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Restrictions

Deloitte was engaged to assist the Province to prepare a research report on the state of innovation in British Columbia. This includes providing a definition of innovation, an explanation of British Columbia’s capacity for innovation, the identification of future economic and technological trends likely to affect the provincial economy, as well as analysis and recommendations.

This analysis relied upon publicly available data and scholarship as well as interviews with key stakeholders that were identified by the Province. Deloitte is not, by means of this document, rendering any professional advice, opinions, or services. This document is not a substitute for such professional advice, opinions, or services, nor should it be used as a basis for any decision or action that may affect your business. Deloitte shall not be responsible for any loss sustained by any person or entity who relies on the information contained in this document.

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Contents

| | | |
|--|---|----|
|  | Executive Summary | 04 |
|  | Section 1: Defining innovation and why it matters | 09 |
|  | Section 2: How BC's innovation ecosystem stacks up | 20 |
|  | Section 3: Major global trends will impact BC's economic future | 49 |
|  | Section 4: What it all means for BC | 61 |
|  | Section 5: Recommendations | 66 |
|  | Section 6: List of cited works | 69 |

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Executive Summary

Innovation is a key driver in building a sustainable economy; for BC, capitalizing on this requires action

BC's economy has been doing well lately, but global headwinds are coming and growth is expected to slow

BC's Projected Real GDP Growth (annual % change)

Sources: BC Ministry of Finance. Q1 Report (2018/19); Statistics Canada. Table 36-10-0222-01



A slower economy results in fewer new jobs, pressure on family incomes and reduced growth in government revenues

Innovation helps the economy prosper in the face of the following trends:



BC's Population is Aging: The demographic trends affecting BC include an aging population, slower labour force growth and an increase in the productive years of workers.



Technology is Disrupting Everything: Connected citizens, businesses and physical objects; big data; increasing mobile phone adoption; enhanced human-technology collaboration; and exponential technological change are driving digitization and disruption.



The Nature of the Work is Changing: The workforce's demographic makeup is changing and firms are seeing growth in the gig economy. The emergence of automation, Artificial Intelligence, big data and the Internet of Things—combined with a heightened focus on ethical standards—are shaping the workforce of the future.



BC's Population is Urbanizing: There has been an acceleration towards urbanization, as city populations increasingly conglomerate around metropolitan cores.



The Climate is Changing: Rising temperatures, increased precipitation, droughts and heatwaves, and an increase in the intensity and frequency of forest fires are the expected results of climate change.



The World is More Globalized: There is an increase in global competition as international movement of goods, services and people is expanding. This is combined with emerging competitors that are no longer merely low-cost suppliers.



Advanced Economies are Growing at a Slower Pace: As advanced economies mature and opportunities for growth in domestic markets are limited, regions must look to new sources of economic growth.

Past successes are not an indicator of future performance, particularly in a world where change is now happening at an exponential rate. In order to remain competitive, BC's economy will need to adapt to these emerging global trends.

Innovation helps regions adapt to the exponential changes that characterize modern economies

Innovation promotes agility as a method to stay competitive. This, along with developing the ability to reinvest in programs and the economy, and enabling a society to solve complex problems, are just some of the benefits of innovation.

This leads to...



...regions being able to secure jobs of the future, become more globally competitive and create more resilient economies and healthier communities.

A stronger and more resilient economy



...regions being able to invest in their societies through improvements in education, housing, health care and other public initiatives.

Enabling society to solve complex challenges



...more high-paying and sustainable jobs in the long term.

Better jobs over time



...collaboration among firms, organizations, governments, and other institutions, forging connections across several important components of society.

Fostering collaboration and partnerships



...an economy that grows at a faster pace, fueling a rise in income levels and the creation of products and services that enhance the quality of citizens' lives.

Improved quality of life



Empirical evidence from international jurisdictions reveals a correlation between investing in innovation and economic benefits.

Regions and firms that invest in innovation see positive long-term benefits in the form of...



Higher productivity – as production processes become more efficient



Stronger employment – as innovation creates greater demand for products/services (and therefore demand for more employees)



Higher wages - for employees at innovative firms



Stronger exports (as innovative companies attract demand from abroad) and **investment** (as foreign capital seeks out innovative regions)

The pace of BC's economy is predicted to slow, innovation can boost growth

The Pillars of an innovation ecosystem

| | | |
|--|---|---|
|  Ideas | Ideas are needed to inspire and fuel innovation. | BC has areas of research excellence that create marketable ideas, but lags other jurisdictions on investment in research and development as well as commercialization. |
|  Customers | Customers drive consumption for products and services, and are needed to fuel demand. | BC has a strong and diverse international market for its products, while its domestic market faces some challenges. |
|  Collaborators | Collaborators are essential in nurturing innovation and providing resources to growing firms. | BC has a growing network of small organizations working to improve BC's innovation ecosystem – but these organizations are mainly concentrated in Vancouver. |
|  Talent | Talent facilitates innovation by providing the people power required to operate firms. | BC has an educated workforce, but gaps exist in areas that support innovation. |
|  Capital | Capital provides much-needed funding at many stages of innovation. | There is a relatively sound level of venture capital investment in BC firms. |
|  Firms | Firms put ideas into action. | BC has many small firms but they struggle to achieve scale and become large companies. As large firms bring significant economic benefits, BC risks a missed opportunity. |

The Enablers of an innovation ecosystem

| | | |
|---|---|---|
|  Access to Markets | Markets connect innovators to customers, facilitating much-needed demand toward firms. | BC is well-positioned geographically and has the international trade infrastructure needed to effectively tap into large markets. |
|  Enabling Public Policy | Governments support innovation through funding, programs and regulations. | BC's public programs help small companies get started, but could do more to help them scale. |
|  Culture | An innovative culture supports creative thinking and attracts top talent. | BC's natural livability attracts people and firms from all over the world, but the high cost of living (especially in Vancouver) makes it challenging for new and existing residents to stay. |
|  Infrastructure | Infrastructure connects organizations, people, ideas, resources and governments with one another. | BC has some of the physical and communication infrastructure to help facilitate innovative activity. More investment is needed to expand infrastructure to all regions. |

BC can take purposeful action on innovation to help secure its future prosperity

The course toward a more innovative BC can be charted with some of these changes



Business:

- Create incentives for small firms to scale up – eventually becoming large firms that are able to employ more people, pay higher salaries and invest more in innovation.
- Maintain a competitive tax environment for business, including maintaining any capital investment incentives.
- Grow businesses in a sustainable way, being conscious of the environment and consumers.



Talent

- Invest in building talent for all industries (especially in the high-tech sector, where the talent gap is expected to grow in the coming years).
- Ensure that lower-skilled workers affected by disruptive change are re-skilled to meet the demands of a more innovative economy.



Research and Development

- Enhance investment in research and development—as well as the commercialization of ideas—to get more ideas to market.



Public Investment

- Continue public investment in higher education, infrastructure and marketing abroad.
- Develop an innovation strategy for the province's economy.

BC can proactively shape its economic future

BC can hope that commodity prices, housing prices and residential construction have sufficient strength to maintain the province's current level of prosperity.

Or BC can proactively strengthen its economy—preserving and enhancing its prosperity—by making investments in key components of the province's innovation ecosystem. This will aid sustainable growth in the province's emerging sectors and high-potential firms, and will make BC more competitive in a global market experiencing significant disruption from numerous sources.

1: Defining innovation and why it matters

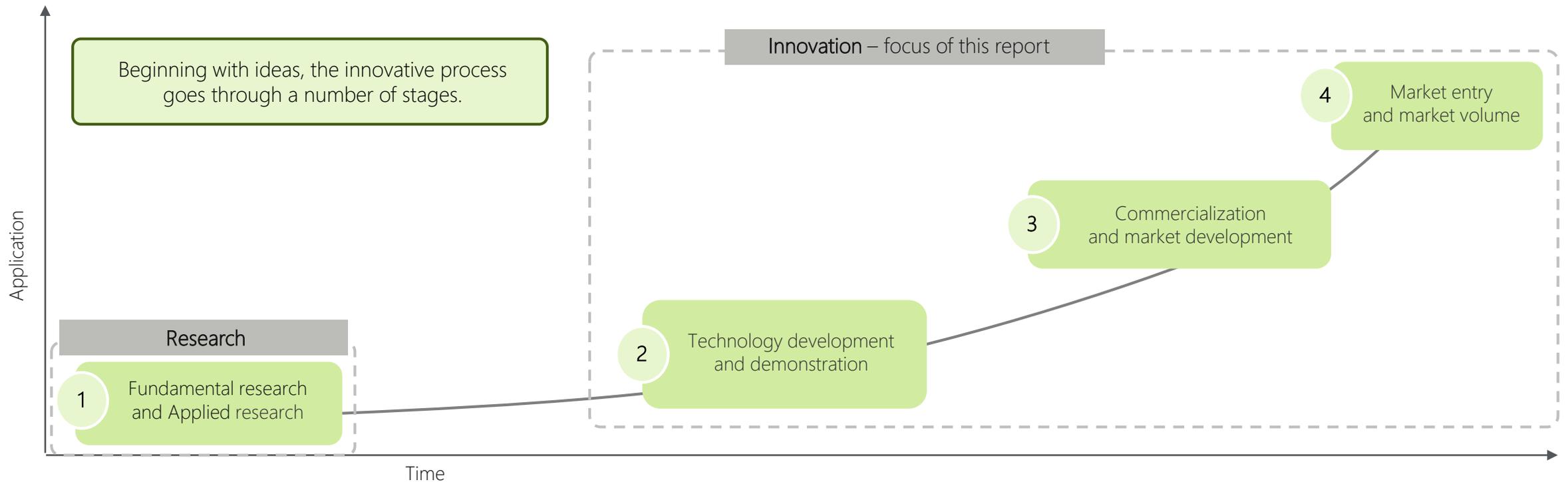
Not all innovation is revolutionary – most innovation is more incremental than drastic.

Going beyond just products.

Innovation is the creation and adoption of a new idea, process or product that generates sustained social and economic value.

Creating **sustainable social and economic value** for our citizens, government, customers, and firms.

Innovation moves ideas towards commercialization



1 **Fundamental research:** is exploratory and driven by interest or curiosity. The goal of fundamental research is to advance knowledge or explain relationships between variables.
Applied research: tends to be descriptive and is typically based upon fundamental research. Applied research is not carried out for its own sake, but in order to solve specific questions or problems.

2 **Technology development and demonstration:** is the creation of minimally viable products and prototypes, market testing of these initial versions, analysis on tests and implementation of improvements until a market-ready version is complete.

3 **Commercialization and market development:** is the process of introducing new products or services to the general market. It takes into account production, distribution, marketing, sales and customer support required to achieve the commercial success of the new product or service.

4 **Market entry and market volume:** the initial offering of the commercialized product, service or process, with plans for scaling up to larger volumes as demand and traction increase.

More than products: innovation comes in many forms

Types of Innovation



Process

A new or significantly improved way of doing something.

Example

Boost Environmental Systems developed a process for treatment of sewage and agricultural waste, allowing municipal wastewater treatment plants and manure management in agriculture to reduce the amount of sludge generated and lower operational costs.



Boost Environmental Systems Inc.



Organization

A new business model or way to organize or conduct business, or external relations.

Example

Lululemon is using data intelligence to enhance customer experience. They have partnered with tech firm AgilOne to integrate customer data from digital and physical sources. Data is then analyzed to provide a clear picture of each customer.



Lululemon



Product

A good or service that is new or significantly improved.

Example

Safeguard developed Mass Water Sprinkler Curtains to replace all small scale pumping systems on project fires with more efficient, cost effective, consistent and reliable mass water systems.



Safeguard



Marketing

A new marketing process involving significant changes in design or packaging, placement, promotion or pricing.

Example

RainCity created ads on street benches for a nonprofit agency that aims to provide housing for people living with mental issues, addictions and other life challenges. Each bench can transform into a temporary shelter with a roof. Inside is a message with contact information for RainCity.



RainCity Housing

Investing in innovation has positive effects on productivity, employment, wages, investment and exports

Productivity

Innovation is positively linked to long-run productivity growth and has accounted for a significant share of productivity growth in advanced economies.



The effect of R&D on productivity is positive, regardless of the productivity measure studied (i.e., labour productivity or total factor productivity).



Investment in innovation by one firm can lead to innovation and productivity gains for other firms.



Compared to investments in physical capital, investments in innovation have made equal or greater contributions to labour productivity growth in several advanced and highly innovative economies.

Sources: Donselaar and Koopman, (2016); Bloom et al. (2013); European Investment Bank (2016).

Wages

Innovative firms pay higher wages than non-innovative firms.



There are several ways that innovation can improve wages, including:

- Innovative firms may be willing to pay a premium for workers that are complementary to their R&D investments.
- Innovation generates higher profits for firms that can be shared with workers in the form of wage increases.
- Innovation may be biased towards certain skills/tasks that could increase employment demand and impact wages in various occupations.

In addition, innovative firms pay higher wages for both high-skilled and low-skilled workers (when low-skilled workers are complementary to high-skilled workers).

Sources: Aghion et al (2017); Bogliacino et al (2018)

Employment

Improvements in innovation can lead to long-term employment growth.



As innovative firms (whether through creating new demand for products and services or reducing their costs of production) become more competitive within their industries they will be able to capture larger shares of their respective markets, and increase their numbers of employees in the long run.

Labour-saving increases in productivity can lead to some short-term disruptions in employment, but over time innovative firms can see employment gains as they become more competitive and improve their market share.



Sources: Simonetti et al. (2000); Harrison et al. (2014); Gellegati et al (2016).

Investment and Exports

Innovation can increase a firm's propensity to export and innovation ecosystems attract investment, which amplifies R&D benefits



Innovative firms tend to be more productive and are therefore better positioned to compete internationally.



International firms and capital may be attracted to regions with established innovation ecosystems as they can access talent, ideas and inputs relevant to their own innovation objectives. International firms may look to locate in regions with strong ecosystems because they can receive a higher return on their investments.

Sources: Cassiman and Golovko (2011); Harris and Li (2009); Esteve-Perez and Rodriguez (2013); Girma et al (2008).

Around the world, R&D investments bring significant economic benefits



Norway's oil and gas industry is characterized by high levels of innovation and attracts significant R&D investment.

The outcomes of this investment are not realized only within the oil and gas sector – many technological innovations born in oil and gas are subsequently adopted by other sectors. For example, the supplier industry to oil and gas has advanced a range of technologies that have been adopted in the offshore wind industry.

What makes Norway's oil and gas industry so innovative?

Tax credits for R&D - Despite the fact that oil production is highly taxed, Norwegian firms can write off most of their investment due to generous R&D tax credits.

Close collaboration between oil companies, suppliers, government and research institutions has underpinned the successful development of new technology and solutions.

Prudent fiscal management – Norway's Government Pension Fund - Global (GPF) is a sovereign wealth fund that has grown from zero to \$865 billion in 18 years. The fund allows the Norwegian government to manage oil revenues in a way that sustainably benefits both current and future generations while giving back to industry and the economy overall. Prudently, it uses the funds to stimulate Norway's economy in periods of low growth or employment.

Source: Research Council of Norway (2015).



Australia's mining industry is a major driver of growth in the Australian economy and investments in R&D have been a significant contributor to the industry's growth.

Specifically, R&D expenditures in mining more than doubled between 2006 and 2012, improving safety procedures/detection of hazards, increasing yields from extraction and reducing operating costs.

What makes Australia's mining industry so innovative?

Australian mining technology is utilized worldwide and across sectors – more than 60% of the world's mines operate with software developed in Australia. Further, technology suppliers in the mining industry are also developing software systems used by firms in other sectors such as utilities, educational institutions and government.

International trade and investment openness has allowed the mining industry to enhance its comparative advantage and given it access to international capital for large investments.

A culture of collaboration between academia, research institutions and industry allows suppliers, research organizations and investors work together to ensure that the mining industry maintains its competitive advantage.

Sources: Australian Trade and Investment Council (2017); IGF (2014).



Finland's forestry industry has seen new technologies and innovative production practices give rise to a wood-based bioeconomy, which relies on renewable natural resources to produce food, energy and other consumer products and services.

Finland's ambition to be a global leader in sustainable natural resource development has driven a great deal of innovation in the country's bioeconomy.

What makes Finland's bioeconomy so innovative?

Government's commitment to addressing climate change ensures the development of the bioeconomy is a national priority (a target of reducing greenhouse gas emissions by 80% by 2050, from 1990 levels). Extensive **certification schemes** that guarantee the sustainable harvesting of forests helped contribute to this goal. In Finland, 85% of forests are certified, compared to 11% of forests globally.

A multi-sectoral perspective on the economy – Finland maintains strong connections between the forestry, energy, technology, chemical and construction industries.

High levels of collaboration between industry, academia and national research organizations within Finland.

Global collaboration - Tekes, a publicly funded funding agency for technology and innovation, prioritizes international cooperation through the internationalization of R&D and research and passing on 'know-how' from international sources.

Sources: Ministry of Economic Affairs and Employment of Finland (2017); Ministry of Employment and Economy of Finland (2014); OECD (2015).

Investing in innovation creates positive economic and social outcomes



Regions are able to secure jobs of the future, become more globally competitive and create more resilient economies and healthier communities.

A stronger and more resilient economy



Regions are able to invest in their societies through improvements in education, housing, health care and other public initiatives.

Enabling society to solve complex challenges



In the long term, innovation creates more high-paying, sustainable jobs.

Better jobs over time



Collaboration among firms, organizations, governments and other institutions forges connections across several important components of society.

Fostering collaboration and partnerships



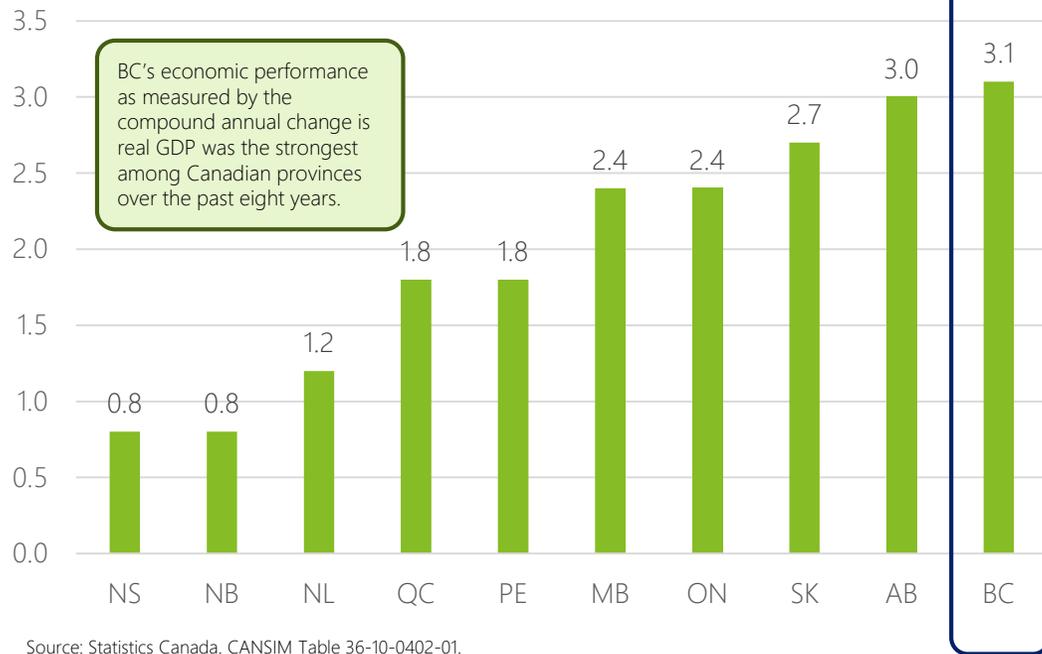
An economy that grows at a faster pace, fueling a rise in income levels and the creation of products and services that enhance the quality of citizens' lives.

Improved quality of life

BC's economy has performed well since 2010

At **3.1%**, BC's economy had the highest compound annual growth rate among provinces since 2010. This strong performance relied heavily on housing, with over **30%** of the growth during this period due to BC's increases in real estate, leasing and construction.

Compound annual growth rate in real GDP, 2010-2017 (%)



Source: Statistics Canada. CANSIM Table 36-10-0402-01.

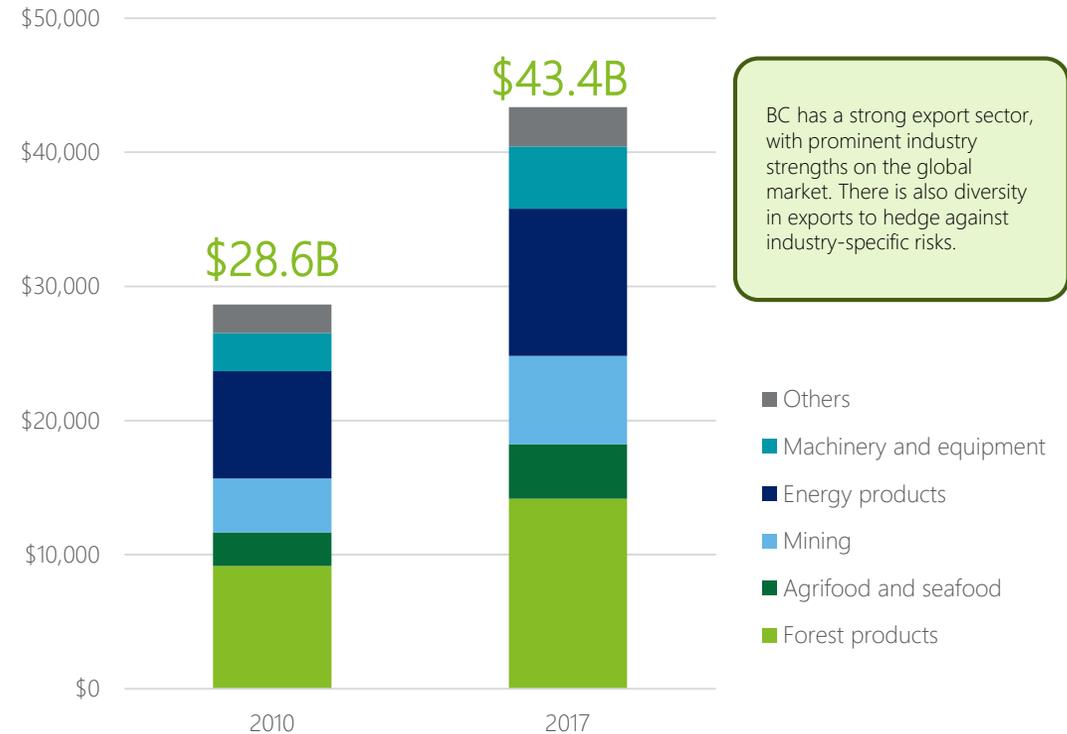
British Columbia had an unemployment rate of **5.1%** in 2017. This is the lowest rate since 2007 and best amongst provinces in Canada.

Source: Statistics Canada. Table 14-10-0018-01.

The value of BC's international commodity exports have increased by **\$14.7B since 2010 (or 51%)**

Growing global demand for commodities have helped to increase BC's exports of wood, energy, minerals and other items.

BC Product Exports growth 2010 - 2017 (\$millions)



Source: BC Stats. Annual BC Origin Exports (2018).

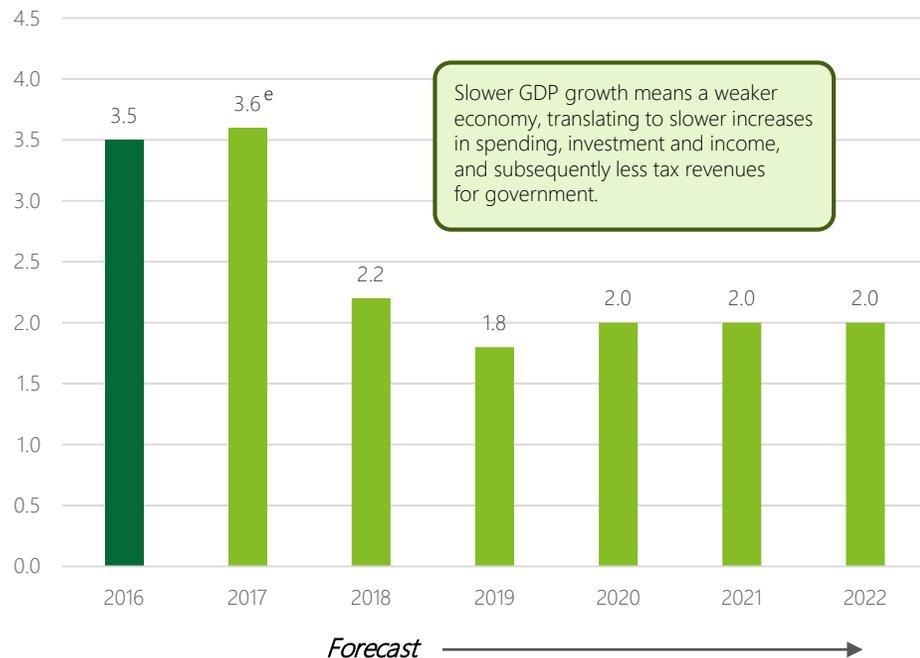
There are economic headwinds on the horizon for BC

Due to a number of economic factors, including a slowing housing market, aging population, and volatile commodity prices, BC's economic growth (measured in real GDP) is projected to slow.

The pace of economic growth is expected to slow

While BC outperformed nearly all of its provincial counterparts in real GDP growth in the last several years, economists now expect BC's rate of growth to be significantly slower going forward due to:

BC's projected real GDP growth (% change)



Sources: Statistics Canada. Table: 36-10-0222-01; BC Ministry of Finance. Q1 Report (2018/19).

1. BC's housing market is slowing

about $\frac{1}{3}$

Of BC's economic growth last year (and since 2010) was driven by the province's housing sector.



Fewer home sales, rising inventory, and fewer housing starts all indicate a cooling market for residential investment in 2018. Poor affordability combined with rising interest rates will further weaken demand from buyers. High household debt is also a constraint on future real estate growth.

44%

Increase in housing starts from 2014 to 2018.

67%

Gain in annual Property Transfer Tax revenues from ten years ago. The size of this revenue stream is at risk if the province's housing market continues to slow.

2. BC's demographic profile is changing



An **aging population** is not a demographic trend unique to BC – but in order to maintain a high standard of living, the provincial economy will need to get more output from a labour force growing at a slower rate.

3. Commodity prices are volatile



Though world commodity prices have rebounded somewhat from the last recession, history shows that these prices are volatile and subject to large swings in global demand. This means looking forward, we should expect fluctuations in commodity prices.



Government revenues from natural resource royalties tend to follow commodity prices, and have been up and down over the course of the last several years.



For example, the BC government received \$1.3B in royalty revenue in 2008/09 from the sale of natural gas. In 2017/18, that figure was \$161M – an 87% decline from the amount collected a decade ago.

Sources: Statistics Canada (CMHC). Table 34-10-0143-01; Statistics Canada. Table 36-10-0400-01; BC Ministry of Finance. 2018 Financial and Economic Review; RBC Housing Trends and Affordability (2018); BC Housing: New Homes Data (2018).

In a world of exponential change, past successes are not an indicator of future performance

Disruptive technology is changing the nature of business



Robotics, Artificial Intelligence, Blockchain and other disruptive technologies are changing the way the world does business.



The talent pool of students in school are preparing for jobs that do not yet exist.



Big Data is allowing businesses to better understand their customers and tailor their products and services more effectively.



Automation and Artificial Intelligence propel economies towards creating higher-value jobs; those that are more sustainable with higher compensation.



Disruptive technologies allow firms to be more productive, efficient and effective; thus, organizations and the economy as a whole become more competitive.



Technology helps create more flexible working relationships, facilitating emerging trends such as the gig economy, remote working, etc. This in turn allows individuals to increase their number of productive years, in combination with advances in life sciences that help workers stay healthier for longer.



Citizens are more connected than ever – with most having access to mobile technology and being increasingly connected through wireless internet. This means a more informed population, who are more capable and more productive.

Past successes are not an indicator of future performance, particularly in a world where changes are happening at an exponential rate. Firms in BC will need to adapt to these global trends in order to remain competitive.

Sources: Deloitte. Future of Work (2017); Deloitte Insights. Age of Disruption (2015).

International case

The New South Wales (NSW) innovation strategy presents the government's vision to foster and improve innovation in NSW.

This strategy focuses on four areas of action:



Government as an innovation leader



Fostering and leveraging R&D



Skills for the future



A home for entrepreneurs

The government helps support innovation by:

- Removing regulatory hurdles
- Using procurement to drive change
- Addressing market failures that can prevent or slow innovation
- Making policy decisions to help foster innovation
- Highlighting groundbreaking research, innovative ideas and solutions

Concentrated regional innovation activity (also known as 'innovation precincts') is seen as a key to offering economic and productivity advantages to businesses, investors and workers.

Precincts developing in NSW can be generally categorized under the following four dimensions:



Health & education



Universities



A major asset



Inner city

Cited benefits of successful innovation precincts:

- Enhanced collaboration and commercialization
- Superior products and services
- Financial benefits, growth and resilience
- Greater productivity
- Export growth
- Jobs growth and higher wages
- Social, environmental and cultural benefits

Innovation enables regions to remain competitive when facing global changes

Innovation enables regions to remain agile in order to stay competitive, and be adaptive to the exponential changes that characterize modern economies.

Investing in Innovation leads to:

- A stronger and more competitive economy
- Society able to solve complex challenges
- Better jobs over time
- More collaboration and partnerships
- Improved quality of life

BC's economy has done well since 2010....

- **GDP growth:** BC's economy had the highest compound annual growth rate among provinces since 2010.
- **Exports:** Growing global demand for commodities have helped to increase BC's exports of wood, energy, minerals and other items.
- **Unemployment:** BC had an unemployment rate of 5.1% in 2017 – the lowest in Canada.
- **Housing:** BC has high housing prices combined with strong levels of residential construction.

...But economic headwinds are coming

There are challenges ahead for the BC economy, with slower expected GDP growth due to:

- A changing demographic profile
- A slowing housing market
- Slower global demand

BC needs to consider exponential changes in the global economy, driven by technological innovation.

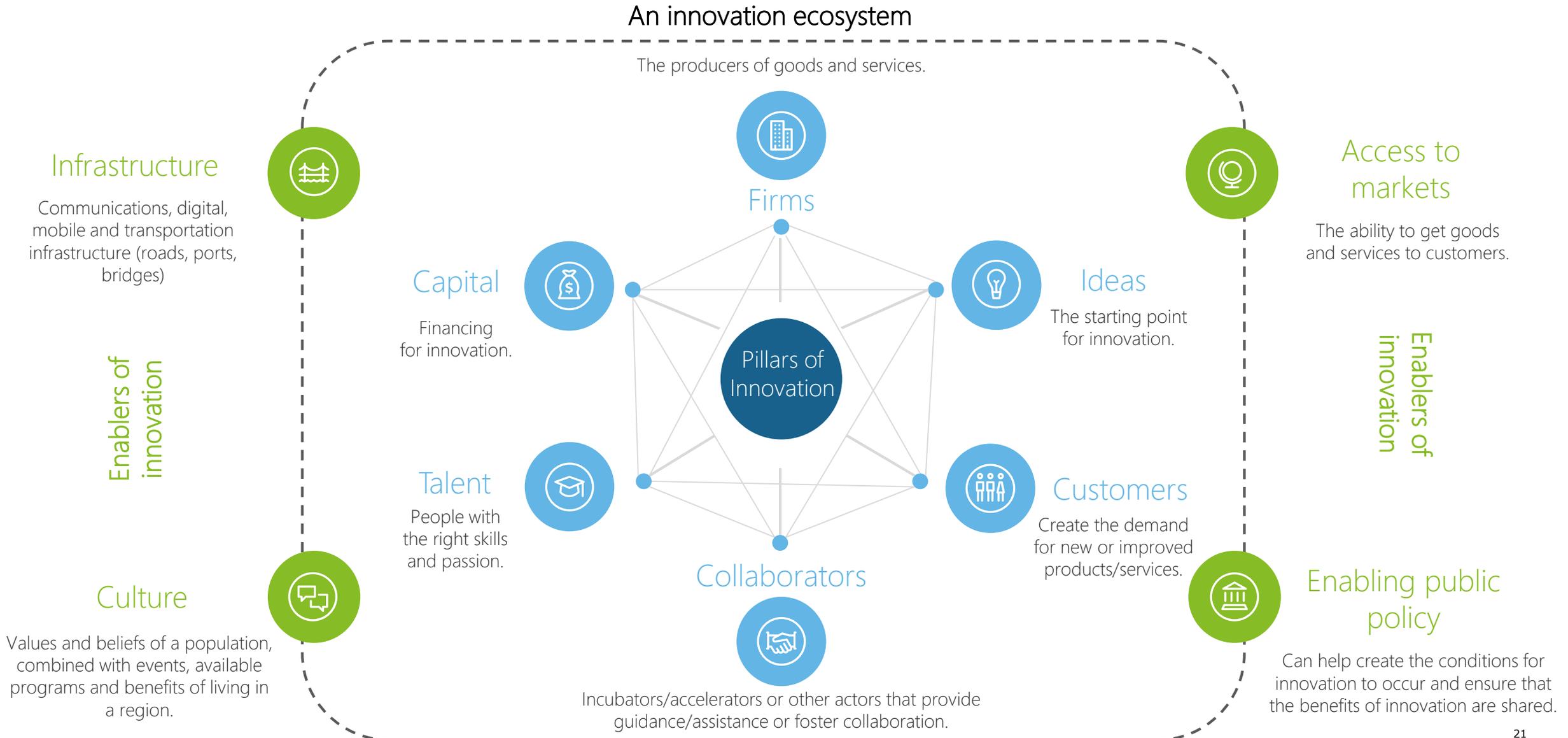
Why innovation is important

Past successes are not an indicator of future performance, particularly in a world where changes are now happening at an exponential rate.

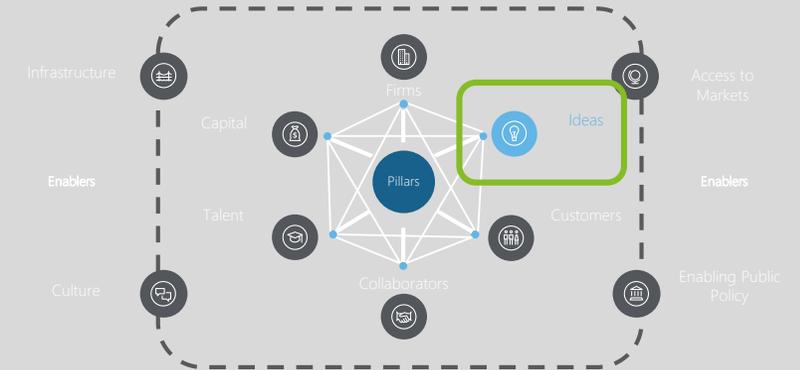
BC's economy needs to become more innovative to remain competitive and continue to provide a high quality of life to its citizens.

2: How BC's innovation ecosystem stacks up

Innovation lives in an ecosystem and is comprised of several key components



Ideas



Ideas are needed to inspire and fuel innovation.

How BC stacks up:

BC has areas of research excellence that create marketable ideas, but lags other jurisdictions on investment in research and development as well as in commercialization.

BC has great ideas, but lags other provinces in R&D investment

BC is home to several top-ranked universities – with a reputation for research excellence in numerous fields.



University of British Columbia



Simon Fraser University



University of Victoria



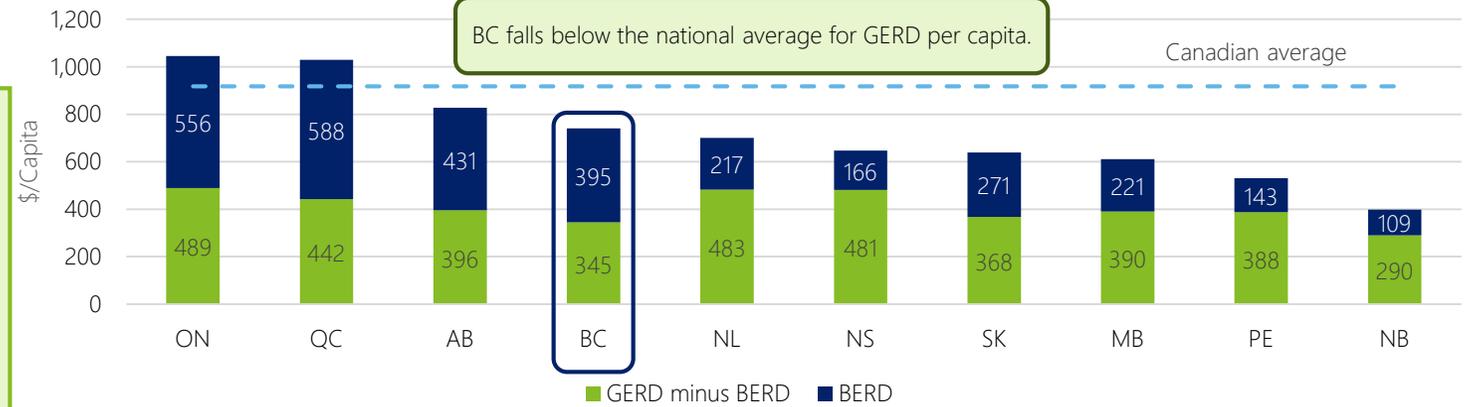
University of Northern British Columbia

These institutions are critical in grounding a location for innovation and providing the talent that helps to fuel research efforts as well as providing employees to firms.

BC institutions are a hub for world-leading research

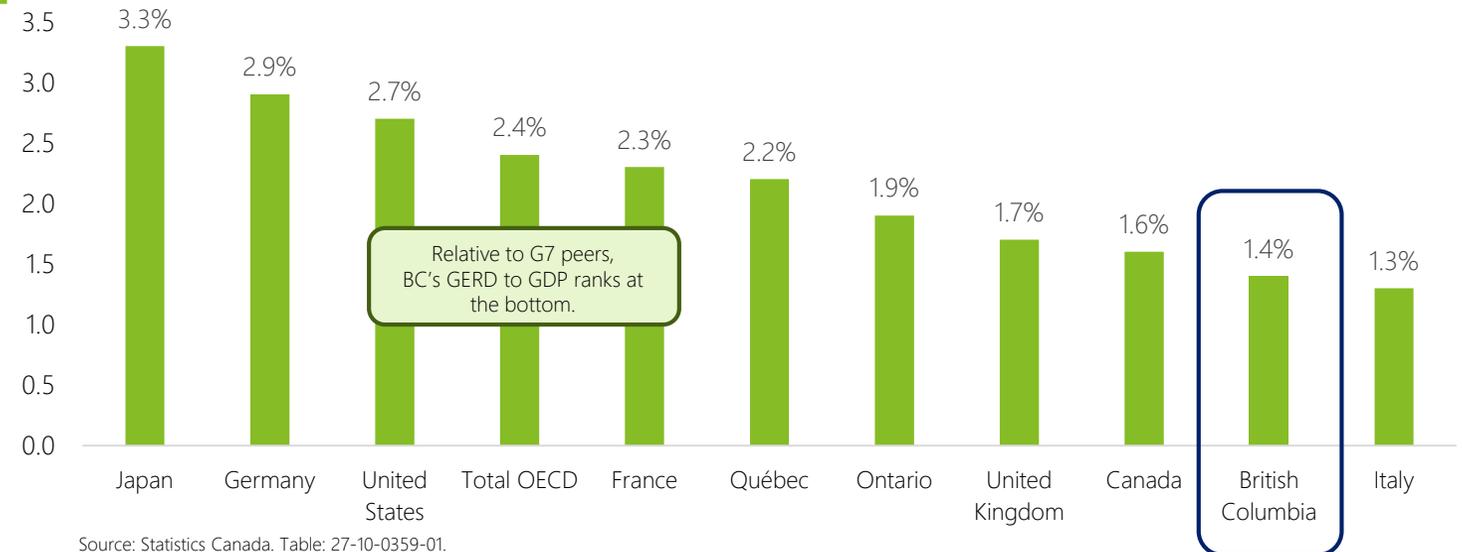
Nine Nobel Prize winners are current or former BC university faculty and alumni, and more than 25% of all US patents derived from post-secondary research in Canada have come from BC. This research excellence enables BC universities to attract strong levels of federal research funding.

Gross expenditures and business expenditures on R&D (GERD) per capita, 2015



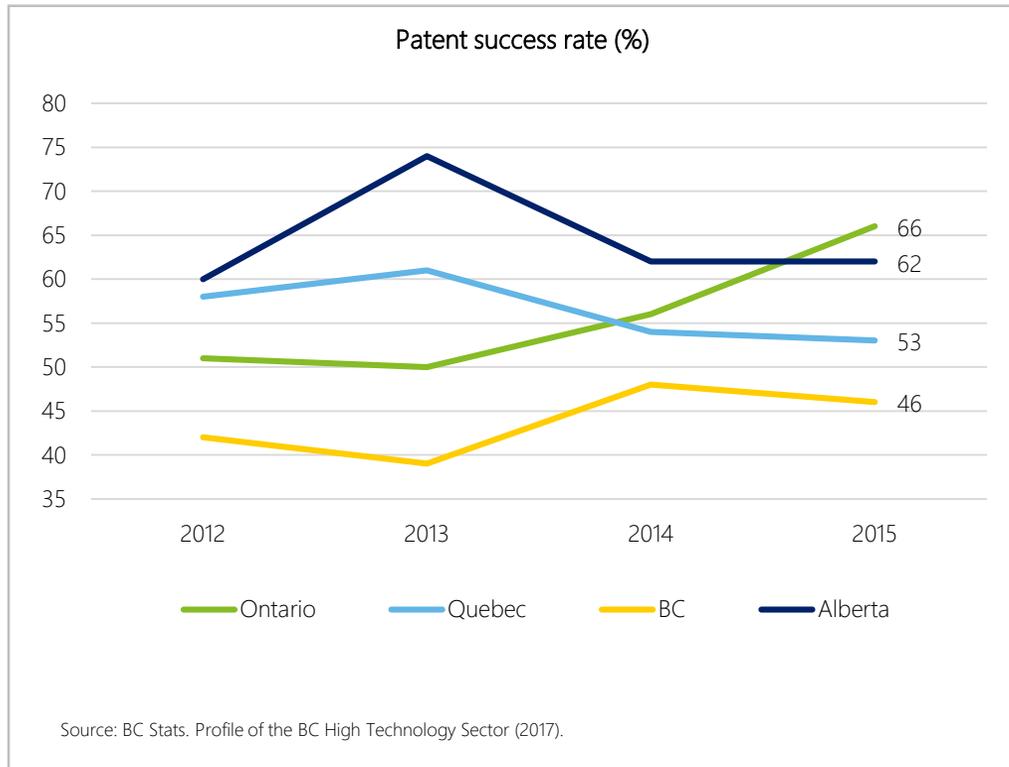
Source: Statistics Canada. Table 27-10-0273-01; BERD = Business Expenditures on R&D.

Gross expenditures on R&D as a percent of GDP, 2015

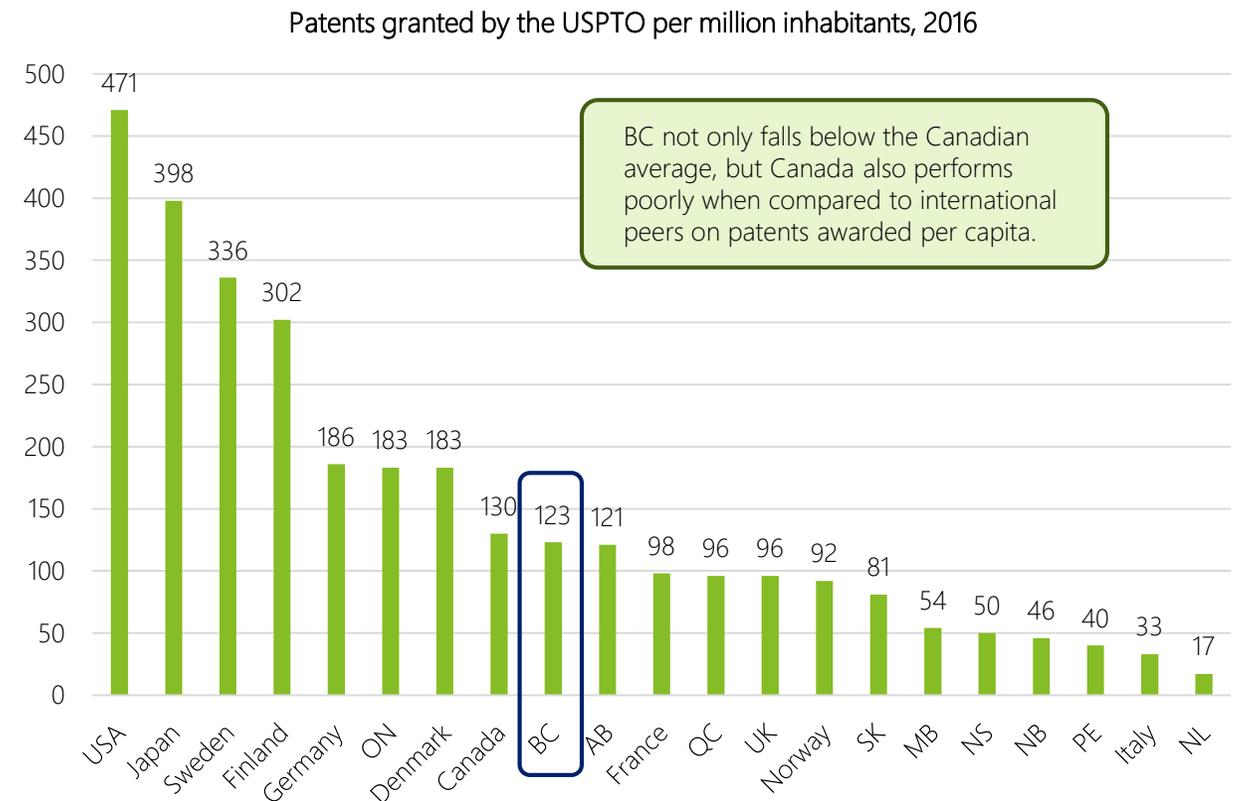


Source: Statistics Canada. Table: 27-10-0359-01.

BC's record of commercializing its ideas also lags other jurisdictions



BC's has a lower than average number of patents awarded per capita, combined with a lower than average patent success rate.



For patents granted through the Canadian IP Office, BC continues to rank below Ontario, Alberta and Quebec with the fewest applications in construction, utilities, and more recently, electronic product manufacturing.

Source: KPMG. BC Tech Report Card (2018)

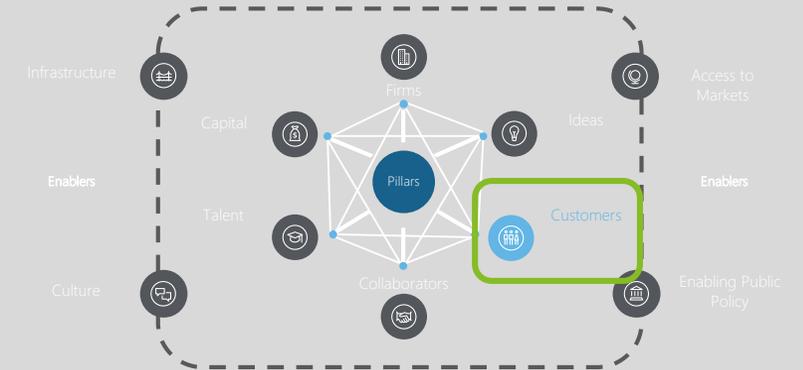
Sources: United States Patent and Trademark Office (2018); UNESCO Observatory of Science and Technology (2018); United Nations World Population Prospects (2017); Statistics Canada table: 17-10-0005-01.

Customers

Customers drive consumption for products and services,
and are needed to fuel demand.

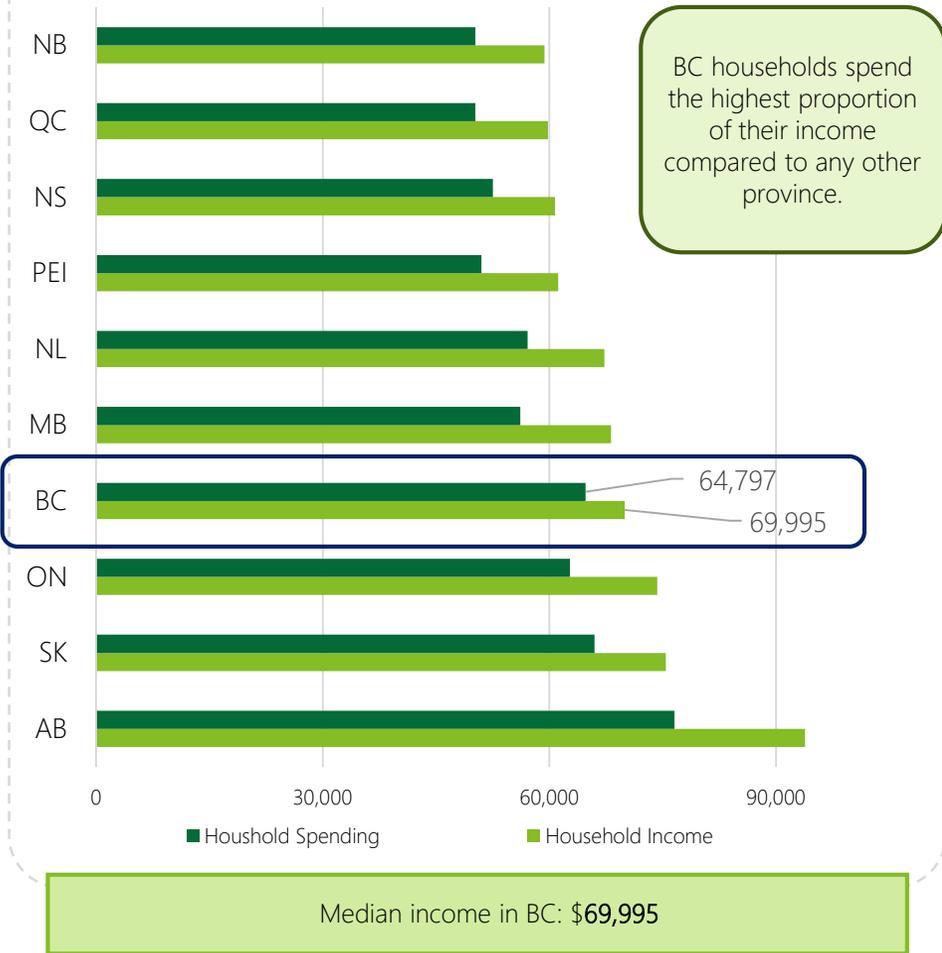
How BC stacks up:

BC has a strong and diverse international market for its products, while its domestic market faces some challenges.



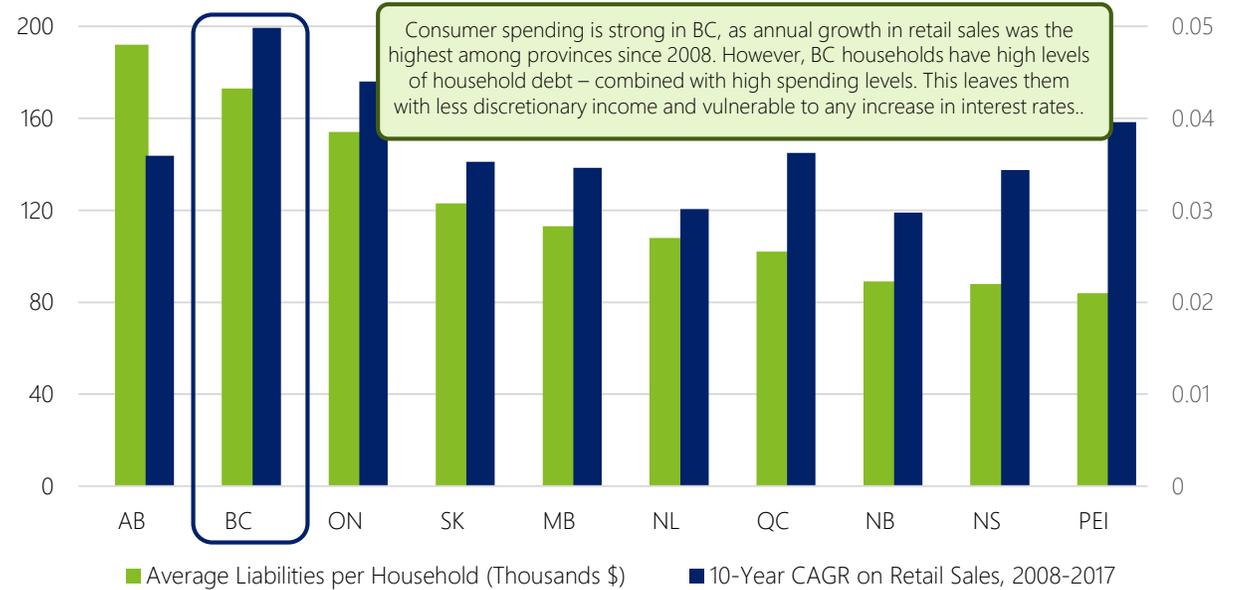
British Columbians spend a lot relative to incomes, and have less discretionary income to spare

Household Income vs. Spending, 2015 (\$)



Source: Statistics Canada. Table 11-10-0222-01; Statistics Canada. Census 2016.

Consumer Propensity to Spend: Liabilities and Retail Sales



Sources: Statistics Canada. Table: 20-10-0008-01; Table 36-10-0586-01.

Global Customers are Important When Firms Scale Up:

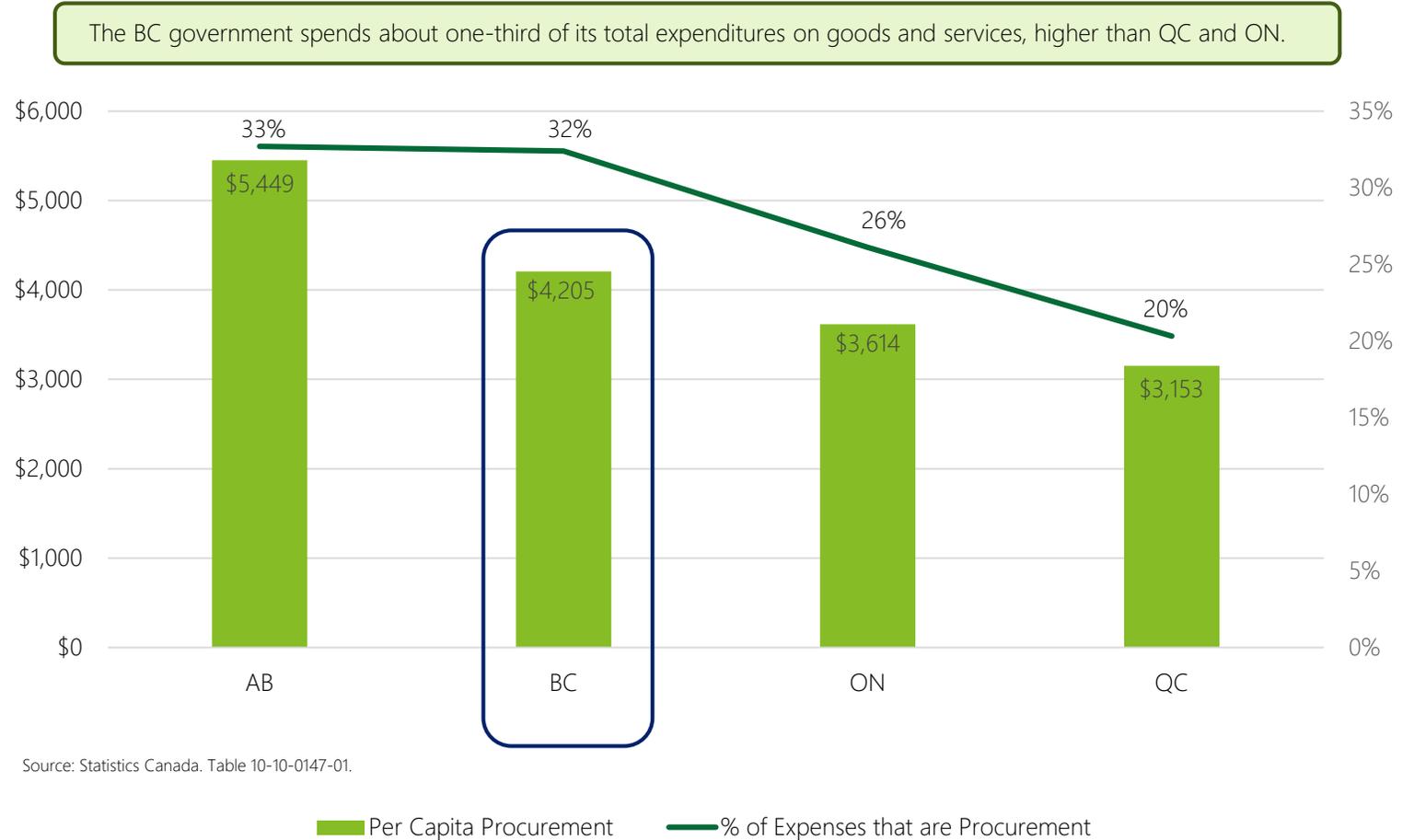
- When starting a business in Canada, domestic demand is much smaller compared to a region like the US, which has ten times the population.
- Exporting is therefore a critical success factor when businesses are looking to scale up: to drive greater revenue growth companies need to look beyond domestic borders and capitalize on international demand.

Governments are also important consumers in the innovation ecosystem

One of the Biggest Customers: Business to Government (B2G)

- Government buyers at every level are especially relevant to developers of **technology**. Governments can be an impactful source of demand for technologies and **are highly reputable clients**.
- Having government support and procurements can **reduce the risks of commercializing** technologies for small firms.
- Government procurements are **large commercial opportunities** for firms, and **can help scale technology solutions** available in the market quickly.
- Governments can also **support firms in the pre-commercialization phase of development** that is critical to success, reducing the risk and uncertainty associated with the market response.

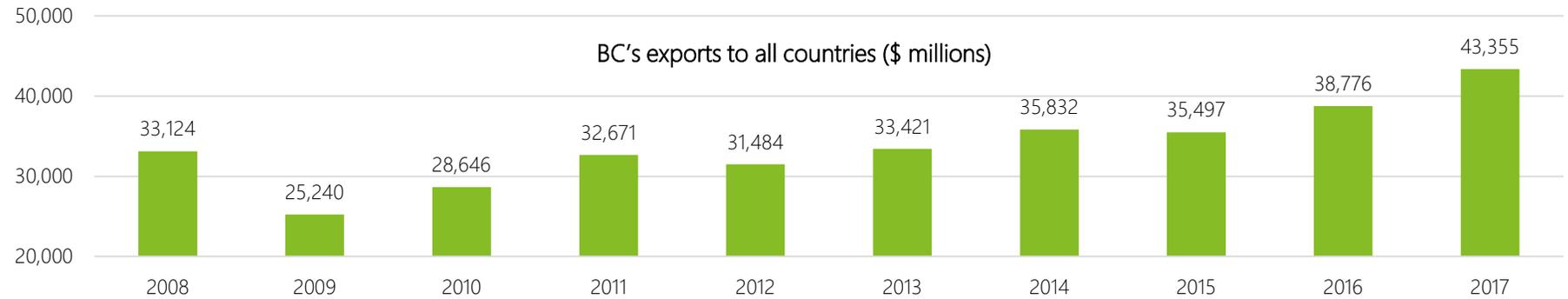
Government Spending on Goods and Services per Capita, 2016



Source: Deloitte. Enabling Technologies (2016).

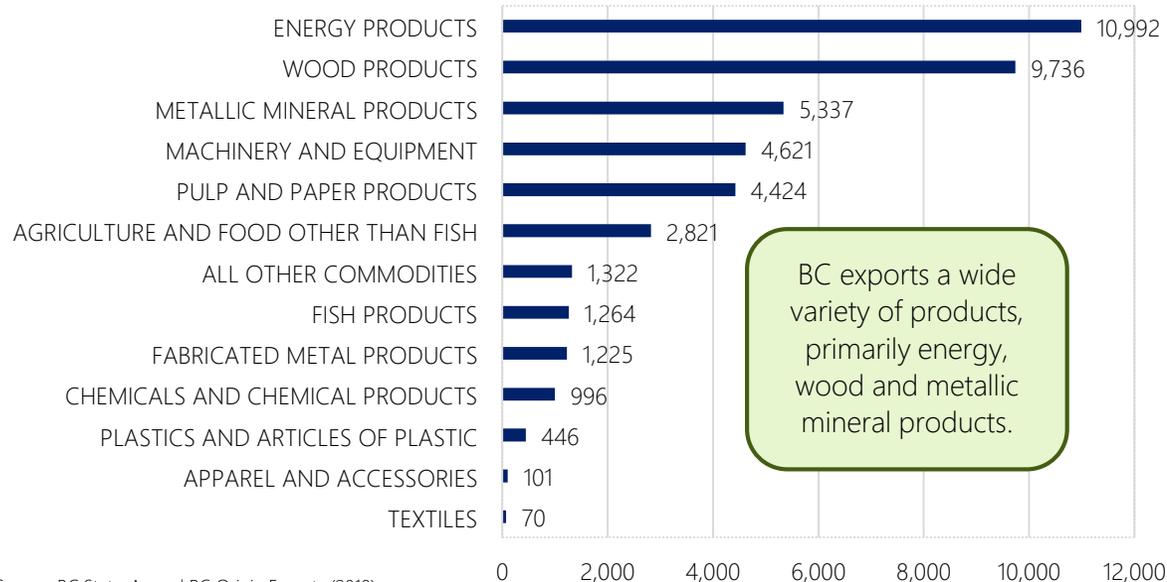
Increased demand for BC goods is fueled by customers around the world

BC's exports have increased in recent years, providing an opportunity to further its competitiveness among exporting jurisdictions.



Source: BC Stats, Annual BC Origin Exports (2018).

BC origin exports to all countries, 2017 (\$ millions)

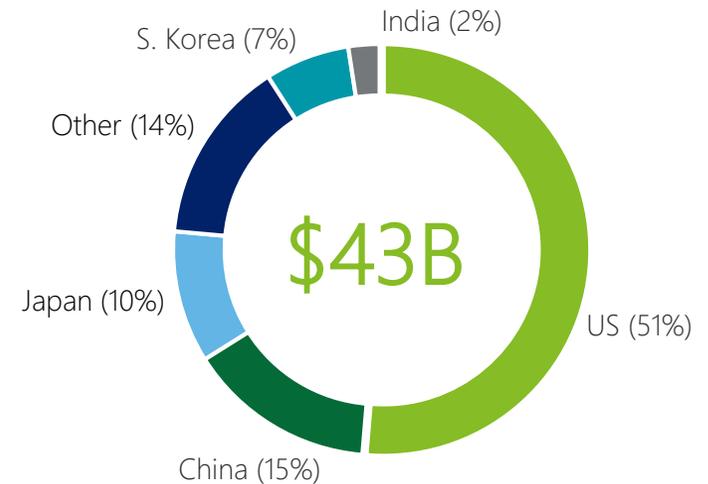


BC exports a wide variety of products, primarily energy, wood and metallic mineral products.

Source: BC Stats, Annual BC Origin Exports (2018).

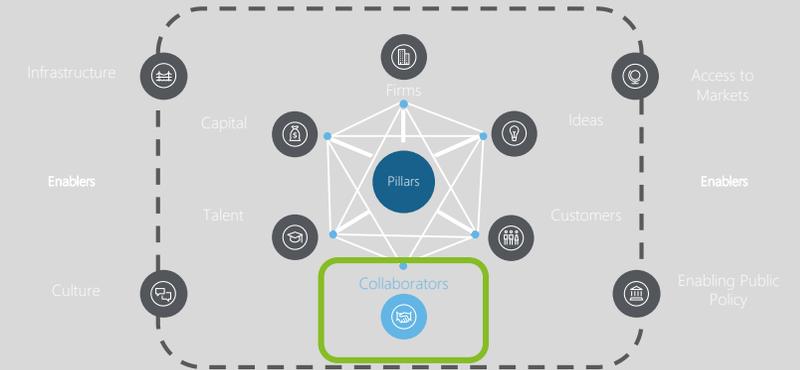
BC's proximity to large international markets facilitates exports to a variety of regions.

BC origin exports to selected destinations, 2017



Source: BC Stats, Annual BC Origin Exports (2018).

Collaborators



Collaborators are essential in nurturing innovation and providing resources to growing firms.

How BC stacks up:

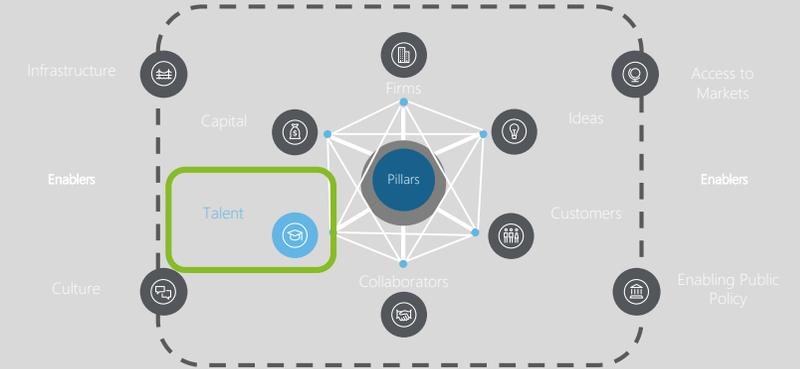
BC has a growing network of small organizations working to improve the province's innovation ecosystem. However, these organizations are mainly concentrated in Vancouver.

Collaborators work to bring innovators together—in BC most are centered in or around Vancouver

There are a number of small regional organizations that work to foster innovation in their communities. However, an overarching strategy will enable collaborators to create synergies and expand the reach of their networks.



Talent



Talent facilitates innovation by providing the people power required to operate firms.

How BC stacks up:

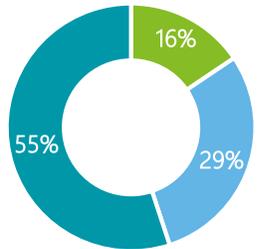
BC has an educated workforce, but gaps exist in areas that support innovation.

BC's workers are talented, but some challenges exist

BC's educational attainment levels are strong compared to other jurisdictions. However, when considering future labour demand, BC falls short in some fields of study, particularly STEM.



Educational attainment – age 15 and above, 2016

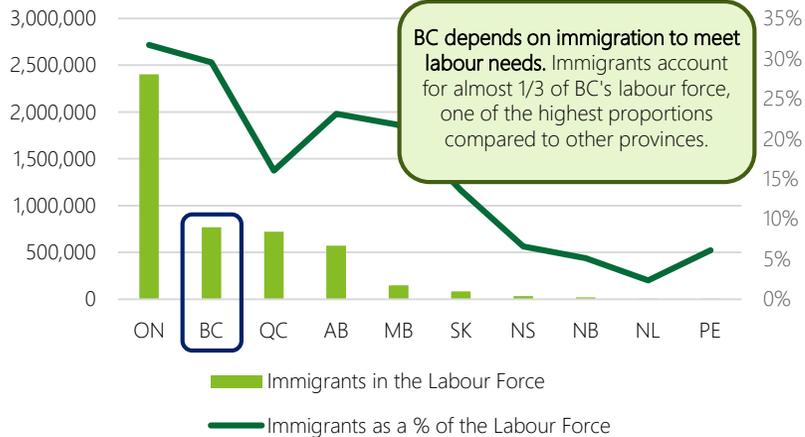


With the largest share among provinces of high-school only educated residents, BC has a somewhat outsized population of underskilled workers.

- No certificate; diploma or degree
- Secondary (high) school diploma or equivalency certificate
- Postsecondary certificate; diploma or degree

Source: Statistics Canada. Catalogue no. 98-316-X2016001.

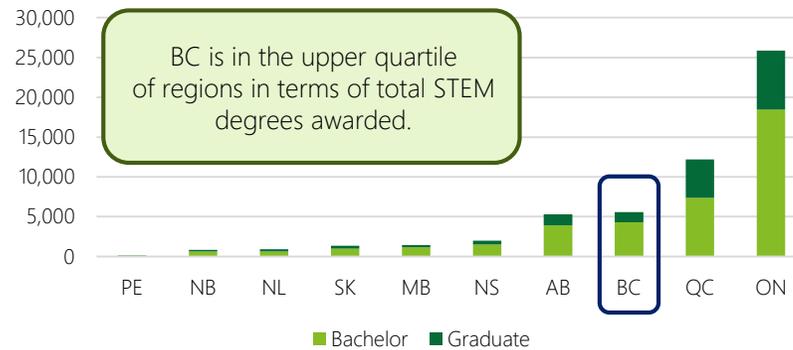
Total immigrants in the workforce and percent of the workforce comprised of immigrants, 2017



BC depends on immigration to meet labour needs. Immigrants account for almost 1/3 of BC's labour force, one of the highest proportions compared to other provinces.

Source: Statistics Canada. Table: 14-10-0085-01.

Bachelor and graduate degrees awarded in STEM, 2015

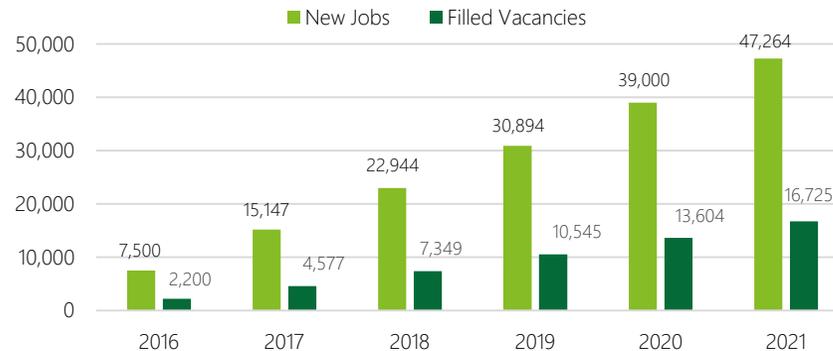


BC is in the upper quartile of regions in terms of total STEM degrees awarded.

Source: Statistics Canada. Catalogue no. 98-400-X2016279.

BC's tech sector is expected to rapidly expand, with the number of new tech jobs reaching by 47,000 by 2021. However, based on current talent availability and employment growth forecasts, only 16,500 of these vacancies will be filled, leaving 30,500 vacant positions.

Cumulative new jobs and filled vacancies in BC's tech sector

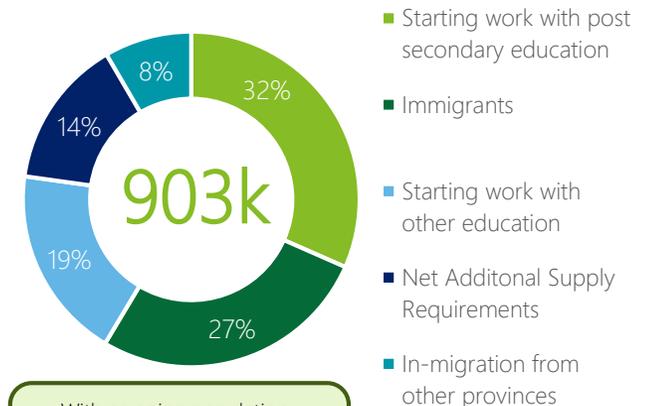


Source: BC Tech Association. Tech Talent BC Report (2016).

BC ranks **3rd** among provinces and OECD countries for education and skills.

But labour forecasts indicate demand will outpace supply in the near future.

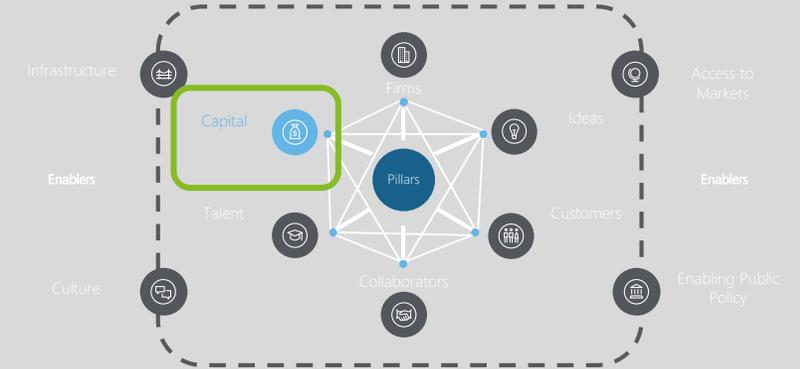
Forecast of supply composition for the BC labour force, 2018-2028



With an aging population, BC will need to rely increasingly on immigration to meet labour demands.

Source: WorkBC. Labour Market Outlook (2018).

Capital



Capital provides much-needed funding at many stages of innovation.

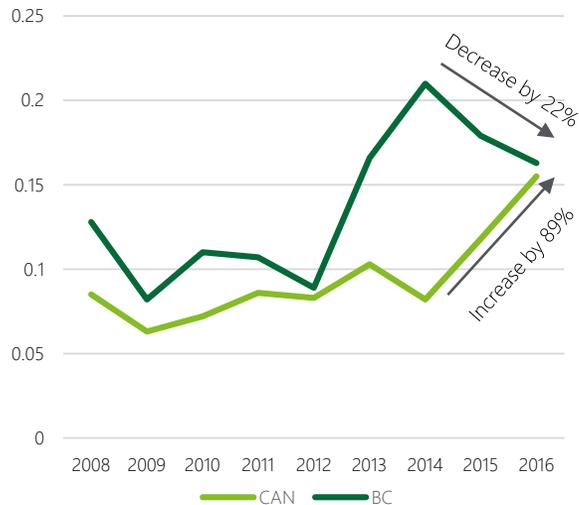
How BC stacks up:

There is a relatively good level of venture capital investment in BC firms.

Investors buy into BC's innovators

While BC outperforms the Canadian average for VC as a % of GDP, the sharp decline in BC after 2014 contrasts a national spike.

Venture Capital investment (% of GDP)



Source: Conference Board of Canada. Innovation (2018).

BC's rate of Venture Capital investment is greater than the national average, but lags the US significantly.

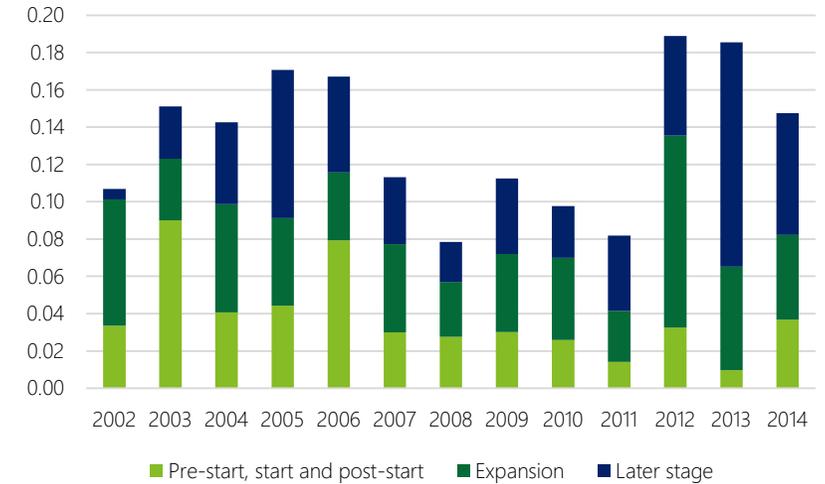
Venture capital investment, 2014-2016 average (provinces), 2015-2016 average (int'l) as a % of GDP



Source: Conference Board of Canada. Innovation (2018).

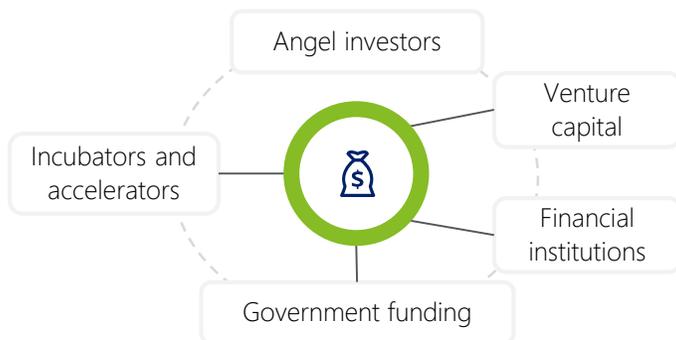
The total value and composition varies from year to year, but fell in recent years for which data is available.

BC venture capital as a % of GDP, by stage



Source: Industry Canada. Venture Capital Monitor (2014).

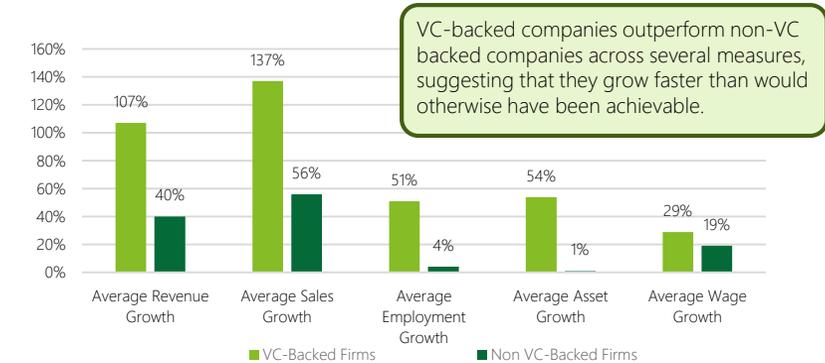
Sources of capital



A main issue

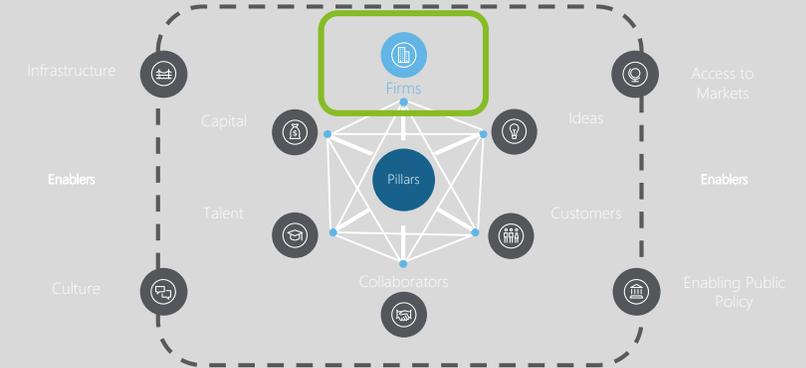
In Canada and globally, businesses experience challenges in finding funding as they move their innovations closer to commercialization. This challenge has been referred to as the pre-commercialization gap or "valley of death" for technologies.

Relative performance of VC-backed firms after 5 Years



Source: Industry Canada and CVCPEA. Performance of Canadian Firms that Received Venture Capital Funding (2013).

Firms



Firms put ideas into action.

How BC stacks up:

BC has many small firms but they struggle to achieve scale and become large companies. As large firms bring significant economic benefits, BC risks a missed opportunity.

BC is a great place to start a company, but small firms often move elsewhere to grow

Large firms provide significant benefits to an economy, as they:

- Serve as anchors for local and regional economies, pay higher average salaries and invest more in R&D.
- Are better able to draw benefits from participating in industry clusters, and be part of collaborative arrangements with universities and external research and commercialization organization.
- Are more likely to engage in international trade.
- Have a greater capacity to finance innovation, commercialize new ideas, forge and sustain alliances, hire and develop engineers and scientists, and deploy new process technologies.
- Draw other firms into their supply chains, attracting management talent to their locations.
- Are less likely than small firms to change locations, keeping economic benefits at home.
- Are able to take advantage of economies of scale – reducing cost structure and facilitating growth.

The scaling up issue: The BC economy is good for starting lots of little companies but struggles to scale them up.

- In Canada and globally, businesses experience challenges in securing funding as they move closer to commercialization – a significant contributor to this is the lack of experienced managers in BC companies.
- As noted earlier, this challenge is known as the pre-commercialization gap or “valley of death” for technologies.
- The overwhelming majority of companies in BC are small—of the 404,000 businesses registered in the province, 98% have fewer than 100 employees. Relative to its population size, BC has the highest concentration of small businesses among Canadian provinces.
- Given the economic benefits that flow from the presence of large companies, enabling small businesses to get bigger is beneficial for workers (i.e. more high-paying jobs) and the BC economy generally.

Source: Government of Canada. Evaluation of the Build in Canada Innovation Program (2017).

1.09 mm total companies in BC in 2016.

Source: BC Stats. Number of Businesses & Employment by Industry (2018).

BC has lots of small companies and not many big ones.

The negative feedback loop

One of the main problems BC faces with scaling up small businesses is a lack of management expertise. This is exacerbated by the lack of large firms in BC that work to attract and retain individuals with this management expertise.

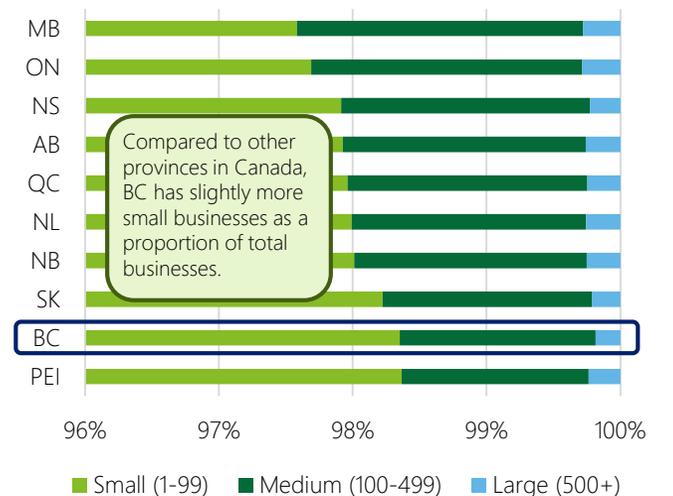


The issue with the few who scale up

While there is an issue with scaling up in BC, some firms manage to successfully achieve scale. However, many of these firms either relocate or sell to buyers in the US.



Provincial comparison by company sizes (# firms), 2016



Source: BC Stats. Number of Businesses and Employment by Industry (2018). 36

Innovative firms that scale-up in BC have historically fallen into one of five subsectors

Sector strengths

 **Cleantech:** there are 7,700 employees working in over 50 Cleantech companies in Vancouver. A strong interplay between start-ups and incumbents is underlined by Evok Innovations, a \$100mm fund led by local Cleantech entrepreneurs and energy companies Cenovus and Suncor.



 **Digital gaming:** 1/3 of Canada’s gaming studios are based in Vancouver, including EA’s largest studio. Vancouver is also Canada’s leading digital entertainment cluster and a top global Altered Reality/Virtual Reality (AR/VR) hub.



 **Health and life sciences:** The Life Sciences sector in BC contributes approximately \$14.4B to GDP, including a workforce of around 14,000 people. Notable start-ups include 3D bio-printing company Aspect Biosystems, cell research firm StemCell Technologies, and bio-therapeutic platforms company Zymeworks.



 **Blockchain (emerging):** Many industry players have identified Blockchain and Distributed Ledger Technologies as revolutionary and will have implications for social and economic infrastructures as well as impacting multiple industries.

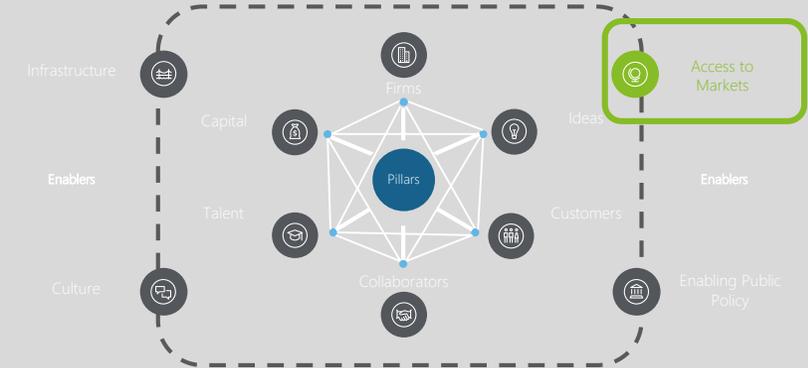


 **Unicorns:** BC has produced 3 of Canada’s 5 “unicorns” (private companies valued at \$1 billion or more). This is a result of BC developing technology-sector talent for decades.



Sources: Start-up Genome. Global Start-up Ecosystem Report (2018); Deloitte. BC-led Canadian Digital Technology Supercluster (2018).

Access to markets



Markets connect innovators to customers,
facilitating much-needed demand toward firms.

How BC stacks up:

BC is well-positioned geographically and has the international trade infrastructure needed to effectively tap into large markets.

Access to international markets creates a large and diverse customer base for innovators in BC

Asia boasts some of the world's fastest-growing economies and is a major contributor to global growth – this is a stark contrast to the mature western economies experiencing slower growth in recent years. The combination of BRIC powerhouses China and India, former powerhouse Japan, an increasingly affluent South Korea and the fast-growing Association of South East Asian Nations (ASEAN) all indicate that the region's ascendancy in the global economy will continue. BC is well positioned in proximity to these regions to harness the demand from these markets.

Source: Deloitte Insights. Asia Pacific Economic Outlook (2017).

British Columbia provides a strategic location for supply chain management and logistics

-  **Air:** BC's six airports that serve international markets include: Victoria (YYJ), Vancouver (YVR), Kelowna (YLW), Abbotsford (YXX), Cranbrook (YXC), and Prince George (YXS). BC is Canada's largest air gateway to Asia.
-  **Rail:** BC is the only gateway on the west coast of the Americas served by three continental Class 1 railways, connecting ports on the Atlantic, Pacific and Gulf coasts to key markets throughout Canada, the US and Mexico.
-  **Road:** An extensive, all-weather highway network makes transporting goods and services to North American markets seamless and reliable.
-  **Sea:** The Port of Vancouver is Canada's largest port and the third largest port in North America. It is responsible for Canada's trade with more than 170 world economies. The ports of Vancouver and Prince Rupert, ice-free year-round, are Asia's closest ports of entry on the west coast of North America – saving shippers over two days of transportation time compared to other west coast ports.
-  **Communications:** BC has the highest rate of broadband and overall Internet connectivity in Canada.

YVR is at the travel centre of the global economy (hours to major centres)

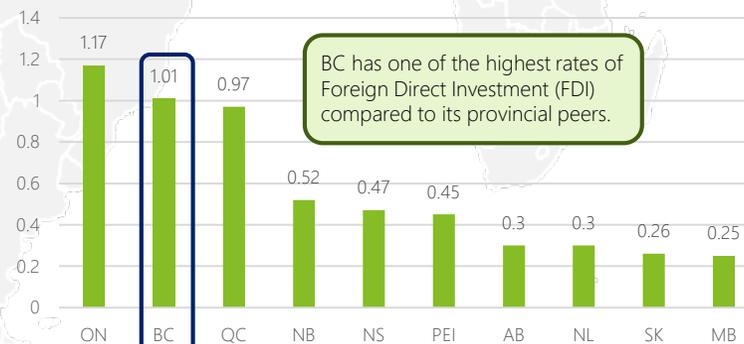


Exports to all countries by province of origin, 2017 (\$millions)



Source: BC Stats, Annual BC Origin Exports (2018).

Inward greenfield FDI performance index



Source: Conference Board of Canada. Provincial and Territorial Ranking (2017).

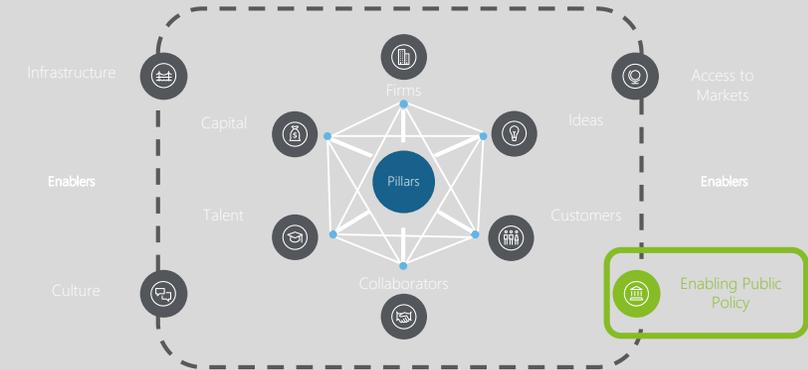
The shortest sea route from North America to Asia*

| | Prince Rupert | Vancouver | Oakland | Los Angeles |
|-----------|---------------|-----------|-----------|-------------|
| Hong Kong | 11.2 days | 12 days | 12.6 days | 13.2 days |
| Shanghai | 9.9 days | 10.6 days | 11.3 days | 11.9 days |
| Yokohama | 7.9 days | 8.8 days | 9.5 days | 10.1 days |
| Pusan | 9.5 days | 9.7 days | 10.4 days | 11.0 days |
| Chennai | 17.1 days | 18.0 days | 18.6 days | 19.3 days |

*Estimated based on vessel speed of 20 knots

Source: Trade and Invest BC. Easy Global Access (2018).

Enabling public policy



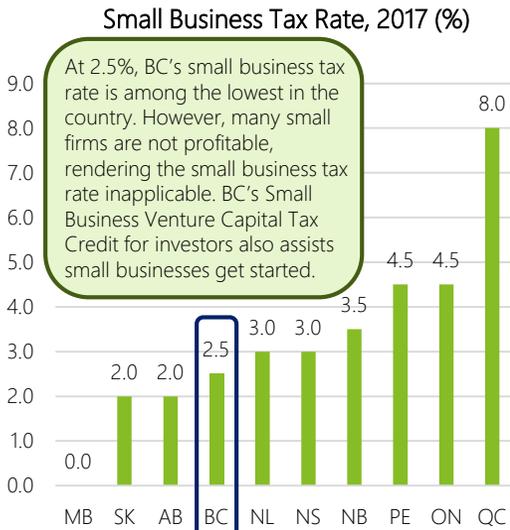
Governments support innovation through funding, programs and regulations.

How BC stacks up:

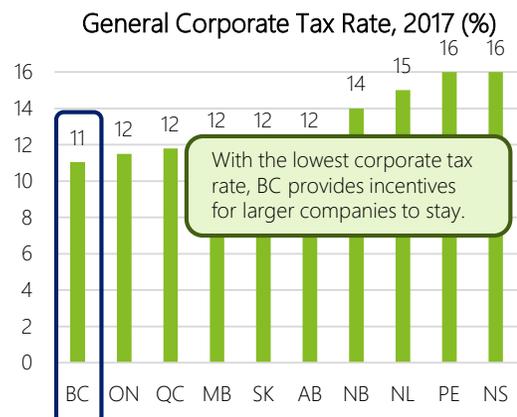
BC's public programs help small companies get started, but could do more to help them scale.

BC maintains some public programs, but would benefit from increased investment and a defined strategy

BC does a lot for small start-ups, but there is a policy gap for helping businesses scale.



Source: BC Ministry of Finance. Budget and Fiscal Plan 2018/19.



Source: BC Ministry of Finance. Budget and Fiscal Plan 2018/19.

The Canadian government also supports the development of innovative companies through programs such as:

- Sustainable Development Technology Canada (SDTC):** a foundation created to support Canadian companies with the potential to become world leaders in their efforts to develop and demonstrate new environmental technologies that address climate change, clean air, clean water and clean soil. Since 2001, the Government of Canada has committed \$1.4 billion to SDTC.
- Strategic Innovation Fund (SIF):** allocates repayable and non-repayable contributions to firms of all sizes across Canada's industrial and technology sectors. The program has a budget of \$1.3 billion over five years.
- Superclusters Program:** investment of up to \$950 million, to be matched by the private sector, for the creation of geographic centres of excellence across Canada.

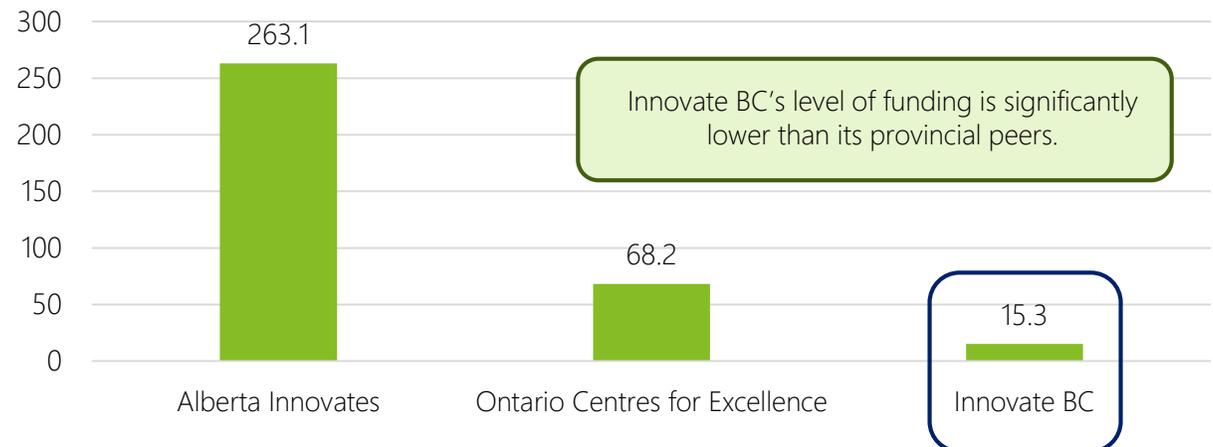
While BC has a series of programs, there is no overarching innovation strategy.

The BC Start-up In Residence (STIR) program connects start-ups in the tech industry with specific business areas in the provincial government. These relationships allow firms, within a 16-week timeframe, to collaboratively and iteratively develop technology solutions for societal challenges.

These selected start-ups participate in development and a product trial. At this point, each business area has the option to enter into an ongoing contract to further the solution.

Latero Labs
Arkit
App-Scoop
DE
Big Bang Analytics
Purpose Five

Program Annual Revenues, Year End 2017 (\$ millions)



Source: Innovate BC. Annual Report (2017); Alberta Innovates. Annual Report (2017); OCE Annual Report (2017).

Case study: Israeli government taking action on innovation

Israel has a strong culture of entrepreneurship, and has relied on improvising and experimenting to become a world leader in innovation.

Several steps have been taken by the Israeli government in 2016 and 2017 that are expected to prove beneficial to fostering innovation. Among these steps are regulatory easing measures and actions to strengthen the infrastructure necessary for industry.



Law for the encouragement of capital investments: reduced corporate tax rate for high-tech companies from 25% to 6-12%.



The Knesset passed a bill aimed at removing bureaucratic obstacles and easing the completion of high-tech mergers and acquisitions.



A government resolution was passed to implement a national program for increasing the number of skilled personnel in the high-tech industry.

The Innovation Authority's Plan of Action



Innovation infrastructure

- Fostering skilled personnel
- Investment in research infrastructure
- Development of financing infrastructure
- Utilization of all pools of potential personnel



Technological value creation

- Addressing the market failures in R&D
- Participation in risk
- Bridging the 'finance death valleys'



Economic value capture

- Participation in risk
- Bridging 'finance death valleys'



2nd on the WEF Innovation Index worldwide.



300 MNCs' R&D Centres.



600 Net new start-up companies per year.



1st In R&D investment as a ratio of GDP worldwide.



1st in VC investments as a ratio of GDP worldwide.



High-tech employees earn 114% more than the national average.

Israel is a leading innovation centre. With its first-rate performance, many think it is second in the world only to the Silicon Valley.

The cultivation of additional thriving innovation systems in areas in which the Israeli economy possesses a leveragable advantage is a central component in the Innovation Authority's strategy.

Israel has the second largest presence on Nasdaq:

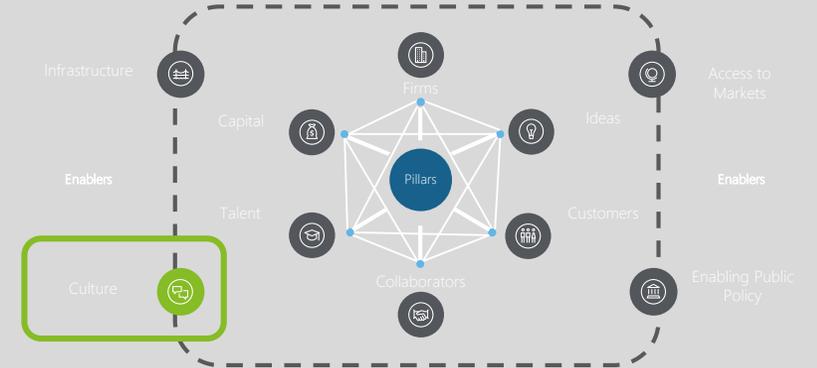


Over 90 Israeli companies are listed on Nasdaq.



Their aggregate market capitalization is 70 billion USD.

Culture



An innovative culture supports creative thinking and attracts top talent.

How BC stacks up:

BC's natural livability attracts people and firms from all over the world, but the high cost of living (especially in Vancouver) makes it challenging for new and existing residents to stay.

BC's inherent livability attracts top talent, but the high cost of living is a challenge

Vancouver is the
6th
Most livable city
in the world.

The Global Livability Index: Vancouver

97.3 overall ranking

-  95 in stability (crime, terror, and conflict).
-  100 in healthcare (availability and quality of healthcare and OTC drugs).
-  100 in culture and environment (climate, corruption, religious restrictions, sports, food and drinks, goods and services, cultural availability).
-  100 in education (availability and quality of education).
-  92.9 in infrastructure (quality of roads, public transport, energy provision, water provision, telecommunication, international links and availability of good quality housing).

Source: Economic Intelligence Unit. The Global Livability Index (2018).

A spectacular and safe setting...

BC's natural scenery, combining mountains and ocean throughout all four seasons make it one of the most beautiful regions in the world. Canadians are known for their friendly nature, and BC's citizens take great pride in the welcoming, clean, safe streets – day or night, all year round.

...But high housing costs make it challenging to live here

Since 2013, real estate prices in BC have been sharply on the rise and are becoming restrictive, with a concentration of price increases in Vancouver.

Average House Prices, 2018



Source: Canadian Real Estate Association, National Statistics (2018).

Health Ranking: BC (2015)

- | | | |
|--------------------------------------|--|--|
| A Premature mortality | A Self-reported health | A overall score |
| B Infant mortality | B Mortality due to nervous system diseases | B Mortality due to respiratory diseases |
| A Mortality due to cancer | B Mortality due to heart disease and stroke | C Mortality due to diabetes |
| B Self-reported mental health | B Suicides | B Life expectancy |

Healthiest

Province in the country and ranked

#3

healthiest place in the world.

Source: Canadian Conference Board, Health (2015).

Looking at BC's innovative culture

Local connectedness

Sense of community index

3.9

Global Avg: 4.9

Number of relationships between founders

20.1

Global Avg: 20.15

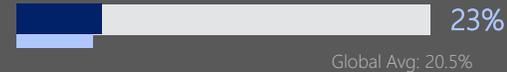
Collision index

4.3

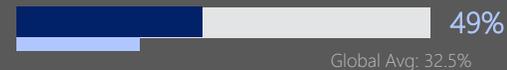
Global Avg: 4.9

Founder mindset

Entrepreneurial mindset



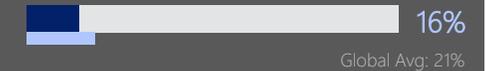
Builder mindset



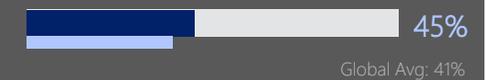
Source: start-up Genome Global start-up Ecosystem Report (2018).

Founder DNA

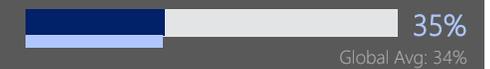
Founders with High Ambition



Founders Who Want to Change the World



Founders with Experience in Each Subsector



Founder know-how

Theoretical know-how index

6.4

Global Avg: 5.1

Practical know-how index

4.3

Global Avg: 4.8

Defining terms for an innovative culture

Entrepreneurial mindset: Founders closely matched the validated profile of successful early stage entrepreneurs along the five attitudes tested: initiation, reflection and patience, breadth, depth and structure.

Founders with business builder mindset: Founders that closely matched the profile of successful business builders (late stage entrepreneurs).

Theoretical know-how: Theoretical knowledge of key start-up methodologies.

Practical know-how: Measuring a behaviour demonstrating knowledge of key start-up methodologies was put into practice.

Sense of community index: The degree to which founders informally receive help from investors, experts and fellow founders.

Number of relationships between founders: Number of quality relationships between founders, where they know each other and can call upon each other for help.

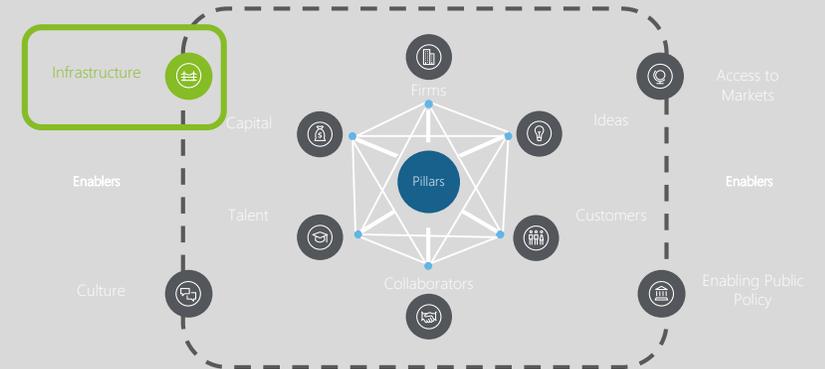
Collision index: Number of events founders recently participate in and the number of collisions with start-up community participants.

Infrastructure

Infrastructure connects organizations, people, ideas, resources and governments with one another.

How BC stacks up:

BC has some of the physical and communication infrastructure to help facilitate innovative activity. More investment is needed to expand infrastructure to all regions.



BC has a fairly comprehensive transportation infrastructure, but still lags in some metrics

Transportation infrastructure

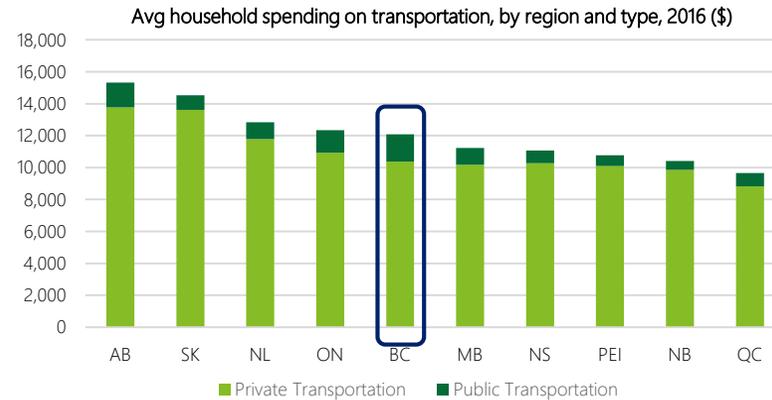
Includes

-  Aviation Infrastructure (planes, helicopters, etc.).
-  Rail infrastructure (tracks, signals, electrification).
-  Road infrastructure (roads, bridges, tunnels).
-  Marine infrastructure (ports, docks, shipping).

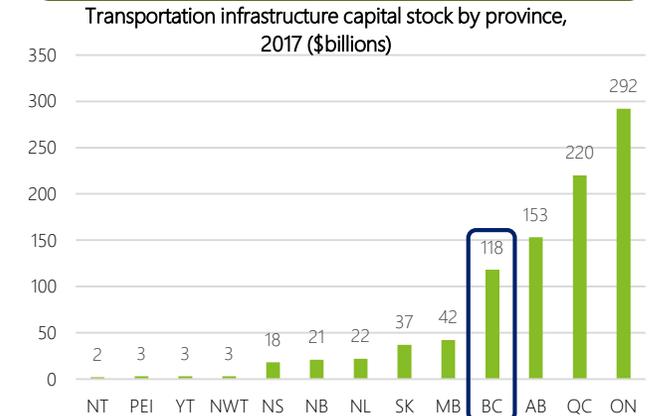
BC's infrastructure at a glance

-  Approximately **47,000 km** of provincial highways and rural side roads.
-  Over **2,800** bridges.
-  Over **2,900** transit buses.
-  **133 km** of SkyTrain and commuter rail.
-  **3** class 1 railways (having annual carrier operating revenues of \$250 million or more in 1991 dollars).
-  **300+** airports, heliports and other air facilities.
-  **19** international border crossings.
-  **3** international ports, **4** regional ports and **40** local ports.
-  **40+** ferry routes.

While BC households spend a mid-range amount on transportation, BC has the highest average household expenditure on public transport of all provinces.



BC's investment in transportation infrastructure is in the upper quartile among provinces.

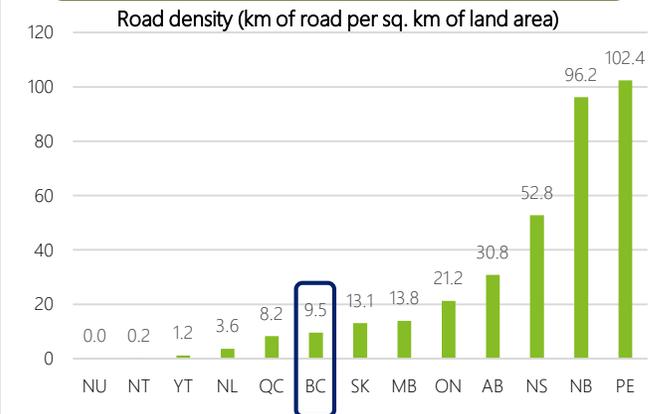


International case

Australia's 30 minute city

- Australia is transforming Sydney into a 30-minute city (spending no more than an hour travelling, particularly for work, every day – 30 minutes each direction).
- As a global gateway to Australia, the future Sydney requires more accessibility, networks of infrastructure and consequently, more connectivity for all people.
- Some potential applications of technology in terms of reducing congestion and increasing accessibility include: Big Data, On-demand Transport, Ridesharing, Driverless Vehicles, 5G and Robotics.

When assessed on a basis of land area, BC's road network is below that of the majority of Canadian provinces.



British Columbians are connected, but internet speed and wireless connectivity lag

Technology infrastructure

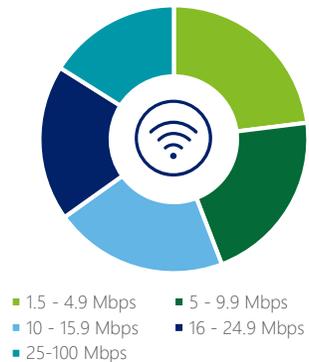
Includes

- 📶 Broadband internet access and speed.
- 📱 Prevalence of mobile technology and devices.
- 👤 Technology adoption rates.
- 📶 Mobile data rates and accessibility.

How BC performs

98% of BC households have access to high speed internet.

Broadband availability by speed



TELUS is also creating a 5G testbed to help accelerate application development for Internet of Things and drastically enhance speed to market.

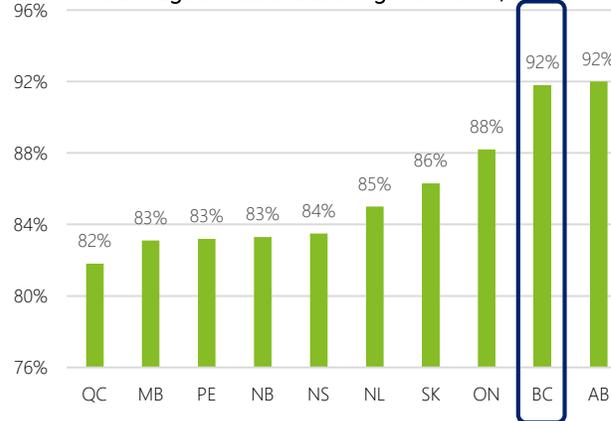
77%

of BC's population own a smartphone.

Source: CRTC. Communications Monitoring Report (2017).

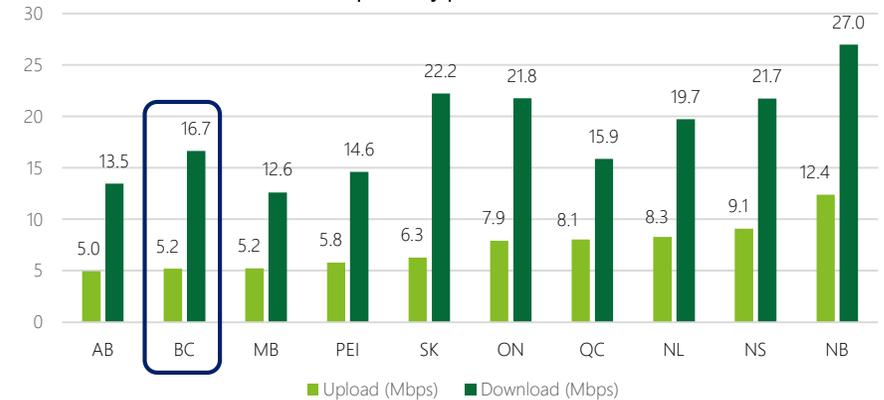
BC, relative to other provinces, has a high prevalence of internet access, indicating a very well-connected population.

Percentage of households using the internet, 2015



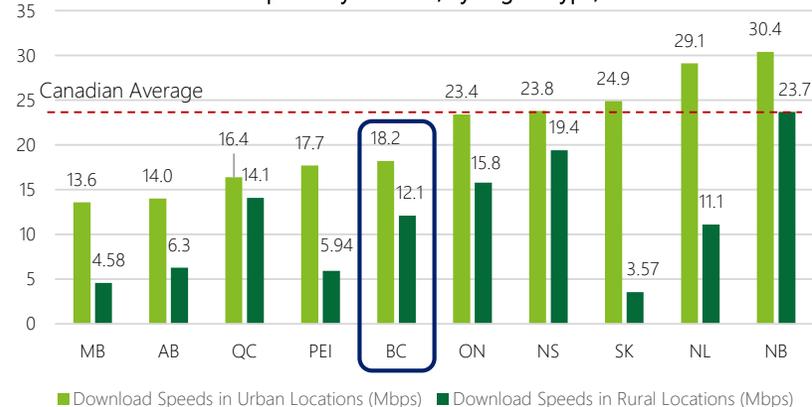
BC, relative to other provinces, has the **2nd lowest** internet speed in the country.

Internet speeds by province, 2016



BC's download speed is below the national average, with a large disparity between urban and rural area speeds.

Internet Speeds by Province, by Region Type, 2016



Compared to a high proportion of internet users, BC has a low proportion of those users on Wi-Fi networks.

Percentage of households using Wi-Fi internet, 2015



Source: CIRA: Canada's Internet Performance Report (2016).

The pace of BC's economy is predicted to slow, innovation can boost growth

The Pillars of an innovation ecosystem

| | | | |
|--|----------------------|---|---|
|  | Ideas | Ideas are needed to inspire and fuel innovation. | BC has areas of research excellence that create marketable ideas, but lags other jurisdictions on investment in research and development as well as commercialization. |
|  | Customers | Customers drive consumption for products and services, and are needed to fuel demand. | BC has a strong and diverse international market for its products, while its domestic market faces some challenges. |
|  | Collaborators | Collaborators are essential in nurturing innovation and providing resources to growing firms. | BC has a growing network of small organizations working to improve BC's innovation ecosystem – but these organizations are mainly concentrated in Vancouver. |
|  | Talent | Talent facilitates innovation by providing the people power required to operate firms. | BC has an educated workforce, but gaps exist in areas that support innovation. |
|  | Capital | Capital provides much-needed funding at many stages of innovation. | There is a relatively sound level of venture capital investment in BC firms. |
|  | Firms | Firms put ideas into action. | BC has many small firms but they struggle to achieve scale and become large companies. As large firms bring significant economic benefits, BC risks a missed opportunity. |

The Enablers of an innovation ecosystem

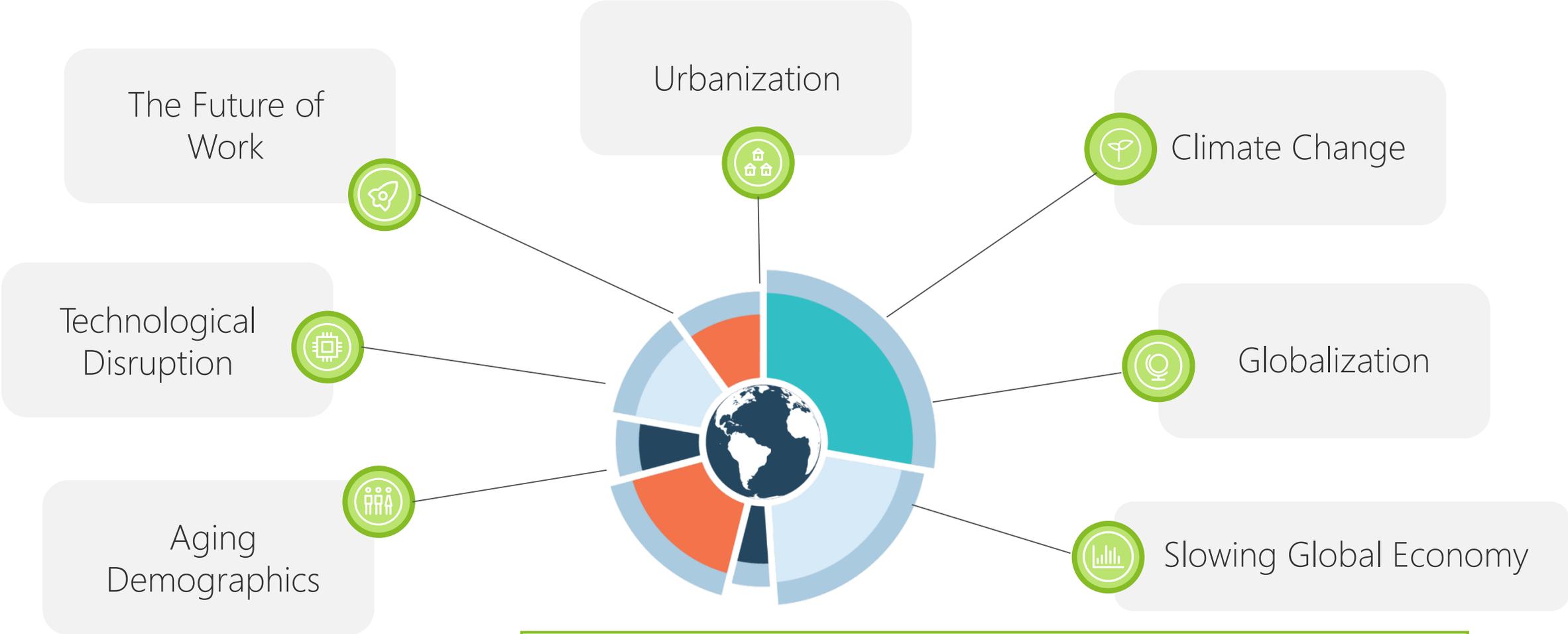
| | | | |
|--|-------------------------------|---|---|
|  | Access to Markets | Markets connect innovators to customers, facilitating much-needed demand toward firms. | BC is well-positioned geographically and has the international trade infrastructure needed to effectively tap into large markets. |
|  | Enabling Public Policy | Governments support innovation through funding, programs and regulations. | BC's public programs help small companies get started, but could do more to help them scale. |
|  | Culture | An innovative culture supports creative thinking and attracts top talent. | BC's natural livability attracts people and firms from all over the world, but the high cost of living (especially in Vancouver) makes it challenging for new and existing residents to stay. |
|  | Infrastructure | Infrastructure connects organizations, people, ideas, resources and governments with one another. | BC has some of the physical and communication infrastructure to help facilitate innovative activity. More investment is needed to expand infrastructure to all regions. |



3: Major global trends will impact BC's economic future

Major global trends will affect the course of BC's economic future

Being content with BC's current economic trajectory presents significant risk. These trends make it important to be proactive about being more innovative.



These imminent trends provide **opportunities** for nimble jurisdictions and ambitious companies and entrepreneurs, but also pose **risks** for regions and organizations that are slow to move or resistant to change.

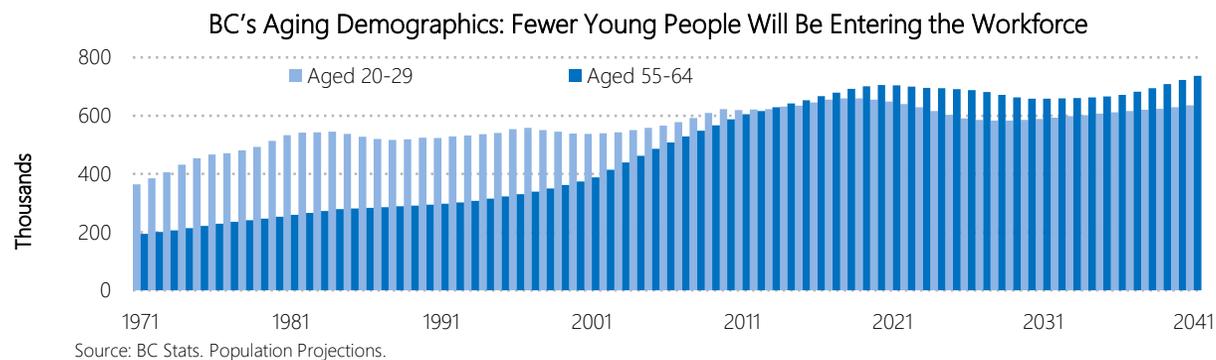
These trends in the global economy are pushing firms and jurisdictions to change



Aging Demographics

- **Population aging** coupled with **slower labour force growth** is occurring in all advanced and some emerging economies.
- An **aging population means a slower growing workforce**, greater government spending on services to citizens, as well as slower growth in government revenues.
- **Individuals are increasing their “work life”**, opting to remain in the workforce longer and extend their productive years. This has been further enabled by significant improvements to technology and internet connectivity.
- More people are working longer, but that **will not offset** the shrinking workforce driven by an aging population.

Sources: Business Council of BC. Innovation for Jobs and Productivity (2016); Deloitte Future of Work (2018); Deloitte Review of MaRS Discovery District (2017).



These imminent trends provide **opportunities** for nimble jurisdictions and ambitious companies and entrepreneurs, but also pose potential **risks** for regions and organizations that are slow to move, or resistant to change.



Technological Disruption

- **Connected citizens, businesses and things**— there is an increase in demand for 24/7 access to information and digital services, leading to a change in operational models. The rise of the Internet of Things means constant connectivity to objects as well.
- Companies and governments are increasingly **leveraging analytics** to translate big data into insights, to better understand their customers and to tailor their products and services.
- **Extensive global mobile phone technology adoption** means more connected people and better access to information.
- **Enhancing technology-human collaboration** (to take advantage of automation and disruptive technologies) allows the economy to benefit from both technology and human input.
- Globally, economies are being defined by **accelerating technological change** and the rise of the digital economy. This means adoption and adaption are critical.
- More jobs are becoming **contracted** and fewer **full time positions** result from technological advances.

Sources: Government of Canada. ISED Innovation Advisors (2018); Our World in Data. Technology Diffusion (2018); Deloitte Insights. Age of Disruption (2015).



These trends in the global economy are pushing firms and jurisdictions to change



The Future of Work

- A **changing demographic makeup** of the workforce means new considerations for management, and new preferences and needs as baby boomers retire.
- The **gig economy** is becoming more popular as millennials continue to opt out or are forced out of “traditional” job roles.
- An increase in **automation** and **Artificial Intelligence** is shifting the economic makeup of the workforce towards higher-paying, more sustainable jobs.
- **Big Data and the Internet of Things** are driving companies to become more data-driven, allowing them to become more customer-centric, and optimizing results.
- Organizations are holding themselves to **increasingly higher ethical standards**, pushing firms to consider in greater detail the needs of workers. This can be seen in the increasing implementation of Triple Bottom Line (financial, social and environmental) accounting, and a push toward diversity and equality.

Source: Deloitte Future of Work (2017).



Urbanization

- The trend towards urbanization is **accelerating** – over 80% of the Canadian population lives in urban centres.
- **To accommodate growth**, cities must invest in infrastructure in sustainable ways.
- As a result, rural regions will need to assess their strengths, and invest in them, in order to continue to attract newcomers.
- Six major urban centres exist in Canada, concentrated around Toronto, Montréal, Vancouver, Ottawa-Gatineau, Calgary and Edmonton receive the bulk of immigrants and investment.

Source: UNESCO. Global Trends Towards Urbanization (2010).



City populations are growing by 65 million per year, which is equivalent to seven new Chicago’s every year.

Source: McKinsey. Urban world: Mapping the economic power of cities (2011).



Climate Change

- Global temperatures are forecast to continue to rise, following 17 of the 18 warmest years on record that have occurred since 2001.
- The intensity, frequency and duration of major events like hurricanes and forest fires are expected to increase.
- The changing global climate is pushing firms to reduce waste and produce goods and services in more sustainable ways.

Source: NASA: Climate Change and Global Warming (2018).



The average sea level is expected to rise one to four feet by the year 2100.

Source: NASA. Climate Change and Global Warming (2018)



With current global trends in diets and population, 60% more food will be needed in 2050.

Source: Food and Agriculture Organization of the United Nations (2012)



These trends in the global economy are pushing firms and jurisdictions to change



Globalization

- **Expanding international flows** of goods, services, finance, people and data make for a more globalized world. This trend continues to magnify the competition for capital, talent and high-value business activity.
- **Increased competition** due to vastly more powerful communication technologies and more readily available data and information.
- **Emerging competitors are no longer merely the low-cost suppliers** of services and manufactured goods. They are using education, research and the commitments of their governments to innovate and create value quickly.

Source: Business Council of BC. Innovation for Jobs and Productivity (2016).

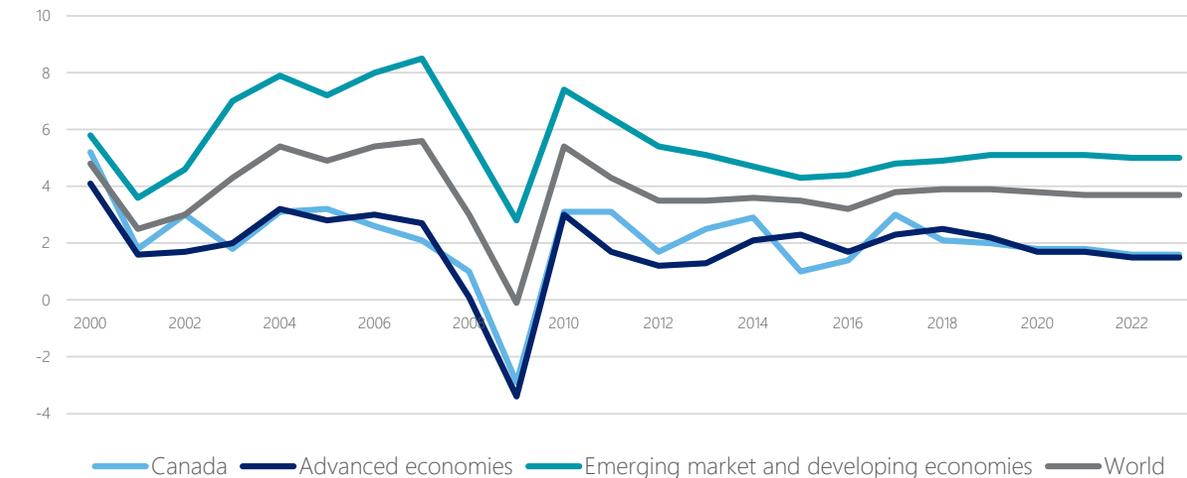


Total value of global exports of goods and services have increased by about 15,000% since 1961.

Source: World Bank. Exports of Goods and Services (2018).



Real GDP growth, by region



Source: OECD Economic Outlook: Statistics and Projections (2018).

The global economy is slowing down (especially in developed economies), with an average annual GDP growth rate of 3-4% from 2016-2022 (down from 6% in 2006).

The growth rate of advanced economies is limited

- As advanced economies mature, they must find more creative ways to boost growth.
- Regions should look for new ways to generate economic activity, such as through increasing productivity to get greater outputs for fewer inputs.
- Innovation facilitates an increase in productivity – meaning an increase in outputs per input.

Why does GDP matter?

- Real GDP growth is related to rising incomes, which have a critical role in maintaining and improving living standards.
- If real GDP is slowing, it means income growth is likely weakening – and expenditure growth is also slowing.
- Slower overall GDP growth translates to slower increases in living standards and, with slower growth in public revenues, limited financial resources for governments.



Emerging technologies will continue to change the shape and pace of global business

Emerging technologies will impact every business – irrespective of size, sector or geographic region. The development and application of these technologies is accelerating at an exponential rate.

Advancing technologies have been disrupting the nature of work and society for centuries.

19th century: The Industrial Revolution introduced new and innovative manufacturing processes.

20th century: Electrification, automobiles, and mass production.

Today

Innovation is currently being driven by emerging technologies, which will bring significant and permanent change to the landscape of global business. Some of the most significant emerging technologies include:



Networks

Integrated Services Digital Networks enable voice and data to be transmitted simultaneously – this has improved internet and mobile connectivity, as well as online commerce and social media.



Collaborative and Connected Platforms

The internet facilitates communication and collaboration, increasing connectivity and making crowdsourcing, crowdfunding and cloud computing possible. It also gives people and organizations the ability to access skills, knowledge, funds and resources in new ways.



Advanced Manufacturing

With new manufacturing methods like 3D printers, nanomaterials, biomaterials, rapid prototyping and custom product creation – the ability of businesses to produce custom-made, high quality goods quickly and cheaply is quickly changing traditional manufacturing models and supply chains.



Advanced Robotics

Although robots have been used by manufacturers and other businesses for decades, the increasing rate at which robotics are being developed is replacing the need for humans to perform highly repetitive tasks.



Blockchain

Blockchain technology is emerging as a business focus in several industries, including consumer products, manufacturing, financial services, health care, life sciences and the public sector. Blockchain offers heightened trust, immutability, transparency and security along with time and cost efficiencies.



Artificial Intelligence

AI has become a multi-disciplinary field that includes computers and robotics, as well as computer science, mathematics, neuroscience, linguistics and psychology. The prevalence of AI has increased as has the capability of machines to process more information at very fast speeds.



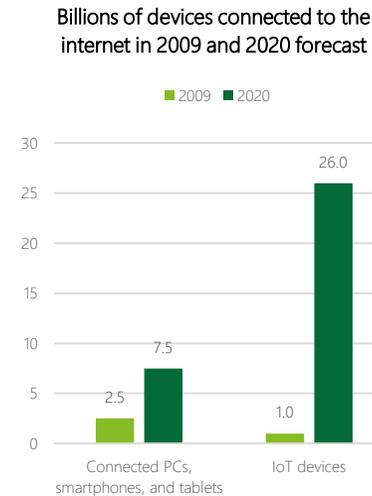
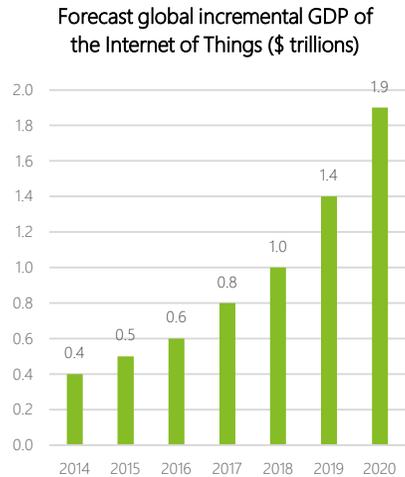
Networks and Collaborative Platforms are changing how we connect and collaborate



Networks

- The world's digital **networks continue to grow in size and capability** as the number of connected devices continues to increase. With more servers, personal computers, mobile devices and sensors of all kinds connected to the internet (and to each other), the Internet of Things (where computing devices are embedded within everyday objects) is shaping how people interact with the world around them.
- Gartner forecasts that the global incremental value (or GDP) of the Internet of Things (IoT) will grow \$1.9 trillion by 2020.

Source: Deloitte Insights. Age of Disruption (2015).



What are the implications?

- Rapid shift in customers' expectations around responsiveness and tailored offerings.
- Concerns around data security and privacy are likely to rise. Companies will be under growing pressure to ensure they use customer data responsibly.



Collaborative and Connected Platforms

- For businesses, collaborative and connected platforms (like crowdsourcing or cloud computing) are **providing opportunities to tap into expertise and analytical capacity outside their organizations**.
- As internet capacity continues to increase and the number of people connected to it continues to grow, companies will use these platforms more and more.
- More and more companies are **using crowdsourcing to find solutions** to complex business problems quicker and cheaper than using traditional methods.
- Workers themselves are discovering that **these platforms enable more of them to work as independent contractors rather than remain with a single organization for years**.

Source: Deloitte Insights. Age of Disruption (2015).

Increasing average speed of broadband and mobile Internet in Canada



What are the implications?

- Rethinking of how work is done and of the workplace needed to support this new way of working.
- Increase in number of participants in the "gig economy".



Advanced Manufacturing and Robotics are changing the delivery of goods and services

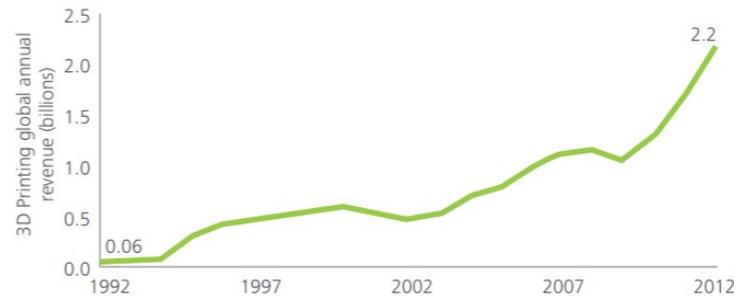


Advanced Manufacturing

- 3D printers, nanomaterials, biomaterials, rapid prototyping and custom product creation are quickly moving manufacturing away from traditional mass-produced, one-size-fits-all goods production.
- Increasing customization of products **will reshape the consumer goods industry** throughout supply chains.
- Advanced manufacturing is **also enabling companies to quickly produce, test and modify new products.**

Source: Deloitte Insights. Age of Disruption (2015).

Global industrial 3D printer sales from 1992 to 2012



What are the implications?

- Substantially greater customer choice and an expanding market for customized goods.
- The need to maintain large amounts of stock will be significantly reduced as made-to-order goods can be produced quicker and cheaper.

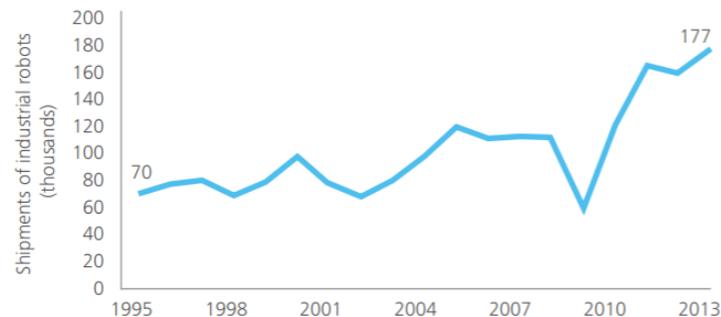


Advanced Robotics

- Today, robots perform numerous repetitive, high-volume tasks 24 hours a day. Over time, robots have been able to take on increasingly complex tasks.
- Robots can help companies to **lower labour costs, achieve higher productivity and consistently deliver high quality products.**

Source: Deloitte Insights. Age of Disruption (2015).

Estimated worldwide annual shipments of industrial robots from 1995 to 2013



What are the implications?

- As robots become more commonplace, businesses and governments will likely need to reconsider their traditional thinking about the labour force and the skills that markets will require in the future.
- Job impacts in the short run, with opportunities for employees to move towards better paying, more sustainable positions as they re-skill.



Blockchain is disrupting the way transactions are performed across markets

Blockchain

- Blockchain – digital transactions made in virtual currencies being recorded chronologically and publicly – allows for direct person-to-person transactions with applications across numerous industries.
- Blockchain is **rapidly evolving with the development of new platforms, applications, consortia and partnerships**. Many companies are collaborating with Blockchain start-ups and some of the large players are developing their own solutions.
- According to Gartner, “The [global] business value-add of Blockchain will grow to slightly more than \$176 billion by 2025, and then it will exceed \$3.1 trillion by 2030”.

Blockchain and its Applications Across Industries

-  Financial Services
 - International payments: faster, cheaper, more secure, lower risk.
 - Registry for better Know-Your-Customer checks and compliance.
-  Healthcare
 - Share clinical trial launches and enrollments in real time.
 - Smart contracts to connect different parties and automate transactions.
-  Public Sector
 - Registry to manage the digital identity of people and the ownership and transaction information on different assets.
 - Enhanced security and transparency of voting in public election.
-  Energy & Resources
 - Smart contracts for more efficient and faster execution of trades/payments.
 - Managing and recording Oil and Gas transactions and connecting different parties to improve supply chain processes.
-  Tech, Media & Telecom
 - Storing of original music, linked to digital identities of owners and using smart contracts for compensation.
 - Supporting data storage and interaction among a large number of devices.
-  Consumer & Industrial Products
 - Better management of loyalty points programs.
 - Streamlining vehicle purchase and leasing process.
 - Enhanced supply chain management, with traceability.

Sources: Deloitte Insights: Age of Disruption (2015) ; Deloitte Insights. Blockchain: A Technical Primer (2018).

What are the implications?

- Blockchain’s immutability increases the reliability of data and counterparties with reduced chances of fraud.
- Blockchain will help to democratize the exchange of value between parties by removing the need for traditional agents to manage transactions.



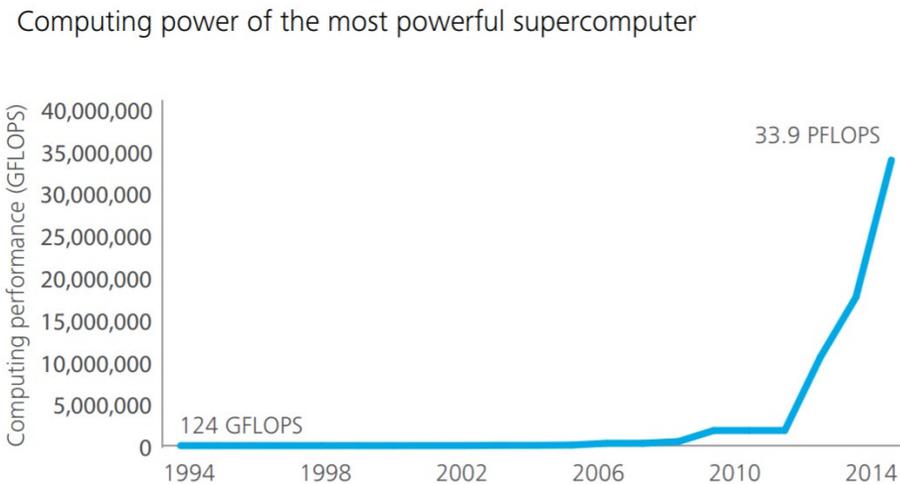
Emerging technologies will continue to change the shape and pace of global business



Artificial Intelligence

AI capabilities are based on raw computer processing power – and with the **price of servers, cloud computing and other computer architecture falling rapidly**, the use of AI technology will continue to expand.

- Between 2010 and 2013, the cost of the servers that comprise the most powerful AI supercomputer fell by at least 50%.
- AI engines can understand and process human language, and can evaluate arguments by parsing through relevant data from hundreds of millions of pages of structured and unstructured content.
- Today, the combination of cheaper processing power and a growing developer community is enabling AI to take on tasks such as diagnosing diseases and writing detailed legal briefs.
- Machine learning, statistical analysis and natural language processing allow AI to provide educated, evidence-based answers to everything from complex statistical problems to plain English questions.



Source: Deloitte Insights. Age of Disruption (2015).

What are the implications?

- Modern AI systems are now capable of displacing human workers in professional practices such as accounting, engineering and law, which have traditionally relied on the deep, narrow knowledge of experienced subject-matter experts.
- AI systems will provide businesses with the means to become much more efficient and to reduce their costs of doing business, as computers perform analytical tasks that once required dozens of workers (e.g., pricing optimization, portfolio optimization and claim predictions) – but faster, cheaper and more accurately.
- In the long-run, AI will increase the number of highly skilled, higher paying, more sustainable jobs.



The nature of the workforce is also being disrupted

The emergence of new digital and communications technologies are changing how businesses get their work done. The growth of the gig economy (more contract workers) and advances in robotics and Artificial Intelligence are changing who (or what) performs the tasks for each business. Further, the nature of work itself is being examined as a continually evolving marketplace drives organizations to explore new business models.

New realities in the future of work



Exponential Organizations

- Exponential Organizations can unlock the value presented by emerging technology and the availability of data. These organizations are expected to outpace their peers in the future.



Lifelong reinvention

- The productive years of workers are lengthening and these workers require lifelong learning to maintain skills.
- Longer lifespans are challenging traditional ideas about careers, retirement and work-life balance.



Unleashing the workforce

- Factors such as the growth of freelancing, mobility, crowdsourcing, automation and gamification have unleashed the workforce, freeing it from the bounds and constraints of traditional workplaces.
- This broadening of available talent gives employers an opportunity to engage in a multi-channel workforce strategy that leverages a mix of traditional full-time employees, contractors, freelancers, crowds and robots.



Technology, talent and transformation

- The falling cost of automation, rising use of Artificial Intelligence and the rise of human-machine collaboration have created a new reality of transitions for workers. This reality presents the opportunity to reimagine the economic value of work through the increased productivity that human-machine collaboration can bring to the workplace.



Ethics of work and society

- The evolving clash between traditional conceptions of work, societal values and public policy will likely shape the limits and conditions placed on future organizations. Artificial Intelligence and job market fragmentation could produce significant shifts, changing how we think about work, what is valued at the workplace and what is valued by society.
- In particular, worker demands are pushing organizations to focus on worker interests—such as the effect of some technology applications on workers' well-being—along with broader social benefits. New policies and programs might eventually be needed to balance organizational interests with the need to protect workers from the emerging uncertainties of new working environments.

What are the implications?

- More flexible working arrangements, with people participating in the gig economy, and a greater pool of talent for businesses to access.
- Firms can become more productive while reducing their operating costs.
- Individuals will be able to remain in the workforce for longer, facilitated by flexible working arrangements. This could be beneficial considering BC's aging population.
- A reduction in highly-repetitive, low-skilled jobs is offset in the long-run by an increase in demand for highly-skilled, highly paid, sustainable positions.



Global trends have local impacts

Key takeaways

1. Emerging trends in the global economy provide opportunities for nimble jurisdictions, ambitious companies and entrepreneurs, but also pose potential risks for regions and organizations that are slow to move or resistant to change.
2. BC should be prepared for the disruptive technologies that are likely to impose substantial changes to its business landscape.
3. No matter the sector in which a business or employee resides, they will be affected in some way by the trends listed below (with every sector enabled by technology).

| | | | |
|---------|---|--|--------------|
| Impacts | <p>1. Aging Demographics The aging population is shrinking today's workforce. However, this impact is softened by people adapting longer "work-life" tenures.</p> | <p>An increase in work lifespan will not offset BC's aging population. The total workforce will decrease if other inflows (such as immigration) are not increased.</p> | Implications |
| | <p>2. Technological Disruption The rise in demand for 24/7 connectivity is increasing technology-human collaboration and creating an immense amount of available data.</p> | <p>Emerging technologies are increasing flexible work arrangements; improving the potential for productivity at firms without increasing operating costs; and, in the long-run, increasing the number of high-paying, highly skilled jobs available.</p> | |
| | <p>3. The Future of Work Sourcing strong talent is becoming progressively more important as businesses begin to see the need to fulfill positions in emerging fields.</p> | <p>Changing workplace dynamics mean individuals will remain in the workforce for longer, along with more employees being engaged in flexible work arrangements. Firms will be able to source more diverse and skilled talent from a range of sources, without being confined by borders.</p> | |
| | <p>4. Urbanization To satisfy growth, investments in infrastructure should now consider both the need to maintain green space in urban centers and the need to develop less populated regions.</p> | <p>Individuals are increasingly locating in metropolitan centres like Vancouver, which means smaller municipalities and towns will see talent leaving their populations. Rural areas will need to review and reinvest in their strengths.</p> | |
| | <p>5. Climate Change Prevalence of extreme climates across the world is calling for further improvements in clean technology and counteractive measures.</p> | <p>The effects of climate change highlight the need for innovation—particularly innovation that reduces waste and consumption, and also improves productivity and operational efficiency.</p> | |
| | <p>6. Globalization As global competition continues to increase, the entire world becomes a marketplace for every business.</p> | <p>Heightened globalization means BC should evaluate its strengths and weaknesses and develop a coordinated innovation strategy in order to remain competitive.</p> | |
| | <p>7. Global Economic Slowdown There is a general growth slowdown as advanced economies reach maturity, pushing regions to look for new ways to generate economic activity.</p> | <p>The overall slowdown in the global economy means slower international demand for BC's goods and services, pushing BC to find ways of becoming more productive.</p> | |

4: What it all means for BC

BC should consider the whole picture when looking to the future

Innovation allows regions to remain agile in order to stay competitive, and be adaptive to the exponential changes that characterize modern economies.

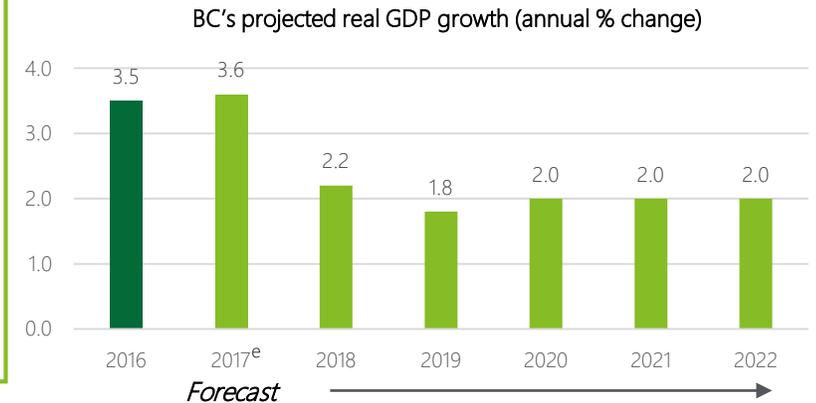
Innovation leads to:

- A stronger and more competitive economy
- Society able to solve complex challenges
- Increased numbers of high-paying jobs over time
- More collaboration and partnerships
- Improved quality of life

Past successes are not an indicator of future performance, particularly in a world where changes are now happening at an exponential rate.

Innovation allows regions to remain agile to stay competitive, and be adaptive to exponential change.

BC's economy has been doing well lately, but slower growth is expected in the coming years.



Sources: BC Ministry of Finance. Q1 Report (2018/19); Statistics Canada. Table 36-10-0222-01.

Global trends shaping economic changes



Aging Demographics: The demographic trends affecting BC are shaped by an aging population, slower labour force growth and an increase in the productive years of workers.



Technological Disruption: Connected citizens, businesses and things; big data; increasing mobile phone adoption; enhancing human-technology collaboration; exponential technological change; and emerging technologies are driving digitization and disruption.



The Future of Work: The workforce has a changing demographic makeup, and firms are seeing an increase in the gig economy. The emergence of automation, AI, big data and the Internet of Things combined with an increased focus on ethical standards will shape the workforce of the future.



Slowing Global Growth: Advanced economies are mature and must look to new sources of economic growth to remain competitive.



Urbanization: There has been an acceleration towards urbanization, as populations increasingly conglomerate around metropolitan cores.



Climate Change: A changing climate is pushing businesses to reduce waste and consumption and become more productive with their inputs.



Globalization: there is an increase in global competition as international movement of goods, services and people are expanding. This is combined with emerging competitors that are no longer merely low-cost suppliers.

Key takeaways

1. Emerging trends in the global economy provide opportunities for nimble jurisdictions and ambitious companies and entrepreneurs, but also pose potential risks for regions and organizations that are slow to move or are resistant to change.
2. BC should be prepared for the disruption in technology that is likely to bring profound change to BC's business landscape.
3. Focus areas include: (1) exploring ways to tap into different parts of today's talent continuum, (2) placing strategic longer-term bets, and (3) engaging in a broader societal narrative.
4. No matter what sector you are in, you will be disrupted by these trends; and every sector will become a tech-enabled sector.

BC's innovation ecosystem - where it does well (and where it can improve)

- Ideas**  BC is home to world-class research universities. While BC's level of investment in R&D is reasonably sound compared to other provinces, it is lower than some other leading jurisdictions. As ideas are the starting point for innovation, investment in R&D will assist in boosting BC's performance in this area.
- Customers**  BC's income levels are slightly below the Canadian average, and British Columbians carry a substantial amount of household debt (which could limit their spending power). However, relative to other Canadian provinces, BC has a diverse mix of international customers for its commodities, services and manufactured exports – helping to insulate the provincial economy against instability in any one specific trade partner.
- Collaborators**  BC has a growing network of organizations working to mentor, connect and foster collaboration between firms and other groups looking to innovate together. These entities are concentrated in Vancouver (e.g. BC Tech, Life Sciences BC, Innovate BC), but are also located in other parts of the province (e.g. Accelerate Okanagan, Innovation Island). While these organizations play a critical role, they receive a relatively low amount of public funding and have a small footprint in outside Vancouver. Further, BC would benefit from an overarching strategy to enable collaborators to create synergies and expand the reach of their networks.
- Talent**  BC has a relatively high proportion of well-educated workers with postsecondary degrees, but also has a large population of workers with high-school education or less. As more work processes become automated and demands for technical skills increase with emerging technologies, the need for lower-skilled labour is likely to decline – with many underskilled workers in BC potentially getting left behind. BC also has a substantial talent gap in its high-tech industry, limiting the ability for many emerging technology firms to survive and thrive.
- Capital**  BC performs fairly well on total capital investment in its firms compared to other provinces, However, the low rate at which small businesses grow into large firms suggests that access to capital may be somewhat constrained relative to other jurisdictions that have capital supply on a substantially larger scale. On the other hand, it is possible that most BC firms are not as successful as those in other places at competing for capital dollars.
- Firms**  BC is great at creating small firms, with the province having a robust number of start-up companies in a variety of sectors. However, BC's start-up companies have a difficult time growing into larger firms, with only a small number of BC's one million+ companies reaching more than 200 employees. While this issue is not unique to BC, a talent shortage at the C-suite level limits small firms' ability to scale and have more substantial impacts in their respective markets. A stronger level of business acumen among managers in growing firms could help more small firms get big.

BC's innovation ecosystem - where it does well (and where it can improve)

Access to markets



BC is situated geographically close to Asian markets compared to other provinces and US states – making for quicker marine and air transportation of goods relative to its neighbours to the south. Further, the expansion of ports in Vancouver in Prince Rupert will help get more of BC's commodity exports to growing Asian markets.

Enabling policy framework



The BC Government maintains low tax rates for corporations, small businesses and individuals and provides funding for its research universities. However, there are no specific incentives targeted at helping businesses grow to become large entities and BC's level of public investment in Innovate BC substantially lags its counterparts in other provinces. BC's innovation ecosystem could also benefit from an innovation strategy developed in concert by government, industry and academia.

Culture



The province has a strong entrepreneurial spirit in its business community. In addition, BC's moderate climate, natural beauty, strong economy and livability attract members of the 'creative class' to the province. However, the high cost of living (in Vancouver especially) limits BC's ability to attract and retain talented people to work and live here.

Infrastructure



BC has an extensive network of road, air and marine transportation to help move goods and people around, in and out of the province. BC is also well-connected to the internet (but has some connectivity challenges in rural areas and somewhat slow internet speeds), having the second-highest proportion of residents connected among Canadian provinces. Like most of Canada, BC has a small population on a large land mass, making it more challenging for people to co-locate outside of Vancouver. In addition, residents also face the highest public transportation costs in the country, hindering the ease of commuting around the region.

5: Recommendations

The course toward a more innovative BC can be charted with some of these changes



Create incentives for small firms to scale up – becoming large firms over time

- Large firms create many high-paying jobs – measures to encourage more small firms to scale-up could help increase the number of large companies.
- Initiatives aimed at improving the management expertise of firms can assist in helping more small firms get bigger.



Invest in building talent (especially in the high-tech sector)

- BC lags in STEM graduates – encouraging more of these will help fill the growing talent gap among BC's innovators (primarily in the high-tech sector).



Incentivize R&D spending and commercialization by businesses to get more ideas into the market

- BC has some great ideas and several world-class research centres – more funding into R&D would increase the likelihood of more great ideas. Support for the commercialization of great ideas will help get these ideas into global and domestic markets.



Maintain a low-tax business environment, including maintaining any capital investment incentives

- BC has a competitive tax regime – maintaining this will help BC's successful businesses remain in the province.

The course toward a more innovative BC can be charted with some of these changes



Continue public investment in higher education, infrastructure and marketing abroad

- Public investment in research universities and infrastructure (both physical and digital) should continue to keep up with the pace of global change.
- To further diversity its customer base, BC can actively promote its exports of good and services to other geographies.



Focus on sustainable business practices

- The changing global climate is pushing businesses and citizens to reduce their waste and become more productive. Education and incentives to focus efforts of British Columbians to move their practices and habits in this direction could accelerate a rise in more sustainable behaviour.



Ensure that lower-skilled workers affected by disruptive change are re-skilled to meet the demands of a more innovative economy

- Current trends in global growth, technology and the structure of the labour force can have significant effects on underskilled workers. It is important to ensure those workers receive the right training to meet the needs of the evolving economy.



Develop an innovation strategy, with commitment from government, business/industry and academia

- A coordinated policy program developed and executed alongside major stakeholders stands a greater chance of success in making BC more innovative than if public programs are designed and operated independently.
- Leverage the opportunity presented by the BC-based Canadian Digital Technology SuperCluster.

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