have developed their own initiatives to support the inclusion of persons with disabilities, tailored to their countries' unique requirements and resources. The Canadian Charter of Rights and Freedoms is Canada's primary legislation. Section 15 of the CCRF contains guranteed equality rights. The Canadian Human Rights Code protects people with disabilities in the provision of goods, services and facilities or accommodation's. In the United States, the Americans with Disabilities Act is a law enacted in 1990 (amended in 2009) that protects people with disabilities

from discrimination due to their disabilities. Areas covered include employment, facilities, accommodation, and public transportation. Other countries around the world, including the UK, Sweden, Australia, and Singapore have legislation or initiatives that address the inclusion of people with disabilities within their societies - all addressing a common theme. These initiatives focus on inclusion in a reactive manner - most make recommendations and policies regarding inclusion, and enforcement is complaints-based - action is taken when an individual who experienced discrimination makes a complaint. Many initiatives mandate support programs for people with disabilities, instead of enabling a more inclusive society as the core objective (summarized in Table 4).

Ontario's approach to equality is unique in a number of ways:

- It applies to all public and private organizations (no exceptions).
- It requires mandatory reporting of compliance.
- It is proactive in audits and enforcements.
- It sets specific accessibility goals to be met.
- It sets a graduated time frame for all Ontarians to meet these goals.

A comparison of Ontario's approach to accessibly with other initiatives globally is summarized in Table 4.

![](_page_9_Figure_11.jpeg)

#### Key legislation and initiatives around the world dealing with the rights of people with disabilities

# Summary of key legislation and initiatives around the world dealing with the rights of people with disabilities

Region	Initiative	Designed to enable full participation of all citizens?	Who does the initiative apply to?	Requires mandatory reporting?	Provisions set for proactive enforcement?	Clearly defines specific accessibility goals?	Clearly defines time frame to meet goals?
Ontario	AODA	V	<b>All</b> public and private organizations	V	V	V	~
Canada	Canadian Human Rights Act	V	Most public and private organizations	X	×	×	×
US	Americans with Disabili- ties Act	V	Most public and private organizations	X	×	×	×
UK	Equality Act	V	Most public and private organizations	X	×	×	×
Sweden	Act Concern- ing Support and Service for Persons with Certain Functional Impairments	~	Individuals. This is a support -based Act	×	×	×	×
Australia	Disability Discrimination Act	V	Most public and private organizations	×	×	×	×
Singapore	Enabling Masterplan	V	Most public and private organizations	X	×	×	×
UN	Convention on the Rights of Persons with Disabil- ities	~	Most public and private organizations	×	×	×	×

Table 4: Summary of key legislation and initiatives around the world dealing with the rights of people with disabilities (Analysis by MaRS Discovery District)

# Rationale: Why accessibility?

### The right thing to do: We all benefit

Accessibility is the right thing to do. We all want to be treated well, and want to treat others the way we want to be treated. The small steps we take to enable social inclusion – making it easier to shop, watch a movie, surf the Internet, work and travel – will have a significantly large impact on people with disabilities. Disability is part of the human condition: almost everyone will be temporarily or permanently affected by a disability at some point in life. A recent survey<sup>12</sup> indicates that of all Canadians who reported a disability at some point between 1999 and 2004, only 13% were affected all six years, suggesting that the onset of a disability can occur throughout a person's life, whether due to an episodic nature of the disability or a sudden turn of events. Furthermore, as Ontario's population shifts toward an older demographic, and as the rate of disability increases with age, the numbers show that most of us will experience a disability as we age. Eliminating barriers that prevent people from fully participating in society is not only the right thing to do, but universal accessibility standards and Universal Design principles enrich the lives of all Ontarians – from families travelling with young children and older parents to shoppers to tourists to students of all ages to those with a disability and those who will over time develop a disability.

# The smart thing to do: The economic impact of accessibility

A recent report published by the Martin Prosperity Institute,<sup>13</sup> a leading think-tank on global economic prosperity, reviewed the economic impact of higher levels of accessibility in Ontario. One objective of the study was to determine the outcome of releasing the constraints that limit the full participation of people with disabilities within Ontario. Another objective was to examine whether the expected cost of compliance with the AODA, a major concern for both public and private organizations, can be offset by gains in the market size. The study concludes that implementation of the AODA is advantageous for Ontario, for business and for the public. It notes:

- The educational attainment of people with disabilities will increase, creating new intellectual property and enhancing Ontario's global competitiveness
- Higher participation rates for people with disabilities will occur in the labour force, increasing overall incomes
- Per capita GDP will increase significantly, by up to \$800 annually
- Increased efficiency, productivity and innovation will take place along with the creation of new businesses to serve people with disabilities and enhance products and services available to people without disabilities
- The tourism sector will see \$1.5 billion in new spending, helping generate increases in retail sales
- Retail sales will see a projected increase in Ontario of \$3.8 to \$9.6 billion five years after the full AODA compliance is implemented

It is clear that an opportunity exists for innovators to develop new solutions (products and services) that can enable businesses to compete in the growing number of markets defined by accessibility requirements.

### The opportunity: Cultivating the next generation of businesses and entrepreneurs

#### Spending power

The challenges people with disabilities experience accessing education and gaining employment are well documented,<sup>14</sup> which lead to significantly lower labour force participation rates and lower incomes when compared to people without disabilities.<sup>15</sup> However, even with lower average incomes, people with disabilities represent a massive market opportunity. The total disposable income of people with disabilities is estimated as the following:

- \$175 to \$220 billion in the US<sup>16,17</sup>
- \$25 billion in Canada<sup>18</sup>
- £80 billion in the UK<sup>19</sup>

The income for people with disabilities varies greatly and depends on many factors, including age, type and severity of disability, and the length of time the person has the disability. Average income levels for people with disabilities are summarized in Table 5.

	Number of people with disabilities	Average income
Ontarioª	1,853,580	\$29,200
Canadaª	4,400,000	\$27,031
US⁵	56,672,000	\$23,532

#### Average income for people with disabilities

Table 5: Average income for people with disabilities in Ontario, Canada and the US.

<sup>a</sup> Statistics Canada. Participation and Activity Limitation Survey, 2006.

<sup>b</sup> U.S. Census Bureau. Survey of Income and Program Participation, May-August 2010. People with disabilities are highly motivated to spend money in areas that significantly improve their quality of life or that contribute to the satisfaction of 3 key values: independence, social connectedness and personal growth. These purchases can include everything from experiences (travel, entertainment, or education, for example), to products (clothing, computers, catheters, wheelchairs, exercise equipment), to services (personal attendants, transportation, house cleaning). Furthermore, people with disabilities are likely to spend more than the average consumer on healthcare services.<sup>20</sup> Nearly half (48%) of all people with disabilities are the principal shoppers in their household,<sup>21</sup> 77% have no children (increasing their disposable income) and 58% own their own homes – facts marketers consider attractive enough to target.

#### Marketopportunity:people with disabilities

An opportunity exists for innovators – startups, smalland medium-sized enterprises, and even larger Fortune 1000 companies – to develop products and services that are aimed at people with disabilities or that are universal by design. Products and services targeted exclusively to people with disabilities usually fall under 10 broad categories. These categories are summarized in Table 6 with their relative market size (for the US and Canada, based on estimates in 2010). The sum of all innovationbased products and services targeted at people with disabilities is over \$8 billion, and is considerably higher if one adds in mobility devices (such as wheelchairs and scooters) and corrective vision devices (such as glasses and contact lenses).

#### Market opportunity: universal design

The real opportunity for business, however, lies in the area of universal design. Typically, consumers have been viewed as being either able-bodied or disabled, with products being designed for one category or the other. Previous generations accepted that a loss in capability due to disability or aging meant an inevitable barrier to using certain products and services. This outlook is changing; however, with the baby-boomer generation nearing retirement they are less likely to tolerate barriers.

# Major categories and estimated market size of innovative products for people with disabilities (US and Canada)

**Total Market Size** 

\$8379.14 M

#### \$544.5M

#### **DAILY LIVING AIDS** Clothing and dressing

\$332.42 M

WORKPLACE

**ADAPTIVE DEVICES** 

Specialized input and

output devices, accessibility

software, screen readers

aids, kitchen appliances, eating/drinking aids, reaching/gripping aids, bathroom appliances —

#### \$704M \_

#### EDUCATIONAL/ INSTRUCTIONAL DEVICES

Hand-held computers/ PDAs, sensory integration devices, learning software, training software, scanning/ reading pens, speech recognition software

#### \$717.2 M

#### VISION & READING AIDS<sup>c</sup>

Reading machines, Braille translators, refreshable Braille displays, screen magnifiers, accessible books, screen readers, speech recognition tools

#### \$764.5M

#### MEDICAL AND PERSONAL MONITORING AIDS

Activity/emergency location monitors, remote monitors, pervasive monitoring

#### \$1,140.04 M

MOBILITY AIDS<sup>b</sup> Ambulatory aids, assisted driving devices, automotive conversion kits, navigational aids

#### \$143.55 M

COMMUNICATION AIDS<sup>a</sup> Speech aids, writing/ typing aids, hearing aids, telephony accessories

#### \$27.2 M

#### ENVIRONMENTAL AIDS

Electronic systems that enable a person with limited mobility to control various appliances, lights, telephone(s), and security systems in their room, home, or other surroundings

#### \$2,970 M

#### HEARING IMPAIRMENT DEVICES

Hearing aids (analog, digital or MEMS-based microprocessors), infrared systems

### \$1,035.43 M

#### ACCESS AIDS

Home lifts and devices, stair climbers, door openers, accessible home devices

Table 6: Major categories of innovative products for the people with disabilities market, including estimated market size for the US and Canada (2010).<sup>22,23</sup>

<sup>a</sup> Excludes computers

- <sup>b</sup> Excludes wheelchairs and scooters
- <sup>c</sup> Excludes glasses and contacts

#### Market opportunities

![](_page_14_Figure_1.jpeg)

Figure 5: Market opportunity for products and services targeted at people with disabilities, and compared to the market opportunity designed using Universal Design principles

How to move forward? The answer lies in Universal Design (UD). **The UN Convention of Rights for People with Disabilities defines UD** as the design of products, environments, programs and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. UD principles are:

- Equitable use
- Y Flexible in use
- Simple and intuitive in use
- Perceptible information
- 🔘 Tolerance for error
- Low physical effort
- **i** Size and space for approach.

Designing products and services using the 7 principles of UD enables businesses to not only serve the needs of people with disabilities, but to capture much larger customer categories. Well-designed products, services and environments are more broadly useful, positively impacting sales by appealing to a wide audience. The opportunities available are tremendous, as all products and services can be made better using UD principles. For example, the use of door levers instead of knobs to make opening doors easier. Using larger buttons on automotive control panels. The use of speech recognition on smartphones. Such simple innovations, based on UD, make tasks easier to accomplish for people with disabilities and the general population. The Martin Prosperity Institute predicts that adoption of universally designed products and services across numerous market segments in the US and Ontario is a \$2 trillion business opportunity. Furthermore, investment in universally designed products and services may lead to three key benefits for Ontario's economy and its businesses: improved productivity, increased innovation and extended workforce participation.<sup>24</sup>

An inclusive society presents an enormous opportunity – a \$2 trillion one – for innovators. The demand for innovations in this space has spurred the creation of startups and research institutes across the globe. A few examples are:

- MIT AgeLab (US) investigates the use of technologies to enhance quality of life of an aging population (page 15)
- Institute of Design at Stanford (US) produces creative design solutions to complex issues that affect everyone using a collaborative approach
- Center for Universal Design (US) evaluates, develops, and promotes accessible and universal design in housing, commercial and public facilities, outdoor environments, and products
- Centre for Excellence in Universal Design (Ireland)

   develops standards and solutions to allow for
   a more accessible products and environments
   (Page 16)
- Centre for Accessible Environments (UK) researches and advises on inclusive design and access to the built environment for disabled and older people
- **OPENspace (UK)** incorporates open design concept to outdoor environments (Page 16)

Ontario is a forerunner in this global innovative space. The province has the expertise, resources, talent, research institutes and leaders to create new world-class jobs, technologies, products, services and businesses. Such attributes are essential elements in creating a fully inclusive society, here at home and across the globe. Profiles of Ontario innovators already engaging in this market and making an impact are featured in Part 2 of this report.

### MIT AgeLab, USA

![](_page_15_Picture_1.jpeg)

Created in 1999 within MIT's School of Engineering's Engineering Systems Division in Cambridge, Massachusette, MIT AgeLab researchers partner with businesses, governments,

and non-profits globally to develop new solutions designed to enhance the quality of life of an aging population. As we age, our likelihood of acquiring a chronic disease and/or a disability increases, making everyday tasks harder and less accessible – and that is the problem MIT is trying to solve. Through the innovative use of technology, MIT AgeLab research focuses on the following broad categories:

- Health & Wellness
- Transportation & Community
- Housing & Home Services
- Business & Policy Innovation
- Longevity & Planning
- Work & Workplace

At any one time, researchers at MIT AgeLab are working on a number of project that span 3 interrelated domains: infrastructure (physical environment), information (or communication and comprehension), and strategy. MIT AgeLab has developed a unique set of tools ad methods to enable better data capture and solution development, including the following examples:

- Age Gain Now Empathy System (AGNES): a suit that can be worn, that has been calibrated to approximate the motor, visual, flexibility, dexterity and strength of a person in their mid-70s to research a senior's accessibility requirements in retail, transportation, home, community, and workplace environments.
- Interactive Consumer Design & Evaluation (I-CoDE): a lab environment designed to create customized user interfaces that meets the needs to older individuals, and is especially useful for designing consumer electronics, websites, automobile dashboards, packaging and other design challenges.
- NavStudio: especially useful for the people with cognitive disability, NavStudio is a research platform used to understand how consumers successfully navigate, become distracted, lost, give-up, or put-off decisions in the information seeking process in their interaction with print materials, packaging, the web and other forms of goal oriented communication.
- Miss Rosie: Miss Rosie is an especiallyequipped Volkswagen Beetle automobile, used to evaluate and assess a driver's limitations while driving due aging, physical and cognitive disabilities, disease, or other conditions.

Since its inception, MIT AgeLab has worked on hundreds of projects in collaboration with partners to develop new products, enhance existing product, lead policy discussion, and improve how people with disabilities and the overall aging population interact with their environment, improving their lives in the process.

## Centre for Excellence in Universal Design (Ireland)

The National Disability Authority of Ireland established the Centre for Excellence in Universal Design (CEUD)

![](_page_16_Picture_2.jpeg)

in 2007 to realize the full potential of universal design (or inclusive design) in all aspect of life. With an ultimate goal of enabling all people in Ireland to participate fully in society to the best of their ability, CEUD has three main activity areas:

- Develop universal design standards and guidelines in the domain of information communication technologies, everyday products and services, and built environments. Such guidelines and standards will enable architects, engineers, application and product developers and project managers to create innovative inclusive products and services.
- Provide learning opportunities (through courses and seminars) of the principles of universal design.
- Raise awareness of the benefits of universal design principles through the development and maintenance of a knowledge base of good practice in universal design. CEUD is proactive in outreach about using universal design to mitigate the challenges of inaccessibility in various scenarios, including information communications technologies, products and services, and built environments.

All of the services, programs, and guidelines are available online as free resources. CEUD established most of these resources with the help of a wide range of stakeholders, including government departments, industry and business organizations, academics, and disability rights groups.

# OPENspace (UK)

OPENspace is a UK-based research centre, established in 2001, for inclusive access to outdoor environments, and operates in association with the University of Edinburgh

![](_page_16_Picture_10.jpeg)

and Heriot-Watt University. The centre's mandate is to create innovative solutions to ensure that outdoor environments are fully accessible by all people, including the older population and people with disabilities.

According to OPENspace, there's growing evidence that well-designed outdoor spaces can enhance the longterm health and wellbeing of the people that use them regularly. If a person with a disability is unable to go out and enjoy what the community has to offer, their quality of life decreases significantly. There are many variables involved that can enhance or worsen the accessibility of open spaces, and OPENspace has a number of ongoing projects tackling these challenges, including:

- I'DGO (Inclusive Design for Getting Outdoors): spanning two phases and 9 years, the I'DGO project explored the impact of barriers - such as traffic, poor pavements, and signage - in outdoor environments on older people (first phase), then looked at solutions that mitigated and resolved such barriers (phase 2) and measure increased quality of life.
- PLUREL, Peri-urban Land Use Relationships: a project in collaboration with 31 research centres across Europe, PLUREL is developing new strategies and innovative planning and forecasting tools to study sustainable development of land. OPENspace's role was to evaluate the potential impact of different land use change scenarios on the quality of life of residents.
- Japan FutureCity Initiative: OPENspace is collaborating with the Japanese government to research environmentally-friendly and age-friendly cities. OPENspace will contribute expertise in accessibility planning as part of the FutureCity Initiative.

OPENspace utilizes an open innovation approach in which it collaborates with multiple stakeholders to conduct its research. Partners include government agencies, not for profits, other research organizations, and private organizations.

## PART 2: Ontario's innovators: making accessibility possible

Ontario's innovation ecosystem consists of startups, universities, research institutes and talent. This ecosystem, coupled with robust entrepreneurial spirit, has created a number of first-in-class advances that solve complex challenges faced by people with disabilities: pain, mobility, agility, hearing, seeing and more (see Table 2 and Figure 4). The following are profiles of leading Ontario innovators.

![](_page_17_Picture_2.jpeg)

### ANTVibes

A Waterloo-based startup founded by Vigen Nazarian (now the CEO), ANTVibes Inc. is the provider of Audible Tags, a cloudbased voice capture and delivery platform which can be used for personal and promotional branding. The company was created when one day Nazarian got a call from a telemarketer.

![](_page_17_Figure_5.jpeg)

The telemarketer badly mispronounced Nazarian's name, losing the opportunity of making a connection with a potential customer. This experience inspired Nazarian to develop Audible Name Tags (ANT<sup>™</sup>). ANT is a small orange icon that looks like an ant and can sit next to your e-mail signature or on your LinkedIn page, and so on. When the icon is clicked, the user can hear the voice of the profile holder and hear how their name is pronounced and any other relevant information. Today ANT is used by internal company directories, in email signatures, and on social and professional networking sites (e.g., LinkedIn). The goal of ANT is to enable workplaces to be more inclusive of diversity and to enhance communication between individuals, both internally within an organization and with outside stakeholders.

The evolution of ANT has led to an invention geared to help people who are visually impaired access information anywhere, including retail stores, restaurants, airports and transit stations and stops. Nazarian and his team are leveraging the ANT platform, which stores audible data in the cloud for ready access, to release a new product with an expected launch in the second half of 2013.

Currently, service providers tailor information for the visually impaired by installing fixed assets that supply the information in Braille or through machines that play audio recordings via headphones or speakers. However, these solutions are costly, are usually fixed in place and difficult to update, and are not interactive. This makes them impractical for many applications. ANTVibes' solution differs by leveraging the vast adoption of smartphones by people with disabilities, together with low-cost QR codes (in Braille) and NFC tags (easy to identify by touch). The QR codes and NFC tags will enable people with disabilities (or anyone) to access audible information stored in the cloud by simply using the device they know best: their smartphone. The inexpensive and simple nature of QR codes and NFC tags enable their placement virtually anywhere written text is placed, such as store shelves, product packaging, transit stations and airports. And the audio recording associated with each tag can be easily modified via a web portal.

This innovation has the potential to positively impact the lives of the visually impaired. For example, people with disabilities can utilize this service to compare two models of laptops at an electronics shop using their smartphone, or learn when the next bus is arriving without reading the schedule. Furthermore, this system enables service providers to make their products and services fully accessible simply and at a low cost. "The capital cost of making signage accessible is huge. It can be millions of dollars. Our solution enables the service provider to just add a Braille QR code and easily program the audible content associated with it," says Nazarian. "Easy to place, easy to replace."

![](_page_18_Picture_0.jpeg)

### Hire Works Inc.

Hire Works was founded by Rob Saric, an entrepreneur who is passionate about creating social value

![](_page_18_Picture_3.jpeg)

through the use of hardware and software technologies. A current project by Hire Works, in partnership with United Way Ottawa, is the Employment Accessibility Resource Network (EARN) Online.

The purpose of EARN Online is to help create meaningful employment opportunities for people with disabilities and to help resolve systemic barriers related to a lack of coordination among employers, service providers and job seekers. The EARN Online solution aims to address three key barriers:

- Employers find it difficult to source sufficient information to develop appropriate corporate social responsibility strategies and recruit talent.
- Service providers serving a large pool of talent find it difficult to reach employers.
- Traditional job matching services fall short of properly assessing skill sets of persons who may have acquired them through self-study or alternative education and training.

The overall effect of these barriers is that they render the job-seeking/recruiting process long and cumbersome for all parties involved, and an unfortunate outcome for those seeking employment is that they may lose motivation over time.

Hire Works is currently developing an alpha version of the EARN Online platform, working with nine employers and 16 service providers. This system will allow employers to ask and share information related to corporate social responsibility as it relates to employment, as well as post opportunities. Service providers will be able to engage with employers to provide expertise and guidance on accommodating people with disabilities and help them to identify talent to match their needs. People with disabilities will be able to use the platform as part of their job-seeking efforts. The beta was released in March 2013, and has been available publicly since April 2013. Once Hire Works has a mature platform, the company it will identify third-party partnerships to help enhance its product.

"The biggest challenge today? The employment participation rate for persons with disabilities is 43% and the average for the general population is about 70%. That discrepancy needs to be fixed." -Rob Saric, Hire Works Inc.

The biggest challenge today? The employment participation rate for persons with disabilities is 43% and the average for the general population is about 70%. That discrepancy needs to be fixed.

-Rob Saric, Hire Works Inc.

![](_page_19_Picture_0.jpeg)

### Komodo OpenLab Inc.

Komodo OpenLab develops inclusive technologies to facilitate the daily lives of people with disabilities. As a "not-just-for-profit" enterprise,

![](_page_19_Picture_3.jpeg)

the company has adopted an innovation model based on open source software to work with their hardware products. This combination allows other users to adapt, enhance and build upon its technology. The company's first product is Tecla, a set of tools that helps make mobile devices more accessible. Komodo is led by Jorge Silva, a researcher in the Inclusive Design Research Centre (IDRC) at OCAD University.

Silva (a co-founder of Komodo) and his business partner, Mauricio Meza, have been working closely with people with disabilities over the past ten years: Silva as a researcher in rehabilitation engineering, and Meza as a clinician in rehabilitation medicine. Through their extensive experience, they identified a growing need of persons with dexterity impediments to be able to access mobile devices. This area had been underdeveloped, with much of the work in accessible computing focused on people with visual impairments.

Originally started as a research project, Tecla today is sold online as a set of tools that enable people with disabilities to control their mobile device using interfaces they are already familiar with, such as wheelchair-driving controls or adapted switches. The set consists of a hardware component, the Tecla Shield (a Bluetooth device that makes it possible to connect switches or wheelchair-driving controls to the mobile device), which interacts with a software component. The software is a freely downloadable application for a smartphone or tablet. Together the components deliver a consistent and usable switch-access experience to those unable to manipulate a mobile device due to disease or disability.

When asked about some of the challenges faced in addressing the accessibility market, Silva notes two major factors. One factor is a general assumption that the market for accessible technology and people with disabilities is small and niche. While this is untrue, Silva explains that this consumer segment can appear this way because it has been marginalized and cannot fully participate. A second and related barrier is that assistive technology companies are set up to supply products and services to funding agencies and insurance companies as the consumer, as opposed to targeting the actual end-user. With this system, product and service providers must steer past gatekeepers who can decide for an entire market segment whether a product is necessary or desirable. The effect can be to block innovation in the whole process. Nevertheless, Silva is optimistic about the changes he sees on both fronts. He has seen initiatives in many countries where people with disabilities are fighting for better accommodation of their needs and the opportunity to spend their government subsidies in ways that increase their inclusion in society. The increasing affordability of consumer technologies also facilitates direct-to-consumer sales of innovative products. Tecla, as an example, was intentionally developed as a direct-to-consumer product, so that end-users had the option to purchase the technology themselves.

In the short term, Komodo is examining ways to further reduce the cost of the Tecla unit while improving technical performance, to make the tool even more accessible to a general consumer market. Over the long term, their vision is to become a standard provider of switch-accessible technology, so that "when people think about switch-access in any context, they'll think about Komodo," says Silva. The company hopes to find partners to work on delivering accessible control of a person's surrounding environment, from calling the elevator and opening doors to controlling the lights and the thermostat all via a mobile device. While Komodo is starting with projects focused on mobile devices, the company's eventual goal lies in exploring how these devices can better leverage investments already made in accessibility infrastructure.

"People in the assistive technology market always assume it is very small. It is a kind of catch-22 because the more inaccessible things are, the smaller the market stays. Once things become accessible, we see that people with disabilities show up in your spaces and your places, who couldn't enter it before." -Jorge Silva, Komodo OpenLab

### **Dolphin Digital Technologies**

Dolphin Digital Technologies is a professional IT consulting firm based in Kitchener, Ontario. Current president Scott Burton and his wife and vice-president,

![](_page_20_Picture_5.jpeg)

Jamie Burton, launched the company in 2006. Today Dolphin is a virtual company with 11 employees, specializing in designing network infrastructure, business process audits and virtual support desk services for businesses and non-profit organizations. One of the most innovative aspects of Dolphin's virtual help desk services is their platform Support Stream. Unlike a traditional online chat service, this platform allows skilled network technicians to remotely make repairs or demonstrate how to solve a technical problem. In 2011 they received the "Innovator of the Year" award at the Canadian Manufacturers & Exporters national forum in Ottawa, in recognition of their achievements in providing barrier-free employment to people with disabilities. Dolphin is currently in the process of taking what it has learned in this area and creating a platform that other organizations can deploy.

Six of the 11 employees at Dolphin have disabilities and all employees bring high technical skills and are paid at or above industry rates. Identifying, screening and hiring employees with adequate technical skills was an early challenge for the company since such individuals are generally in high demand and low supply, creating a very competitive recruiting environment. In the early days of Dolphin, the Burtons were inspired by an employee of one of their client organizations. That person was an excellent technical problem solver and happened to have a physical disability. Around the same time, through working with non-profit organizations like the March of Dimes, they came to understand that there was relatively high unemployment among people with disabilities. Being a virtual company, the Burtons realized that Dolphin could overcome some of the traditional barriers for people with physical disabilities (e.g., having to report for work in a particular office) and began reaching out to employment service providers in this area.

With the overwhelming response they received from this community, the Burtons quickly realized that there was

a major gap in the process of testing and screening for relevant IT skills. To address this new challenge, Dolphin leveraged its virtual remote desktop technology, Support Stream, to develop an online assessment tool, which later became the Virtual Technical Assessment Service (VITAS). At Dolphin, anyone who passes the screening telephone interview proceeds to VITAS. Using this tool, the candidate enters remotely into a virtual lab that has certain parameters and technical problems that require a range of basic to intermediate to advanced skills to solve. A scoring system helps evaluators and applicants identify skills that need further development, as well as provide suggestions on how they might obtain that training, before applying again in the future. In addition, Dolphin evaluates training needs with respect to an applicant's business skills. This is an important element of the process since many candidates are self-taught and have not necessarily had the chance to develop the non-technical business skills that are usually acquired through previous office experience.

Having helped other organizations use VITAS in their recruitment process, Dolphin is now considering how it can adapt the product to test areas beyond IT proficiency. Meanwhile, the team is hard at work finalizing their latest "Evolve" platform that combines the Support Stream technology, VITAS and a virtual office component. The latter component will allow organizations to scale in a virtual environment without incurring physical infrastructure costs. As an example, one non-profit client of Dolphin received funds to grow its operation but was restricted in spending on capital costs such as physical desk spaces. Using the virtual office technology, Dolphin set up 100 virtual spaces in one month so that the nonprofit could expand its operations with staff working from their homes.

"We hire the person and other than that very first question, 'do you require accommodation?', it likely will never be discussed again because the job is about their skills. We are about intellectual property. That's what our company needs, that's what we invest in, that's what we develop, that's what we grow. What we didn't anticipate was the loyalty, the dedication, the absolute continuous investment in themselves and in our business. That is why we will continue to hire in that forum." - Jamie Burton, Dolphin Digital Technologies

![](_page_21_Picture_3.jpeg)

### Jibestream Interactive Media

Jibestream Interactive Media is a software company that specializes in digital wayfinding and interactive technology to enhance public safety. The software

![](_page_21_Picture_6.jpeg)

is used in digital signage and display kiosks in large high-traffic public spaces such as hospitals, universities, office towers, transportation terminals and retail shops. Jibestream is currently deployed in facilities around the world, including St. Michael's Hospital in Toronto, Veterans Affairs Canada, the US Department of Defense (the Pentagon), NATO Headquarters in Belgium, and it is currently in the process of launching in Central South America. The company was co-founded by current CEO Chris Wiegand in 2009.

A significant innovation in Jibestream's solution is to incorporate Human Factor Engineering techniques and principles to provide personalized real-time information based on user profile-driven interfaces, including recognition devices to assist users with disabilities. In the past, it has implemented features for universities where a user can push a button to lower the controls for someone in a wheelchair. In other instances, users can swipe their access card to display more personalized wayfinding interfaces and information, such as barrier-free accessibility routes. Jibestream is partnering with the Sheridan Elder Research Centre (SERC) in Oakville, Ontario, to help resolve key challenges SERC faces in providing accessible wayfinding. In Wiegand's view, there is a large educational aspect to the new compliance regulations in providing accessibility. He believes that many companies would comply if they understood what was required of them, but interactive and digital media continues to be a grey area for many industries. The goal for Jibestream is to stay ahead of the curve and learn as much as it can to continue to be a leader in this space. SERC has been a valuable resource to Jibestream, helping in areas such as conducting research on different regulatory requirements, and supplying the users to test and audit the company's software for compliance and offer feedback.

Jibestream develops applications with an open architecture so that their products can integrate with evolving technologies. A key differentiator of its products is the ability to converge with third-party data and technology, and share information with other applications and devices. In future, the company would like to work on greater integration with mobile technology so that users can operate its software using a personal device, for example, from a wheelchair. Jibestream will continue to work on tighter integration between user data and backend systems, as well as greater automation to allow for alternate accessible routes when needed (e.g., should a certain elevator not be available). It also aims to leverage emerging capabilities such as the Intel AIM software that can recognize the age of a user and deliver ageappropriate interfaces.

"I think, in general, everybody should be cognizant of an aging population... The Sheridan Elder Research Centre has really opened my eyes to a whole group of entrepreneurs and different businesses that are studying an aging population and providing the services that they need." – Chris Wiegand, Jibestream Interactive Media

### Tactile Sight Inc.

Persons with visual impairments often rely on guide dogs to remain mobile and independent. Some of the challenges with using guide dogs are their limited availability and cost. The training of guide dogs may take up to two years and cost upwards of \$65,000. Furthermore, their use is restricted to persons with long-term visual impairments

![](_page_22_Figure_5.jpeg)

FIG. 3 WEARABLE NAVIGATION TACTILE BELT (NOT TO SCALE)

(since the users also require training) and so are not suitable for use by individuals with transient disabilities or those with cognitive disabilities, such as Alzheimer's disease.

![](_page_22_Picture_8.jpeg)

Tactile Sight Inc., a University of Waterloo spinoff currently based in Guelph, is developing innovations with the an objective to complement and/or replace the services of guide dogs. Their first product, the Tactile Belt<sup>™</sup>, is an affordable wearable device that enables users to navigate using only touch. Invented by Dr. John Zelek, a Systems Design Engineering professor at the University of Waterloo, the Tactile Belt uses a combination of a state-ofthe-art GPS, self-calibrating inertial sensors, an altimeter, an accelerometer, a compass, magnetometer tactile motors and customised software to guide its users to where they need to go. It uses no display – all information is conveyed via touch - the belt "nudges" the user in the right direction. The user programs the belt to where they need to go (for example, to the corner store and back) and the belt enables the user to independently make the trip.

The company plans to improve the current prototype by adding new features, such as support for smartphones and the ability to sync with leading mapping applications such as Google Maps. Another feature under development is the incorporation of machine vision; that is, using a camera and object recognition algorithm to increase the accuracy of the device.

The applications of such a device are numerous. In addition to use by Alzheimer's patients who require wayfinding assistance and those who are visually impaired, the underlying technology of the Tactile Belt has broad appeal for commercial users, including long-term care operators and managers of commercial properties (e.g., malls, airports, retailers). Tactile Sight envisions that commercial partners will be able to communicate with next-generation Tactile Belt products, indoors and outdoors, to assist users in navigating complex environments. A property manager, for example, can communicate messages to users based on proximity inside a shopping centre. Other users of the technology may include first responders, the military and automotive manufacturers.

Tactile Sight has completed proof-of-concept work on the technology with Toronto Rehab and Baycrest. It is currently testing the device further with select partners and plans to soon commercialize the Tactile Belt.

### Inclusive Design Research Centre, OCAD University

Formerly known as the University of Toronto Adaptive Technology Resource Centre, the Inclusive Design Research Centre (IDRC) at OCAD

ІСТ

University was founded in 1993 by Jutta Treviranus. The Centre has about 30 permanent staff participating in approximately 20 research projects at any one time. All projects run as large multi-sector national, international and multi-partner research initiatives. A large international network of open source developers, designers, researchers, advocates and volunteers help make them successful.

The goal of the IDRC is to make sure that emerging information and communication technologies (ICT) are designed for diversities (implementing the principle of inclusive design) so that they accommodate people with varying abilities, languages, cultures, gender, age and other forms of human differences. The IDRC tackles

![](_page_23_Picture_8.jpeg)

ICT-based challenges in a variety of realms, from education and health, to government services and policy, to transit, retail, galleries, museums and more. Projects are varied, as the Centre aims to create international specifications and standards, educational materials and learning systems, policies and user interfaces. Additionally, the IDRC offers a master's-level graduate program in inclusive design. "Our philosophy is to not do things that other people can do. We try to pioneer in areas where there hasn't been a strategy developed yet," says Treviranus. "Then when someone else can do it, we pass it on to them. In choosing projects, we usually try to pick projects where we haven't as yet discovered a way to address a particular challenge."

IDRC has been a pioneer in many developments in web accessibility, such as developing the first

Project	Description
Flexible Learning for Open Education (FLOE)	Floe provides the resources needed to enable inclusive access to personally relevant, engaging learning opportunities for the full diversity of learners and content producers. Through the Open Education Resources community, Floe makes tools that help transform, augment, and personalize the learning experience
Fluid	The Fluid community is an international group of designers, developers, volunteers, and advisers who focus on a common mission: improving the user experience of community and open source web applications. To accomplish this goal, Fluid addresses the issue of user experience on all levels, making accessible by design.
Integrating Accessibility into Emerging ICT (AEGIS)	The AEGIS project is a global 20-member consortium that seeks to use third generation access techniques to deeply embed accessibility into mainstream ICT (desktop, rich Internet and mobile applications). This approach is developed and explored with the Open Accessibility Framework (OAF) through which aspects of the design, development and deployment of accessible mainstream ICT are addressed
CollectionSpace	CollectionSpace is an open-source collections management application that meets the needs of museums, historical societies, and other collection- holding organizations. CollectionSpace is designed to be configurable to each organization's needs, serving as a gateway to digital and physical assets across an institution.
ATutor	ATutor is an Open Source Web-based Learning Management System (LMS) designed with accessibility and adaptability in mind. ATutor's availability as Open Source makes it a cost effective tool for both small and large organizations presenting their instructional materials on the Web, or delivering fully independent online courses. With ATutor, students learn in an adaptive learning environment.
Canadian Network for Inclusive Cultural Exchange (CNICE)	The Canadian Network for Inclusive Cultural Exchange is a multi-partner network that has worked together to ensure that Canadian cultural content on-line, and the tools available to participate in creating this content, are accessible to everyone in Canada, including people with disabilities.

accessibility checkers in the 1990s. Its current focus is moving more toward challenging issues such as science and math notations; representing three-dimensional, spatial geolocation information; accessible maps; and cognitive access – the presentation of creative communication materials so that it is cognitively accessible to all. Treviranus explains the need for cognitive access: "We were contracted to work with Japan on disaster management. One of the really tragic things that happen during natural disasters is that a disproportionate number of people with disabilities die, but not because they have mobility impairments... The greatest groups affected [in Japan] were individuals who were deaf or people who had cognitive access issues. They did not understand the communication about the plan for escape and rescue. Cognitive access is all about making communication easy to understand by everyone."

The IDRC supports open standards, as well as open access and open source wherever possible, to distribute its work as widely as possible and encourage broad participation in its initiatives. IDRC teams work in highly collaborative and transparent communities. Over the past 20 years, IDRC has completed numerous high impact projects and continues to do so. Some of the projects are summarized in the table below.

"By virtue of being an inclusive design program, we incorporate a huge diversity of perspectives and so I think it's those challenges, that diversity of perspective, the resourcefulness that's required, that's allowed us to continue to thrive. I have more potential projects and more potential partners that want to work with us than we can address." - Jutta Treviranus, Inclusive Design Research Centre

![](_page_25_Picture_3.jpeg)

### Intelligent Assistive Technology and Systems Lab (IATSL)

The Intelligent Assistive Technology and Systems Lab (IATSL) is a research lab at the Department of Occupational Science and Occupational Therapy at the University of

![](_page_25_Picture_6.jpeg)

Toronto, working in collaboration with Toronto Rehab. As director and associate professor, Alex Mihailidis leads a research team that is exploring the intersection of artificial intelligence, sensors and assistive technology. Their projects include:

- Developing and testing "zero-effort technologies" that will help aging adults to return to work or remain in their homes, and reduce the need for care-givers
- Help clinicians move toward a model of ambient healthcare
- Develop programs for people with disabilities of all ages, from children with developmental disabilities to older adults with dementia
- Improve the rehabilitation process following injury and disease

As a leading research lab in this field of study, the team also develops frameworks, guidelines and methodologies related to Universal design so that other stakeholders can better understand what kind of technologies are needed and how to develop and implement them.

A major research area of the IATSL is the development of smart home systems and intelligent prompting systems that will allow older adults to "age-in-place." Such systems use artificial intelligence to learn about a person's behaviour and activities so that adaptable, timely and relevant computerized prompts can aid those who need assistance in completing necessary tasks. These prompting systems may also be applied to occupational settings: the IATSL is collaborating with the University of Colorado to apply a similar type of prompting system to assembly work in a factory, with the goal of enabling employment for people with disabilities.

Another area of the lab's research focuses on technology that uses computer vision and artificial intelligence to detect falls. Simple devices are available today where if a user falls, they can press a button and ask for help. The goal with the new technology is to develop a system that automatically detects a fall in the home, without the injured person having to let the system know. Speech recognition and automated dialogue will permit the system to communicate with the fallen person to ascertain the seriousness of their injury and which emergency contact to call.

Smaller projects include looking at specific aspects of design and accessibility. A recent example is a mobile application called AgeCAP (Community Assessment Program). This free application is a data-gathering tool that allows users to survey a local area by rating and describing how senior-friendly certain features of the environment are, such as restaurants, public transit, crosswalks and intersections. By building this kind of data set, researchers hope to increase awareness of accessibility challenges that may exist in the building and transportation environment.

The IATSL is one of the longest-running labs conducting research on assistive technology for older adults. Thanks to its early start in this area, the IATSL's prototypes are often frontrunners, as the lab's researchers have been able to undertake clinical trials with users. However, a major challenge remains in finding adequate test areas to further develop and test various technology. Ideally, the IATSL envisions having access to a "living lab" that would entail a community of a hundred homes where its technologies could be installed and studied on a longitudinal basis. As recruitment for this type of project is difficult, the lab continues to improve ways to field test their technology in real homes of older adults and collect information to further their work.

Looking ahead, the IATSL would like to see two trends bolster their efforts. The lab hopes the cost of technology will decrease enough to allow its applications to become consumer products and gain greater traction in people's homes. Home systems today can cost several thousands of dollars and robotic systems can cost about \$100,000 – far beyond the means of many households. The lab also hopes to see funding from stakeholders increase in accordance with the growing acknowledgement and verbal support for work of this kind.

"The current way we provide healthcare (that is, typically in a hospital or a doctor's office or these acute kind of settings) is not going to be able to sustain the aging population. The big push is to alleviate the care system by being able to provide healthcare and support within the person's own community, if not within their own home, and that's exactly what our technologies are hopefully going to be able to do." - Alex Mihailidis, Intelligent Assistive Technology and Systems Lab

### iDAPT Centre for Rehabilitation Research, Toronto Rehab

#### iDAPT Centre for Rehabilitation Research: Research activities

- Artificial intelligence and robotics
- Cardiopulmonary fitness
- Cognition
- Communication
- Mobility
- Neural engineering and therapeutics
- Optimization of the rehabilitation system
- Sleep and upper airway

#### Technology

Toronto Rehab is one of the largest rehabilitation hospitals in North America. It is also home to an outstanding research program with one of the world's most advanced rehabilitation research

![](_page_27_Picture_12.jpeg)

facilities. Research at Toronto Rehab focuses on nine activity areas – from artificial intelligence to cognition to mobility – at the intersection of engineering, computer science and medicine. The research program is headed by Dr. Geoff Fernie, a thirty-year veteran in rehabilitation science and mechanical/biomedical research, with a knack for universal design. "Because I've always been interested in making life happier for people, making it less burdensome, I've always been interested in coming up with practical solutions to common problems that seem to be overlooked by the academic community," explains Fernie.

![](_page_27_Picture_14.jpeg)

Research Innovation	Description	Industry Partner
RoboNurse	This ride-on machine is designed to take a load off the backs of caregivers who are dealing with a growing population of obese patients. Guided by a trained nurse, the robot can lift very heavy patients out of bed and move them to a chair or down the hall for tests.	China, plus various
SensiMat	This product is a thin cushion that goes underneath a wheelchair cushion. Designed to prevent pressure sores, sensors inside can detect if pressure is building.	Elmedex
SoleSensor™	SoleSensor is a special footwear insole designed to enhance balance by heightening sole sensation. The SoleSensor has a raised ridge that surrounds the perimeter of the foot, stopping just short of the large toe, which helps increase "sensory perception."	AJ Hart Group
Winter footwear	Injuries related to falling on ice or snow are a growing problem, particularly with an aging population. Postal workers are also especially at risk because they walk in all types of weather across a range of surfaces. Toronto Rehab has completed a study of how well winter boots and anti-slip devices do on different surfaces, leading to the development of new design criteria.	Workplace Safety and Insurance Board (Ontario)
Eliminating barriers	Traditional roadside curbs often present a barrier to people who use walkers or wheelchairs. Toronto Rehab is working to improve accessibility through a road design that raises the height of the roadbed at intersections to the level of the curb.	N/A

At the heart of the research program is the iDAPT Centre for Rehabilitation Research, a \$36-million initiative that brings together the brightest research minds and state-of-the-art technology. A first of its kind, the iDAPT Centre consists of 15 cutting-edge labs, workshops and other research spaces where Toronto Rehab scientists work in partnership with industry alongside clinicians, students, consumers, engineers and industrial designers. The centrepiece of the iDAPT Centre is the Challenging Environment Assessment Lab (CEAL). CEAL houses the world's first hydraulic motion simulator designed to replicate real-world environmental challenges faced by people with disabilities and seniors, or those with illness and injury. The simulator is unique in that it can be equipped with different chambers and be lifted off its base, mimicking various motions, slopes, terrains and environments (such as ice and snow).

#### iDAPT Centre for Rehabilitation Research: Labs and workshops

Challenging Environment Assessment Lab (CEAL)

Controlled Climate Performance Lab

Communication Function Lab

Rehabilitation Engineering Lab

Sleep Lab

HomeLab

CareLab

Falls Lab

Swallowing/Rehabilitation Research Lab

Intelligent Assistive Technology and Systems Lab (IATSL)

Movement Evaluation Lab

Communication Function Lab

Physical Function Lab

Rapid Prototyping Workshop

Electronics and Instrumentation Development Workshop

Mechanical Workshop

Research and Design Studio

The next addition to the iDAPT Centre will be a driving simulator. "We're very concerned that we have an estimated 26,000 people with dementia driving in Ontario at the moment. We know that taking people's driving licence is in some way equivalent to the death of a spouse – it's huge," says Fernie. "With our planned research, we can assess a person's driving ability, perhaps leading to the development of customized licensing programs depending on the severity of disease."

Ultimately, the goal of the research taking place at Toronto Rehab is to improve people's lives. The iDAPT Centre works to not only prevent injuries but also help design better products and environments, and to help people recover faster when injuries do take place. The commercialization of innovations is therefore an important component of what drives scientists at Toronto Rehab, so that the public can benefit from their research as soon as possible. Fernie and his team commercialize innovations in a number of ways, including through the spinoff of startups (e.g., HandyMetrics Corporation, Simple Systems Inc., ApneaDX Inc.) and partnerships with industry players. Innovation, however, is not the only feature that attracts industry partners to Toronto Rehab: they also gain access to leading designers, prototype specialists, workshops, labs and equipment that that small companies rarely have themselves, and they are involved in product development right from the start, unlike conventional technology transfer models for licensing innovation.

![](_page_30_Picture_0.jpeg)

### National Centre for Audiology, Western University

Based out of London, Ontario, the National Centre for Audiology (NCA) specializes in a number of research areas related to audiology, including hearing science, speech communication, hearing aids and aural rehabilitation.

At NCA, two prominent scientists are focusing on universal design principles in relation to hearing. Instead of concentrating the individual who requires hearing assistance, Drs. Mary Beth Jennings and Margaret (Meg) Cheesman are thinking more broadly about our environment and how it can be hearing-accessible for everyone, as we all face challenges in difficult listening environments. Only 10% to 20% of those who could benefit from using a hearing instrument actually purchase them; the rest (80% to 90%) do not, and many people are not even aware they have a hearing loss. Given these statistics, Jennings explains, she and Cheesman decided to look more globally at how to make environments accessible for everyone. "We took the original universal design principles and we started to work with people with hearing loss to figure out how we would rewrite those so we would have principles of universal design for hearing," says Jennings.

The research effort yielded six universal design principles geared for hearing. The six principles include:

- 1. Optimize the hearing environment for all.
- **2.** Optimize interactions between persons and objects to promote better hearing in an environment.
- **3.** Optimize opportunities for people to have multiple choices of interactions with one another.
- Optimize opportunities for people to perform different activities in and across environments.
- Optimize the opportunity for people have safe, private and secure use of the environment while minimizing distraction/interference, or cognitive loading.
- 6. Optimize opportunities for people to use the environment without extra steps for hearing access during preparatory, use and/or after-use phases.

Using these six principles, the team is now developing a web-based assessment tool to help rate various environments. Its purpose is to help create more spaces in which hearing is easier for everyone (with or without a disability). Such a tool will be useful in assessing and improving accessibility in places such as airports, transit stations, grocery stores, movie theatres and offices.

Currently, architects must follow certain principles and codes when designing spaces. These set out the rules and responsibilities for structural integrity, sound levels escaping to adjacent spaces and so on. However, architectural design and most building codes do not specify communication requirements within a room. Research at NCA is working to change that. "If you are dealing with a person with disability, [it can often be invisible]. People who are hard of hearing can enter a room, smile and nod and look like they are actively participating, but the level of engagement and level of effort that is required to communicate effectively is not really obvious to most people in that environment," states Jennings. NCA researchers are currently identifying public and private partners to fine-tune their assessment tool, and aim to release a working prototype in the second half of 2013. Ultimately, the use of the assessment tool will lead to spaces that are better designed, benefiting not only those with severe hearing loss but also the majority of people with mild-to-moderate hearing loss, a group whose numbers are increasing as our population ages.

![](_page_31_Picture_1.jpeg)

![](_page_31_Picture_2.jpeg)

### Inclusive Media and Design Centre, Ryerson University

The Inclusive Media and Design Centre (IMDC) at Ryerson University designs, creates and evaluates inclusive media technologies, focusing on solutions for individuals who are blind or have low vision, or who are deaf or are hard of hearing. The problem being solved at IMDC, according to its director Deborah Fels, *"is a more inclusive approach to making media consumption more accessible."* 

Fels and her team are working on a number of initiatives in the area of accessible media consumption. Their first project targeted closed captioning of video content and they developed a disruptive solution that is currently being tested. The team recognized that while closed captioning had been around for decades, television technology had limited legibility for using different colours and fonts to convey the message of a video. As a result, the standard closed-captioning format wound up as white uppercase letters on a black background, and this is still in use today. Unfortunately, this format does not capture the emotional context of a message, such as humour, drama, excitement or irony. The team at IMDC conducted studies on emotions and tried various ways to convey these in the content. Initially, they used emoticons and speech bubbles. That evolved into using animated musical instruments and animated text to express emotions, with an excellent response from participants. From such findings, the team developed a software tool called EnACT (Emotive and Affective Captioning Tool) that allows users to create

animated captions. Specifically, EnACT allows a user to assign an emotion and intensity value to different scripts. EnACT is currently in use by a number of media partners and is expected to be adopted by industry for use as a standard practice across various video content, whether on TV, the web or elsewhere.

Other ongoing (and past) projects at IMDC include LiveDescribe, a software tool and associated wiki community that enables producers of video content, studio professionals and amateur home users to add high-quality descriptions to virtually any video source. The community element of this solution enables anyone to create a descriptive audio for a specific video, such as a movie or a TV show, and post it online for others to download and hear. "Using the wiki, you may get 12 different versions of Law and Order. One's your mom's, one is from somebody else's parent. You have a choice of descriptions that you can access," says Fels.

IMDC is also working on increasing the use of sign language online. Websites are predominantly text-based. For many persons with hearing impairments, especially if such impairments are from birth, written text is not considered their main language. "Often their main language, their earliest means of communication, is sign language, not text. Written language is experienced as a second language; therefore, literacy levels can be quite low," explains Fels. The team at IMDC is developing an authoring tool (SignLink Studio) that creates webpages by marking up sign language video files with sign-language-based hyperlinks called "signlinks."

Ultimately, universal design principles are the underlying mechanism for these projects and many others being researched. As Fels states, "the theoretical underpinning of the work we do is inclusive design." IMDC's goal is to level the playing field in the area of media consumption, making the simple things many of us enjoy – videos, TV shows, movies, music and plays – accessible to everyone.

# PART 3: Call to action

There has never been a better time for entrepreneurs and innovators to address the needs of people with disabilities. Not only is enabling accessibility with innovative technologies and services the right thing to do, but it's the smart thing to do. Addressing the needs of people with disabilities, an aging population and all Ontarians through inclusively designed products and technologies is a tremendous opportunity - estimated at \$8 trillion for the US and Ontario. Support for Ontario entrepreneurs is stronger than ever, through a cluster of programs delivered by Ontario's ministries and member organizations, so it's easy to get started. Support initiatives include commitments to support a fully accessible Ontario with specific timelines for implementation, funding programs for innovative research and commercialization initiatives. mentorship and education, market research, and events.

### **Government of Ontario**

The Government of Ontario is committed to providing all Ontarians the opportunity to participate in the social and cultural life of our province, be productive community members, and the beneficiaries of a growing economy. This commitment is reflected in the enactment of the AODA. The goal of the AODA is to make Ontario accessible for people with disabilities by 2025. The Province is moving towards this by developing, implementing and enforcing standards in the areas of customer service, information and communications, employment, transportation and the design of public spaces.

#### The Ministry of Economic Development, Trade, and Employment

The Ministry of Economic Development, Trade, and Employment (MEDTE) leads an extensive outreach effort to educate organizations across the province about their responsibilities with respect to the AODA standards. It provides help both online and by phone. Online at ontario.ca/AccessON, MEDTE has developed a user-friendly tool (the "AODA Compliance Wizard") to help organizations learn about their responsibilities and source the information they need. By anonymously answering a few questions, organizations can find out which accessibility requirements they need to meet and by when. For telephone assistance, MEDTE has partnered with ServiceOntario to deliver answers to routine questions about the AODA and accessibility standards. MEDTE also runs a help desk to handle more complex telephone inquiries - callers are transferred there directly from Service Ontario. In addition, MEDTE administers the EnAbling Change Program which provides financial support and expertise to non-profit organizations so they can education an industry or sector on their obligations under the act.

#### The Ministry of Research and Innovation

The goal at the Ministry of Research and Innovation (MRI) is to help grow a strong, innovative economy that provides jobs and prosperity for all Ontarians. MRI has a number of programs to help entrepreneurs start and accelerate the growth of their business, helping them grow within the province and internationally. By addressing key challenges in the innovation ecosystem, MRI helps entrepreneurs in innovative strategic industries bypass the productivity gap by increasing access to capital, and catalyzing collaborations between entrepreneurs, academia, and investors. One of the landmark programs developed by MRI is the Ontario Network of Entrepreneurs.

### The Ontario Network of Entrepreneurs

The Ontario Network of Entrepreneurs (ONE) is a collaborative network of organizations across Ontario designed to help entrepreneurs and early-stage startups commercialize their innovations. Technology-based entrepreneurs, companies, or researchers who are commercializing new approaches and new technologies have access to a number of special programs and services through local regional innovation centres across the province - there are 14 regional innovation centres in total.

Programs offered include advisor support and mentorship, educational programs (introductory courses to advanced workshops, on-site and online), market intelligence (competition, customer, technology, and industry information), and connections to financing and investors (angel investors and venture capital). Ontarians can find their nearest ONE regional innovation centre at onebusiness.ca.

#### **Regional Innovation Centres**

Communitech, Kitchener-Waterloo

HalTech, Halton

Innovation Initiatives Ontario North (IION), North Bay

Innovation Factory, Hamilton

Innovation Guelph, Guelph

Innovate Niagara, St. Catharines

Invest Ottawa, Ottawa

Launch Lab, Kingston-Eastern Ontario

MaRS Dicovery District, Toronto

NORCAT Innovation Centre, Sudbury

Northwestern Ontario Innovation Centre (NOIC), Thunder Bay

RIC Centre, Mississauga-Peel

Sault Ste. Marie Innovation Centre (SSMIC), Sault Ste. Marie

Spark Centre, Durham Region-Northumberland

TechAlliance, London-Southwestern Ontario

WEtech Alliance, Windsor-Essex

ventureLAB, York Region

### References

Statistics Canada. (2006, January 18). The 2006 Participation and Activity Limitation Survey: Disability in Canada 2006. Retrieved January 18, 2013, from http:// www5.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=89-628-XWE&lang=eng.

<sup>2</sup> Statistics Canada. Population Projections for Canada, Provinces and Territories, 2009 to 2036.

<sup>3</sup> Statistics Canada. (2006, January 18). The 2006 Participation and Activity Limitation Survey: Disability in Canada 2006. Retrieved January 18, 2013, from http:// www5.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=89-628-XWE&lang=eng.

<sup>4</sup> Cancer Care Ontario, Ontario Agency for Health Protection and Promotion

(Public Health Ontario). (2012). Taking Action to Prevent Chronic Disease: Recommendations for a Healthier Ontario. Retrieved January 9, 2013, from http://www.oahpp.ca/ resources/documents/takingactionreport%20Mar%2015-12.pdf.

<sup>5</sup> Ontario Ministry of Health and Long-Term Care. (2007, May). *Preventing and Managing Chronic Disease: Ontario's Framework*. Retrieved January 9, 2013, from http://www. health.gov.on.ca/english/providers/program/cdpm/pdf/ framework\_full.pdf.

<sup>6</sup> Statistics Canada. (2010). Projected population, by projection scenario, sex and age group as of July 1, Canada, provinces and territories, annual (persons x 1,000) [CANSIM].

<sup>7</sup> Human Resources and Skills Development Canada. (2012). *Federal Disability Reference Guide*. Retrieved January 10, 2013, from http://www.hrsdc.gc.ca/eng/disability\_issues/ reports/disability\_guide/disability\_guide.pdf.

<sup>8</sup> World Health Organization. (2001, May 22). International Classification of Functioning, Disability, and Health (ICF). Retrieved January 11, 2013, from http://www.who.int/ classifications/icf/en/.

<sup>9</sup> World Health Organization. (2001, May 22). International Classification of Functioning, Disability, and Health (ICF).

Retrieved January 11, 2013, from http://www.who.int/ classifications/icf/en/.

<sup>10</sup> Statistics Canada. (2006, January 18). The 2006 Participation and Activity Limitation Survey: Disability in Canada 2006. Retrieved January 18, 2013, from http:// www5.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=89-628-XWE&lang=eng.

<sup>11</sup> Human Resources and Skills Development Canada. (2012, March 30). *2011 Federal Disability Report*. Retrieved January 11, 2013, from http://www.hrsdc.gc.ca/eng/ disability\_issues/reports/fdr/2011/page00.shtml.

<sup>12</sup> Statistics Canada. (2009, May). *Perspectives on Labour and Income: Employment among the disabled*. Retrieved January 11, 2013, from http://www5.statcan.gc.ca/access\_ acces/alternative\_alternatif.action?I=eng&loc=2009105/ pdf/10865-eng.pdf.

<sup>13</sup> Martin Prosperity Institute. (2010, June 14). *Releasing Constraints: Projecting the Economic Impacts of Increased Accessibility in Ontario.* Retrieved January 10, 2013, from http://martinprosperity.org/2010/06/14/releasingconstraints-projecting-the-economic-impacts-of-increasedaccessibility-in-ontario.

<sup>14</sup> Martin Prosperity Institute. (2010, June 14). *Releasing Constraints: Projecting the Economic Impacts of Increased Accessibility in Ontario*. Retrieved January 10, 2013, from http://martinprosperity.org/2010/06/14/releasingconstraints-projecting-the-economic-impacts-of-increasedaccessibility-in-ontario.

<sup>15</sup> Institute for Competitiveness and Prosperity. (2007, September). *Prosperity, inequality, and poverty: Working Paper 10 - September 2007.* Retrieved January 11, 2013, from http://www.competeprosper.ca/index.php/work/ working\_papers/working\_paper\_prosperity\_inequality\_ and\_poverty.

<sup>16</sup> United States Department of Labor. (1998, July). *Providing Quality Services to Customers with Disabilities.* 

<sup>17</sup> Diversity Inc. (2002). What Marketers Should Know About People with Disabilities. Retrieved January 14, 2013, from http://disability-marketing.com/newsroom/ diversityInc.php4. <sup>18</sup> Royal Bank of Canada. (2000, April). *Royal Bank* of Canada: Current Analysis. Outlook for people with disabilities...Cautious optimism on a mounting 21st century social challenge.

<sup>19</sup> UK Department for Work and Pensions. (2012, August). Growing your customer base to include disabled people: A guide for businesses. Retrieved January 15, 2013, from http://odi.dwp.gov.uk/docs/idp/Growing-yourcustomer-base-to-include-disabled-people.pdf.

<sup>20</sup> Packaged Facts. (1997, February 1). *Marketing to Americans with Disabilities*. Retrieved January 15,
 2013, from http://www.packagedfacts.com/Americans Disabilities-143426.

<sup>21</sup> National Task Force on Technology and Disability. (2004). Within Our Reach Findings and Recommendations of the National Task Force on Technology and Disability. Retrieved January 15, 2013, from http://ntftd.net/report.htm.

<sup>22</sup> BCC Research. (2011, January). *Assistive Devices for Special Needs: Technologies and Global Markets*. Retrieved January 15, 2013, from http://www.bccresearch.com/ report/assistive-devices-special-needs-hlc067a.html.

<sup>23</sup> BCC Research. (2011, July). *Disabled and Elderly Assistive Technologies*. Retrieved January 15, 2013, from http://www.bccresearch.com/report/disabled-elderly-assistive-technologies-hlc047c.html.

<sup>24</sup> Martin Prosperity Institute. (2010, June 14). Releasing Constraints: Projecting the Economic Impacts of Increased Accessibility in Ontario. Retrieved January 15, 2013, from http://martinprosperity.org/2010/06/14/ releasing-constraints-projecting-the-economicimpacts-of-increased-accessibility-in-ontario.