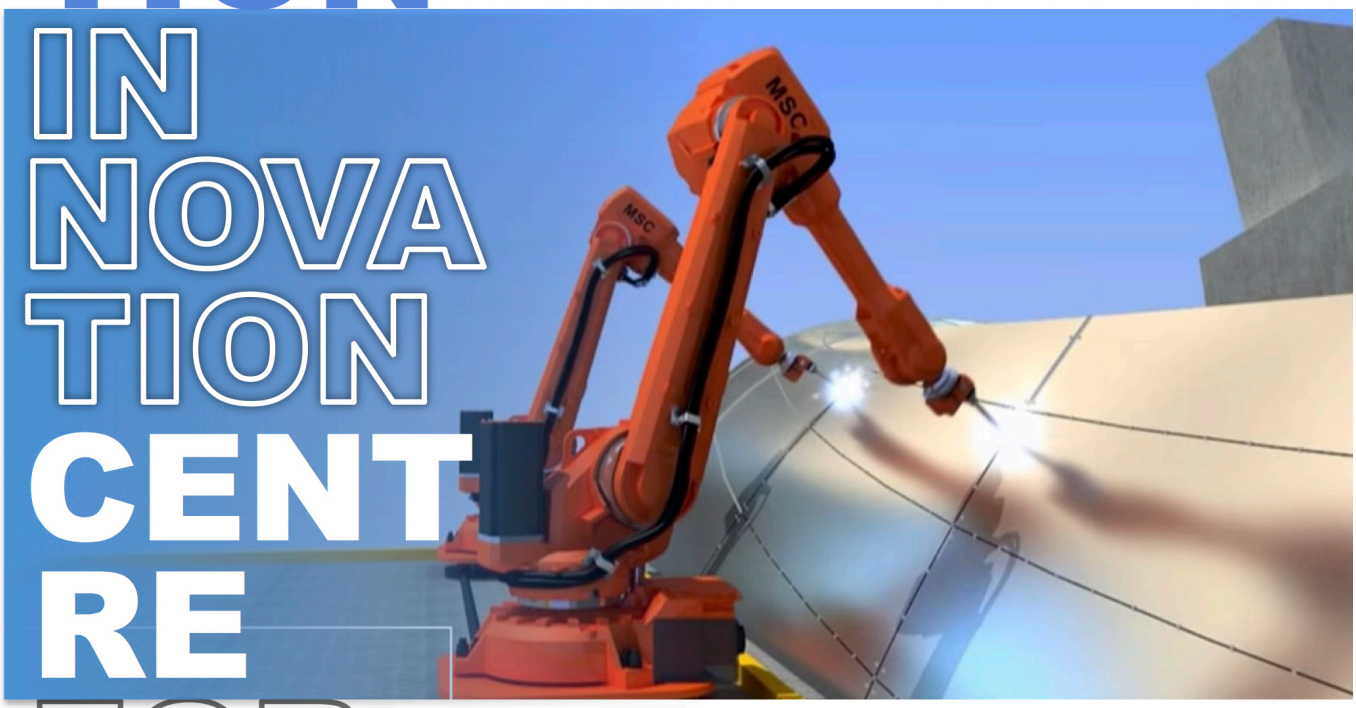
CONSTRUCTION INNOVATION CENTRE FOR BC



Feasibility Study

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Executive Summary

This study demonstrates the feasibility of a construction innovation centre sufficient for an industry advocacy organization (individually or in partnership) to gather the support and funds necessary to host and launch the programs and services that industry stakeholders need to foster a culture of innovation.

By fostering a culture of innovation, BCs construction industry will advance in the following 5 ways:

1. **Leadership** – A cohesive industry that embraces and celebrates innovation
2. **Performance** — A responsible industry that continually improves projects' economic, environmental and social performance
3. **People** – A talented industry that attracts a skilled, technologically-savvy workforce
4. **Growth and resilience** – An efficient, competitive and profitable industry that drives economic growth
5. **R&D** – An advanced industry that develops and implements innovative new products, processes and business strategies.

Centre mission

Believing that harnessing innovation is a critical factor for the survival and prosperity of BC's construction industry, a construction innovation Centre will bring about the transformational change required by industry and society by catalyzing the adoption of innovative construction processes, technologies, materials and business strategies.

The proposed mission would be achieved by fulfilling the following goals:

- **Accelerate** the adoption of innovative practices and technologies in BC construction industry by acting as a bridge between industry, R&D centres and industry stakeholders.
- **Build** on the power of BC's existing incubator and accelerator programmes and work together to foster innovation in the construction industry.
- **Boost** B.C's high-potential start-ups by providing access to one of BC's largest markets
- **Promote** open innovation by establishing new networks and facilitating collaboration and integration across the construction supply chain
- **Support** regional industry advocates in advancing innovation in their communities
- **Stimulate** BC's construction economy and help to protect it against future uncertainty
- **Help grow** BC's technology workforce and enable the construction industry to be a major source of rewarding, diverse and exciting careers.
- **Help businesses be ready** to deliver the economic, environmental and social performance of buildings expected by governments and communities.

The region that develops the next generation of tools and services can target global markets not just regional ones. Indeed, the pressure to improve productivity, resource efficiency and project performance is driving construction firms to not only adopt innovative practices but also be dexterous in the use of new technologies.

Not only can a more efficient, productive and profitable industry tap into significant opportunities locally but also improve its access to other provincial and international markets. However, innovation in construction is applicable to a very wide range of materials, technologies and processes - making the task huge and complex. The industry also lags behind other major economic sectors of BC's economy when it comes to innovation investment and support. Pressures for the BC construction industry to innovate include:

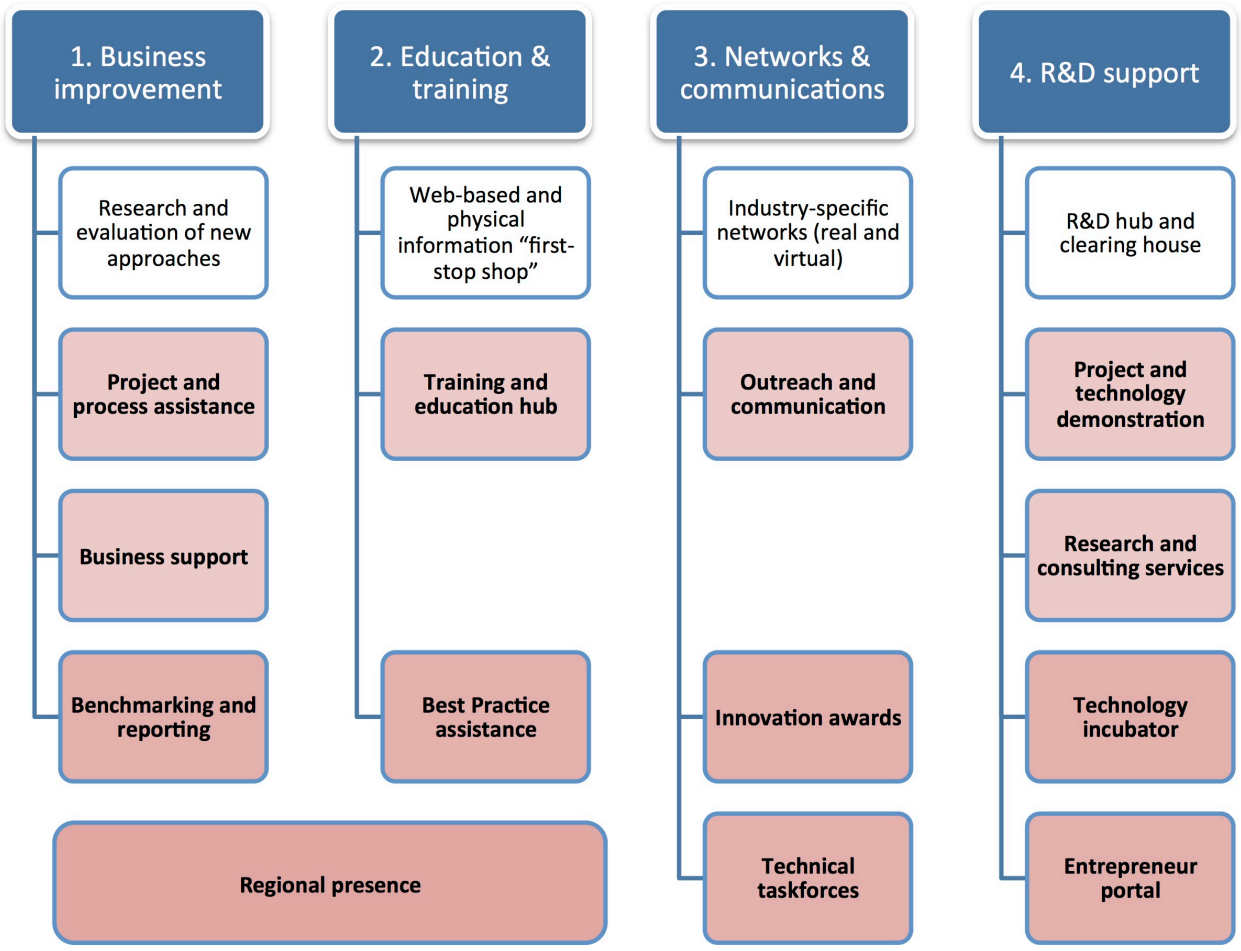
- BC's population is expected to increase by 1.1 million people over the next twenty years
- Aggressive green building and climate policies
- Shortage of skilled workers and rising materials costs
- Housing affordability and quality
- Infrastructure deficit
- Cleantech investment and "green" jobs are top economic development priorities for government

The construction industry's size and unique characteristics point to the necessity for a dedicated sector-specific solution to catalyzing innovation. For this study, the Centre is envisioned to serve as an arms-length R&D team and "first-stop shop" for all aspects of innovation, funding and technical / educational / business support to:

- Help construction companies to research, develop, test, commercialize and adopt products and services essential to its future.
- Tighten the construction value chain, improve communication and encourage collaboration
- Help businesses build an innovation-focussed organization / culture
- Provide the training and skills development, business and technical support and resources for companies of all sizes to realize the benefits of these new technologies and to compete effectively in a rapidly evolving market.
- Identify new services and markets for BC companies
- Support policy makers as they strive to improve the performance of buildings
- Provide collaborative networks of researchers to optimize R&D efforts for BC
- Support the ideation and pre-commercialization process by creating a "front door" for researchers, entrepreneurs and investors into the construction industry.

The Centre will identify problems that, if solved, will lead to significant market opportunity for both construction businesses and entrepreneurs. The activities are intended to address the problems and challenges facing BC construction companies and bring about the transformational change required by industry and society by catalyzing the adoption of innovative construction processes, technologies, materials and business strategies.

Centre programs and services



There are R&D centres in many regions of the province but particularly in Vancouver, Victoria, Kelowna and Prince George. A distributed "hub and spoke" model" for the centre is recommended as the optimal path forward. An existing organization that can leverage substantial networks, is held in high regard by industry stakeholders and is present in multiple locations across the province would make the best project "host".

The 5 year budget for the centre to deliver all the recommended programs and services in four locations would be about $9m with $5 - $6.3m from corporate sponsorship, project grants, government and/or foundation funding and the remainder from self-generated revenues (fees, royalties, etc.). A major source of potential funding is Western Economic Diversification Canada, which is expected to hold its next proposal call in Fall 2016.

The next step is for a host organization to gather letters of support from key stakeholders and prepare funding applications. The timing of the development of a construction innovation Centre is good. Innovation is a hot topic. Companies of all sizes are discussing how they can capture the benefits of new ideas and solutions to produce better buildings, faster and cheaper while improving their bottom lines.

Contents

Introduction

As a $16 billion dollar industry, construction provides 8 per cent of BC's wealth and employs more than 200,000 workers, making it BC's largest employer. Innovation is vital for the continued prosperity not only of BC's construction companies and the economies that support it but the province as a whole.

Innovation can be defined as the successful introduction of new technologies or procedures into industry. Innovation is vital for long-term economic growth and competitiveness for any industry. According to the OECD, long-term economic growth depends upon "building and maintaining an environment that is conducive to innovation and the application of new technologies."[1]

Compared to other industries, construction remains largely locally focused, undiversified and with relatively small export markets. Innovative approaches are needed to reduce capital construction costs and timelines, minimize adverse environmental impacts, increase the number of projects completed on time and within budget, and reduce the number of defects and accidents.

If innovation in construction is going to take hold in Canada, then BC is a good place to start. BC is arguably Canada's most unique market when it comes to construction. Climate, the potential for earthquakes, a passion for all things green and a facility for building with wood are a few factors that set BC apart. BC designers, builders and policy makers are comfortable with being first. BC is home of the first LEED projects in Canada, the first Passive House projects and the first tall wood buildings.

So what will it take to catalyse innovation in one of BC's largest and most important industries? This feasibility study looks at best practices in similar markets and sought input from industry experts to help develop a model for an innovation centre specifically for BC's construction industry.

This study is intended to demonstrate the feasibility of an innovation "centre" so that an industry advocacy organization (individually or in partnership) can move forward with confidence to develop the support necessary to host and launch the programs and services that industry stakeholders need to foster a culture of innovation.

CHAPTER 1 The opportunity

1.1 Centre vision, mission and goals

Believing that harnessing innovation is a critical factor for the survival and prosperity of BC's construction industry, a construction innovation "Centre" will bring about the transformational change required by industry and society by catalyzing the adoption of innovative construction processes, technologies, materials and business strategies.

By fostering a culture of innovation, BCs construction industry will advance in the following ways:

1. **Leadership** – A cohesive industry that embraces and celebrates innovation
2. **Performance** — A responsible industry that continually improves projects' economic, environmental and social performance
3. **People** – A talented industry that attracts a skilled, technologically-savvy workforce
4. **Growth and resilience** – An efficient, competitive and profitable industry that drives economic growth
5. **R&D** – An advanced industry that develops and implements innovative new products, processes and business strategies.

The vision will be fulfilled by achieving the following goals:

- **Accelerate** the adoption of innovative practices and technologies in the BC construction industry by acting as a bridge between industry, R&D centres and industry stakeholders.
- **Build** on the power of BC's existing incubator and accelerator programs and work together to foster innovation in the construction industry.
- **Boost** B.C's high-potential start-ups by providing access to one of BC's largest domestic markets
- **Promote** open innovation by establishing new networks and facilitating collaboration and integration across the construction supply chain
- **Support** regional industry advocates in advancing innovation in their communities
- **Stimulate** BC's construction economy and help to protect it against future uncertainty
- **Help grow** BC's technology workforce and enable the construction industry to be a major source of rewarding, diverse and exciting careers.
- **Help prepare** businesses so they are ready to deliver the economic, environmental and social performance of buildings expected by governments and communities.
- **Earn** the goodwill of British Columbians as a vibrant, diverse and forward-looking industry with boundless career opportunities.

1.2 Rationale

The region that develops the next generation of tools and services can target global markets not just regional ones. Indeed, the pressure to improve productivity, resource efficiency and project performance is driving construction firms to not only adopt innovative practices but also be dexterous in the use of new technologies. With virtual tools, the construction industry is borderless. The consequence of doing nothing exposes BC businesses to the risk of increased competition from automation as well as from overseas companies. A backward looking industry that is resistant to change will also find it increasingly difficult to compete for young skilled workers and to protect itself from resource price shocks.

The scope of innovation in the construction industry is very broad and applies to everything from building products, materials and systems to construction techniques, equipment and business operations (Figure 1).

Figure 1 The four categories of innovation (source: OECD)[2]

1. **A product innovation** is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics. Product innovations can utilize new knowledge or technologies, or be based on new uses or combinations of existing knowledge or technologies.

2. **A process innovation** is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software. Process innovations can be intended to decrease unit costs of production or delivery, to increase quality, or to produce or deliver new or significantly improved products.

3. **A marketing innovation** is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing. Marketing innovations are aimed at better addressing customer needs, opening up new markets, or newly positioning a firm's product in the market with the objective of increasing sales.

4. **An organizational innovation** is the implementation of a new organizational method in the firm's business practices, workplace organization or external relations. Organizational innovations can be intended to increase a firm's performance by reducing administrative costs or transaction costs, improving workplace satisfaction (and productivity), gaining access to non-tradable assets (such as non-codified external knowledge) or reducing costs of supplies.

To chart a course forward, the BC Construction Association's 2016 BC Construction Innovation Project[3] identified the need to establish a Construction Innovation Centre, directed by a cross-sectoral industry leadership group that would include representation from consultants, contractors, academia, owners and governments. Founded on five pillars – Leadership, Performance, People, Growth & resilience and R&D – the report proposes a series of ambitions that, if fulfilled, will enable the industry to build state-of-the-art low carbon buildings quickly and affordably while boosting productivity and profitability. An innovative industry is a cool industry and investments in modernization will help construction companies provide a wealth of opportunities to a diverse and technically savvy workforce.

For this feasibility study, the Centre is envisioned to provide construction businesses of all sizes with as an arms-length R&D team and "first-stop shop" for all aspects of innovation, funding and technical / educational / business support to:

- Help the industry research, develop, commercialize and adopt technologies essential to its future.
- Tighten the construction value chain, eliminate "silos", improve communication and encourage collaboration
- Help businesses build an innovation-focussed organization / culture
- Provide training and skills development, business and technical support and resources so companies of all sizes can realize the benefits of new technologies and compete effectively in a rapidly evolving market.
- Identify new services and markets for BC companies
- Support policy makers as they strive to improve the performance of buildings
- Provide collaborative networks of researchers to optimize R&D efforts for BC
- Support the ideation and pre-commercialization process by creating a "front door" into the construction industry for researchers, entrepreneurs and investors as well as feedback channels from the field.
- Showcasing the accomplishments of BC businesses

The Centre will work to identify problems that, if solved, will lead to significant market opportunity for both construction businesses and entrepreneurs. Many problems may be unique to BC, which has a long-standing reputation of being ahead of the curve when it comes to construction innovation in Canada. The challenges that BC companies are dealing with today are likely to be coming down the road for builders in other regions tomorrow.

The pressing needs to address climate change and population growth emphatically underscores the need for innovation in the construction sector. The immediacy and magnitude of these innovation drivers reinforces the necessity for the Centre to scale up as quickly as possible. At a local level, pressures for the BC construction industry to innovate include:

- **BC's population is expected to increase by 1.1 million people** (23%) over the next twenty years.[4]
- **Aggressive green building and climate policies**. The City of Vancouver will require all new buildings to be carbon neutral (achieving close to Passive House standards) by 2020 and the provincial government is reviewing the BC Building Code for opportunities to implement "step wise" reductions in energy consumption and GHG emissions. Metro Vancouver, Nanaimo and other regions are aspiring to divert as much as 80 per cent of construction and demolition waste from landfill as early as 2020.
- **Shortage of skilled workers and rising materials costs** are forcing all construction companies to do more with less. According to BCCA, 15,000 construction jobs in BC will be unfilled due to labour shortages by 2024 and 94 per cent of BC construction companies are planning to hire over the next 12 months.
- **Housing affordability and quality** in urban centres, rural and on-reserve is in crisis and governments at all levels planning major investments in innovative solutions to improve access to cheaper, better housing
- **Smart infrastructure spending**: the current federal government sees transportation expansion and improvement, energy generation and climate adaptation solutions as important to addressing a long-standing national infrastructure deficit.
- **Cleantech investment is a top economic development priority:** More than 200 BC companies operating in this sector generate over $2.5 billion in annual revenues. Many clean tech solutions are deployed in and

around the built environment and the construction industry is being pressed to participate pro-actively in advancing this important sector.

Not only can a more efficient, productive and innovative industry tap into significant opportunities locally but also improve its access to international markets. Indeed, the global economy requires 1 trillion in investments annually in order to build and maintain a sustainable global infrastructure. However, this will require significant amounts of resource consumption in a market of ever-increasing costs of materials and tightening talent supply. Innovation is necessary to support low carbon and resource efficient development.

According to the World Economic Forum[5], the Engineering & Construction sector has been relatively slow to adapt to the age of sustainable development. Yet, buildings can be a powerful force for good. Using available technology, they can sequester CO_2, generate energy, treat water, produce food and clean the air. They can be spiritually uplifting, serve as cultural markers and document defining moments in human history.

A reluctance to embrace emerging productivity-improving technologies such as drones, VR and 3D printing, along with a painful talent shortage, are contributing to their sluggishness in the face of growing demand. Figure 2 summarizes the drivers of innovation in construction. Fortunately, BC's economy has strong prospects for growth with low interest rates and an attractive corporate tax regime. The BC construction industry's leadership in green building is coming to the fore just at the moment when the world is looking to the built environment to mitigate environmental and social challenges.

Figure 2 Drivers of construction innovation

Societal demands and expectations

Changing needs and requirements from end-users, clients, governments and the general public. These include:

- Environmental sustainability and climate change
- Demographic changes
- Vulnerability and security
- Aspirations for improved quality of life
- Need for social license
- Urbanization and intensification

Market and business climate

Changing market conditions and business models. These include:

- Globalization of the business environment, with increasingly international supply-chains
- Availability and price ofland for development
- Competition and cost efficiency
- Growing demand from emerging economies
- Commodity, materials and energy costs

Workforce

Changing workforce needs and expectations. These include:

- Concern about reputation
- Attracting and retaining skilled trade and knowledge workers
- Health and safety of working conditions
- Aging workforce

Knowledge and technology

Changing technologies and practices. These include:

- Information, knowledge management and communication technologies
- New materials, methods, products and equipment

CHAPTER 2 The approach

The Centre's mandate will be to bring about the transformational change required by industry and society by catalyzing the adoption of innovative construction processes, technologies, materials and business strategies. Given that the industry has been slow to embrace innovation and the pressing need for change, it is imperative to do as much as possible as soon as possible.

Part information clearinghouse, part arms-length R&D department and part trusted advisor, the Centre will help businesses overcome the barriers to innovation and bridge the gaps among builders, research institutions, manufacturers and other key innovation actors. The Centre will provide a single-point of entry for accessing construction innovation information, business support, services and networks. While details still need to be developed, the suite of proposed activities are designed to fit within the priorities of major funders that have expressed interest in the Centre.

> "The key to driving innovation in any industry is collaboration. The objective is to demonstrate to businesses how they can turn ideas into invoices."
>
> **Stephen Good, CEO Construction Scotland Innovation Centre**

2.1 Mission-led programs and activities that will catalyze construction innovation

Centre activities are intended to address the problems and challenges facing BC construction companies and bring about the transformational change required by industry and society by catalyzing the adoption of innovative construction processes, technologies, materials and business strategies.

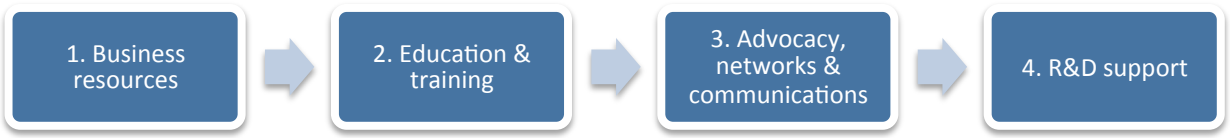
The Centre must establish a robust system for enable ideation and support pre-commercialization of new technologies and solutions. The ideal range of activities, programs and services has been distilled from looking at what has worked elsewhere supported by various consultation processes with industry leaders. The following best practice examples are detailed in **Appendix A**:

- Construction Scotland Innovation Centre
- The London Building Centre
- Centre for Construction Innovation (North West UK)
- Sustainable Built Environment National Research Centre, Australia

Input was sought from over 400 members of BC's construction industry during in the creation of the BCCA Construction Innovation project in 2015 and, additionally, 30 industry leaders and funders offered their thoughts and advice on the concept of a construction innovation Centre (**Appendix B**).

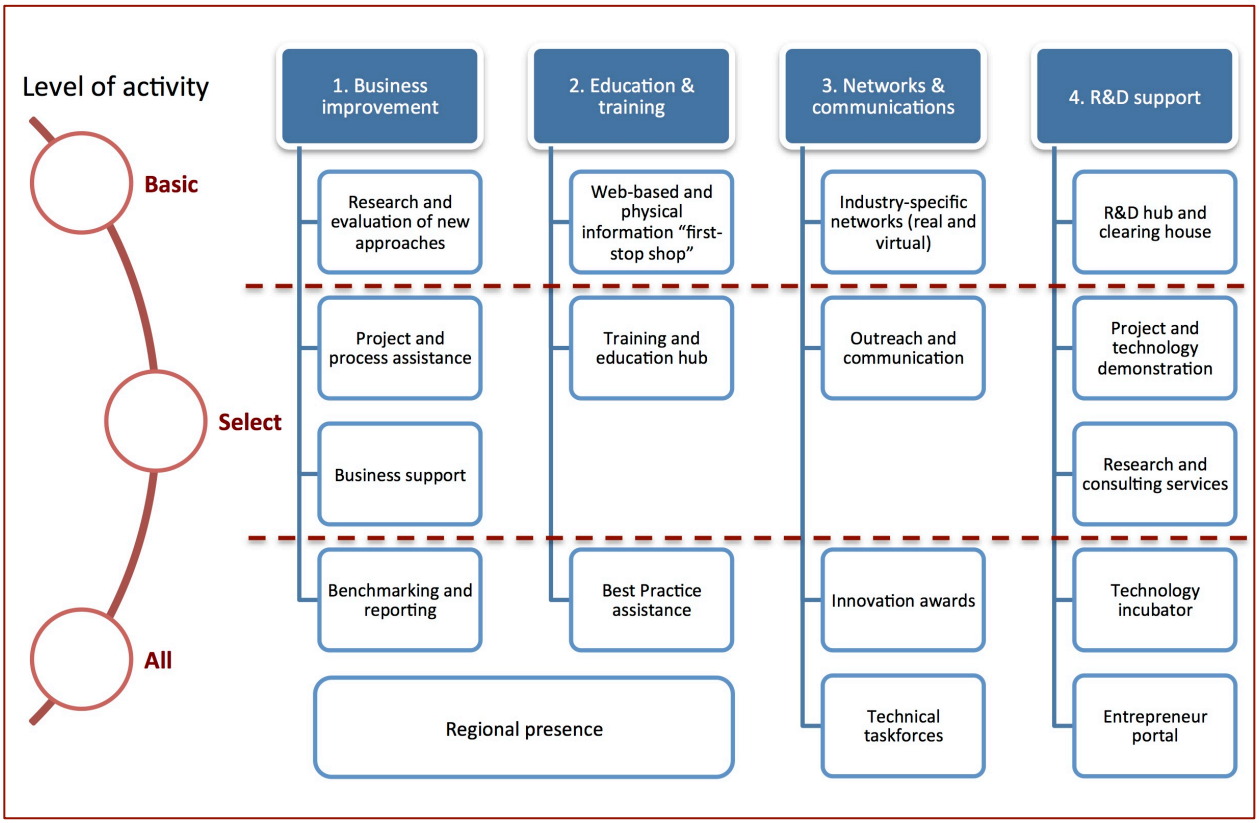
The approach to centre programming has been to develop a cohesive, holistic suite of activities and services that offers the greatest potential for delivering the maximum innovation benefits and therefore a direct response to the urgent need for the construction industry to foster a culture of innovation to be able to address the pressing needs such as climate change. The proposed activities fall under four categories (see Figure 3):

Figure 3 The four key areas of Centre activity



However, it is recognized that but can be phased and scaled up or down depending on available funding, resources and mandate of the host organization. The proposed activities can be scaled up in three levels "Basic", Select" and "All" in order of priority and ease of application (Figure 4). The levels of activity are discussed in more detail in Section 2.6.

Figure 4 Proposed centre activities organized by priority and ease of application



A logic model (Figure 5) has been used to summarize the proposed activities and how they will deliver short-term outcomes and long-term benefits (Figure 6).

Figure 5 Logic model for how proposed activities translate into long-term benefits

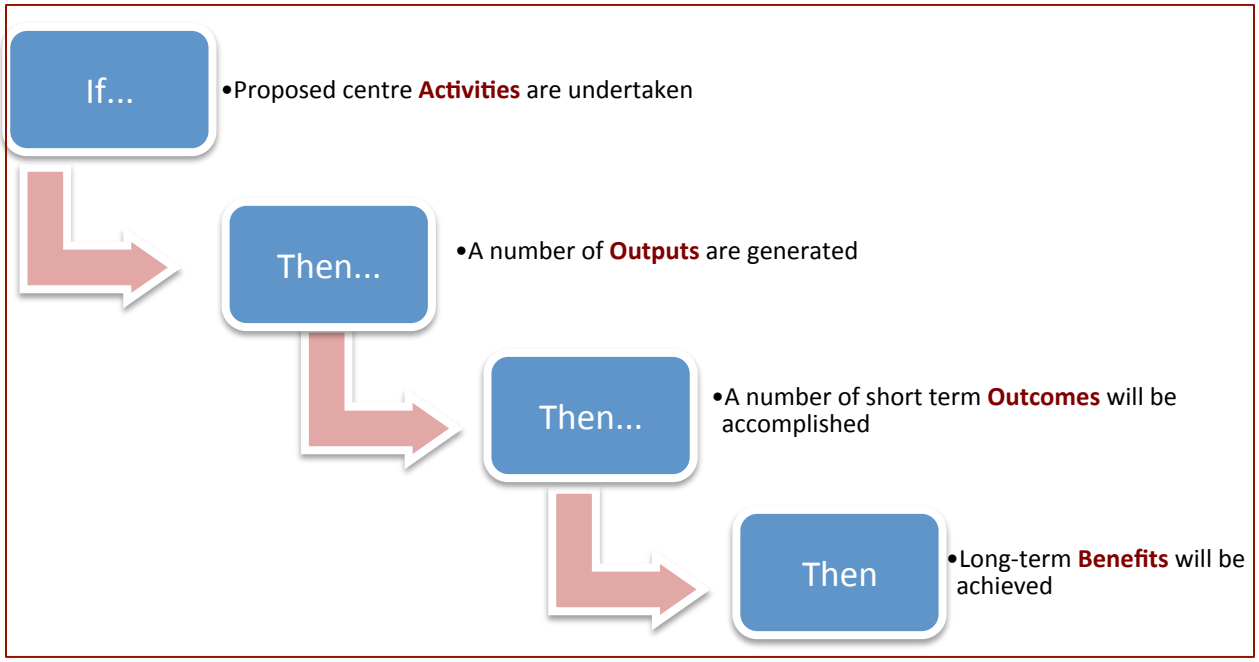
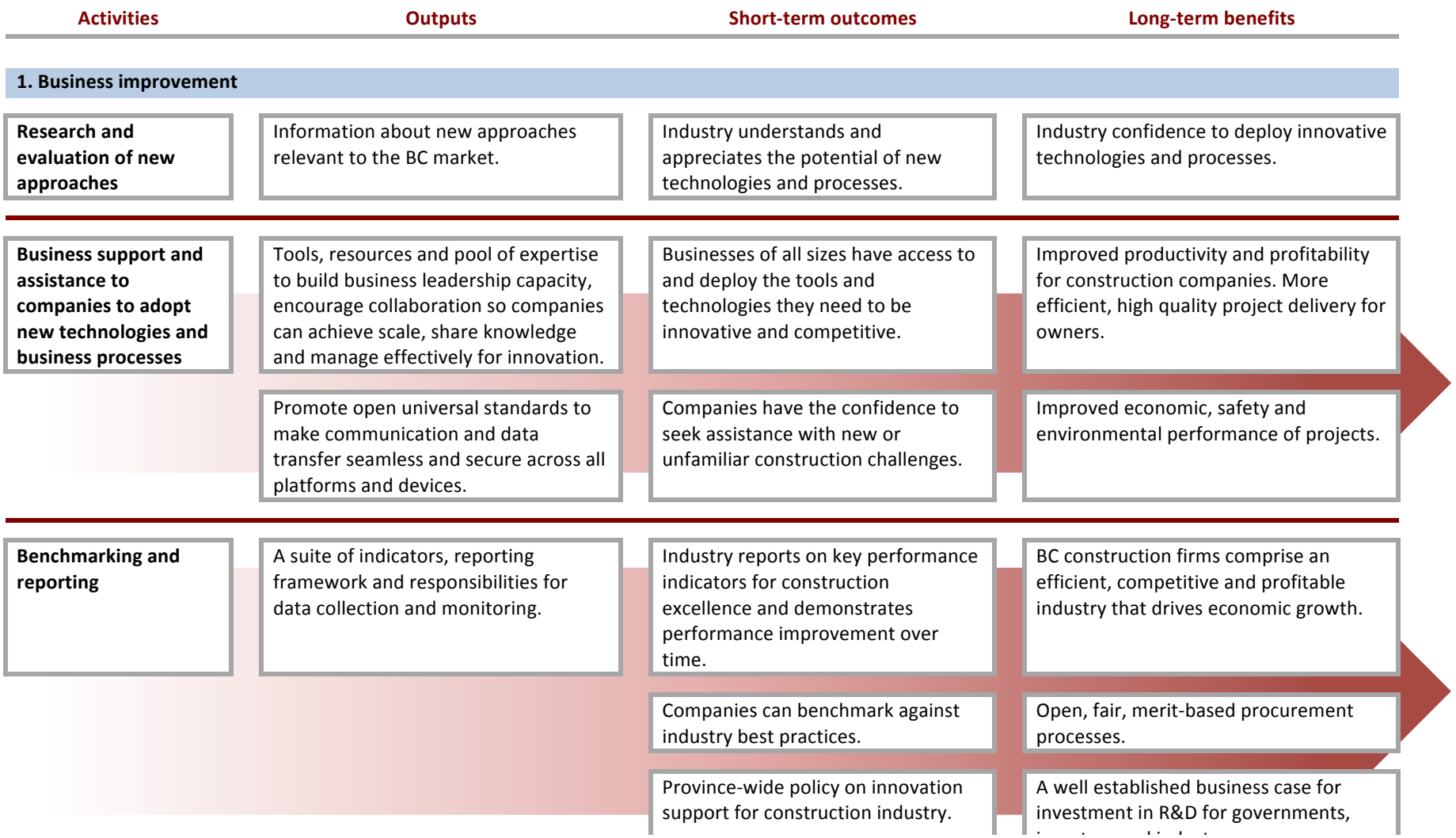


Figure 6 Activities, outputs, outcomes and benefits of a construction innovation Centre



Activities	Outputs	Short-term outcomes	Long-term benefits
2. Education & training			
Web-based and physical information "first-stop shop"	Easily accessible and up-to-date reference guides, technical information and educational materials.	Foster a culture of learning to develop an engaged and informed workforce.	Increase in the number green and technology jobs in construction companies in BC.
Training and education hub	Innovation-oriented curriculum and gap-filling education services.	Improved understanding of the value of innovation and the skills to adopt new technologies and processes.	An educated workforce that is able to deploy innovative design and construction methods that put quality first.
	Occupant and operator training to ensure buildings work properly and protect investments in innovation.	Businesses can acquire the full spectrum of skills necessary to create and implement innovative ideas successfully.	BC companies realize a return on investment in innovation via improved competitiveness.
Best Practice technical and business assistance (mentoring, consulting, etc.)	Help companies help themselves by providing peer to peer connection and sharing of ideas.	Improved project team collaboration and tighten the supply chain.	Improved integration across the supply chain and peer–to–peer.
Education needs analysis	Education and training needs assessment report.	In-depth understanding of current and future education and training requirements (curriculum, equipment, expertise, etc.).	Availability of up-to-date training facilities, equipment and support.

Activities	Outputs	Short-term outcomes	Long-term benefits
3. Networks & communications			
Industry-specific networks (real and virtual)	Sector-wide engagement in program and policy development, investment and procurement.	The conversation is kept alive with a series of “meeting of the minds” dialogues around the province.	A cohesive industry that embraces and celebrates innovation.
	Access to BC’s various export agencies to promote BC companies’ expertise to new markets.	Appearance of BC companies in international trade missions, promotional materials, etc.	Increased presence of BC companies in new markets.
Outreach and communication	Public engagement and stakeholder communication programs.	The many voices of the construction industry have a means of being heard.	Public misperceptions of the industry are shifted.
	An action-oriented innovation council to be the “voice” on innovation in construction in BC.	A clear and cohesive message about what innovation means to BC's construction industry.	Measurable improvement in projects’ economic, environmental and social performance.
	Procurement education and impartial support for owners.	A common language exists for how “innovation” should be described and interpreted in the bid process.	Owners seek a “quality-first” approach to procurement where life cycle costs and the value of design are recognized.
	Programs and resources aimed at improving the image and perception of the industry, recommend solutions.	Robust relationship with industry partners who help to profile local success stories, collect data and build a library of projects.	BC extends its proven track record of “being first” when it comes to innovative projects and as an international "shop window" for construction innovation.
	Recruitment messaging so that it explains the career development opportunities and the diversity of jobs available.	Accepted protocols are in place to mitigate adversarial behaviours and to minimize the underground economy.	Procurement structures meet client and industry needs and provide an equitable framework within which companies can innovate successfully.

Activities	Outputs	Short-term outcomes	Long-term benefits
3. Networks & communications (continued)			
Innovation awards	Promote awards and recognition programs for innovation.	Recognize and celebrate innovation "champions".	Companies act ethically and transparently to build a positive reputation and win work.
Technical taskforces	Participate in key dialogues about important issues and trends.	Construction companies keep up with and pro-actively address regulatory and business requirements.	BC construction companies are recognized as leaders in innovative building design and construction.

Activities	Outputs	Short-term outcomes	Long-term benefits
4. R&D support			
R&D hub and clearing house	An easily accessible information source and technical advice about innovative technologies, processes and best practice examples.	Construction companies are familiar with sustainable materials, technologies and processes	BC's construction industry is a responsible industry that continually improves projects' economic, environmental and social performance.
	Tools and resources to help companies to collaborate.	A vibrant forum in which companies can collaborate effectively to develop new solutions.	Robust R&D networks are created and expanded, BC SMEs achieve sufficient scale to compete on large projects.
		Well-established feedback loops from the field into the R&D lab.	Increased public spending on construction-related R&D.
Research and consulting services	Provide deep technical expertise, research and advisory services.	The Centre is home to a world-class technical and business team.	BC's enhanced reputation for construction innovation.
Technology incubator	A construction-focussed technology cluster (e.g. Passive House products for BC).	Industry adoption of centralized, online bidding and tendering.	BC leadership in green building and the use of wood is a source of major competitive advantage.
Entrepreneur portal	Broker relationships with industry and facilitate access to capital, equipment and expertise.	The release of work between specialists in design, supply and assembly is increasingly reliable.	Strong supply chains so new ideas can be realized cost effectively and in a timely manner.
	Assist large firms in sharing ideas and support collaboration to increase the rate of market transformation.	Support ongoing evolution of standards and codes as a means to push the innovation into the market.	BC is an advanced construction industry that develops and implements innovative new products & processes.
	Business incubation, coaching and start-up advice.	Connection into BC's established venture capital capacity and start-up community.	Improved VC and start-up investment for BC entrepreneurs. Access for BC entrepreneurs to new markets.

2.2 Activities that support business improvement

Businesses of all sizes need the skills and insight to grow their business through innovation.

The Centre will provide a range of business-oriented programs, services and support to help businesses engage in peer-to-peer learning, stay up to date on the latest research, implement the right technologies, systems and processes to remain competitive. The activities, programs and services will comprise the following:

- **Project assistance & process adoption support:** helps industry to access researchers, funding and other expertise to solve innovation challenges by:
    - Exploratory sessions with experts to identify options and next steps
    - Cost-shared projects to develop/ implement innovations
    - Coaching and mentorship programs
    - Assisting businesses to collaborate with academia, public sector and other industry partners to seek out support and training
    - Facilitating access to funding to recruit expertise
    - Helping businesses adopt or create innovative business models and or processes that will capture or create new opportunities.
- **Business support** is particularly important to SMEs to help them gain access to capital for investment in people and equipment. Business management and consulting services can also be provided, potentially at subsidized rates to help with succession planning, establishing business management best practices (financial controls, etc.)
    - Business improvement groups (BIGs) are designed to assist with business development skills, how to plan for the future, add value through the procurement process (saving time, improving predictability) backstopped by checklists, templates, cheat-sheets, technical bulletins. They can be coordinated in partnership with others (such as NGOs) and offer:
        - Marketing and bid coaching
        - Sales and marketing training and services
        - Standards compliance (e.g. ISO9001, etc.)
        - Personnel mentoring and taking on an apprentice
- **Knowledge gathering, evaluation & exchange** on installed technologies and processes from other jurisdictions for potential application in BC. Centres can organize field trips, trade missions and exhibits.
- **Benchmarking and reporting services** are important tools that supports business improvement and demonstrates ROI for funders / investors in construction innovation. Benchmarking is also an important means for the industry to what innovation is and to measure productivity properly. Industry can then show improvement over time. On a business scale, companies can compare their accomplishments to best

practices, and disclose their success as a means to win work. There are many providers of benchmarking data (associations, NGOs, governments, market research firms, etc.), which should be sourced and organized to best suit industry needs. The Centre will fill data gaps, then aggregate and monitor KPIs for industry and provide set-up assistance for companies to manage their own KPIs. Benchmarks can be used to measure:

- Building Performance (e.g. GHG emissions, C&D waste, etc.)
- Project Performance (e.g. reliability, defects, time, budget)
- Organizational Performance (e.g. safety, profitability, workforce diversity)
- Relationship Quality (e.g. client satisfaction, good neighbourliness)

In the future, the Centre may offer access to equipment and facilities to provide opportunities to "try before you buy" with access to resources such as prefabrication equipment (e.g. presses, CNC machines, etc.) and facilities supported by qualified expertise. Equipment libraries and sharing can make new tools available to industry at low cost as well as access to digital services such as Total Stations, 3D printing, 3D laser scanning, cloud-based computing resources, etc.

2.3 Education & training activities

The Centre will offer a "first-stop-shop" for accessing information on innovation market trends, research, technology and programs. This will include a virtual information clearinghouse, profiling innovative projects and developing/delivering outreach, education and training activities in collaboration with its partners.

By expanding education opportunities, the Centre can contribute towards improved professionalism and greater workforce diversity. While many academic institutions, technical colleges, industry associations and NGOs offer education, training and skills development, there may be opportunities for developing gap-filling curriculum dedicated to innovative technical and business improvements, and addressing challenges with adoption of new technologies. The Centre can also support policy makers as they strive to improve the performance of buildings. Activities, may include:

- **A web-based and/or physical information "first-stop-shop**". A great deal can be accomplished through a fully interactive, searchable web presence supported by discussion forums, on-line training and social media. However, buildings are experiential – professionals need to see products and technologies in practice. Industry advocates need to demonstrate BC's accomplishments to investors, visiting delegations and the public. The Centre should ideally include a gallery of innovative projects, technical library, product tradeshow and rentable space for various target audiences (builders, trades, designers, clients). Information might include:
    - Databases of existing relevant documents, technical products, specifications, service providers, etc.
    - A searchable inventory of BC's construction innovation assets (individuals, equipment, laboratories, demonstration projects, organizations, etc.)

- Expert knowledge of funding programs and government services
- Library of trade journals, catalogues, brochures, case studies, news stories

- **Training and education hub** will offer a centralized clearing house of qualified education programs and partner with established education providers to promote existing programs and courses while providing feedback to providers on how to optimize for specific audiences. The Centre will develop and offer gap-filling technical (construction, design) and non-technical (business, marketing, sales) where others do not exist. The Centre's role might extend to include organizing workshops, events, courses and the development and provision of certification.

- **Best Practice Groups (BPGs)** bring the benefits of best practice to a practical, personal and local level for SMEs. BPGs encourage a stronger appreciation of best practice principles, spreading the message to create a culture of continuous improvement throughout the industry. Groups provide peer-to-peer information on what is actually happening in the area by educating the membership. First hand experience can be obtained from those that are directly undertaking and/or are engaged to deliver projects. Group members can guide others in the region and provide support and advice to enable better business and consistency of approach.

- **Best Practice Advisor program** can leverage BC's numerous well-respected experts in areas such as BIM, IPD, QA/QC, building envelope, etc. to create a pool of highly qualified industry experts (Best Practice Advisors) to work with construction firms to find better ways of doing business either one-on-one or by leading ad hoc Technical Task Forces and BPACs.

2.4 Activities that develop networks and communications

It is vital to establish collaborative innovation networks and the tools and processes that optimize R&D efforts and encourage cooperation and integration across the supply chain.

An inclusive industry network that includes all stakeholders is critical to breaking down silos, tightening up the supply chain and building a level of trust at the project team level and transparency at the industry scale. The activities, programs and services will comprise the following:

- **Networking and partnering** will formally and informally bring together and connect industry, academic and the public sector to work together, share knowledge, ideas and experience through events, committees and other activities. This can include:
    - A province-wide network to connect industry innovators from across the sector and a front door into the industry for entrepreneurs, researchers and investors.
    - A focus on defining and addressing major problems / barriers that, if solved, would provide significant market opportunity to BC businesses
    - Regular communications, events and virtual and in-person meetings.
- **A state-of-the-art interactive website** can showcase how the industry is fostering the latest in outreach and engagement tools to ensure optimal information sharing. The Centre can develop and maintain a

comprehensive web platform that fosters ongoing and continuous industry engagement. The website should include:

  - Industry polls and surveys
  - Virtual classroom, meeting room and collaboration tools
  - Discussions via social media
  - Events calendar
  - Online project and technology demonstrator (YouTube video library, etc.)
  - Directory of R&D funding sources, proposal calls, etc.
  - Resource library (reports, publications, standards of work, master specifications)

- **Outreach and communications:** The Centre needs to develop an integrated strategic marketing and communications plan, tactics and tools to convey the value proposition for innovation, drive event attendance and promote the Centre's resources and expertise. Centre staff can participate on external policy and practice committees and establish partnerships with key trade and technology allies. The Centre can also assist partners with industry marketing and PR on topics such as:

  - What innovation means to construction firms and how it can reinforce industry reputation
  - Demystifying what goes on in the construction industry and what the career opportunities are
  - Workforce recruitment materials
  - Reports on industry performance and accomplishments

- **Technical Task Forces (TTFs)** can be established on a case-by-case basis to respond with appropriate depth to specific technical issues such as BIM, IPD, pre-fabrication, codes and standards, energy efficiency, etc. and serve as a bridge between industry, clients, NGO's, government and the research community.

- **Innovation awards** to showcase and celebrate BC's innovation "champions".

2.5 Activities that connect construction businesses to R&D

The Centre is envisioned as an arms-length R&D team and "first-stop shop" for all aspects of innovation.

The Centre can offer deep professional and technical services to help businesses identify and address their innovation challenges. It can help companies to research, develop, test and commercialize products and services essential to its future. This will include custom R&D, business advice and coaching, facilitating partnerships and assisting with securing funding and investment. The activities, programs and services will comprise the following:

> "It could provide a possible home for a lot of the Passive House research I've been wanting to do (or hire)."
>
> **Monte Paulsen, Owner, Red Door Energy Advisers**

- **R&D hub & clearinghouse** helps firms stay abreast of (but not be drowned by) relevant market trends and new technologies via a range of managed and validated information delivered by both traditional and digital

media. It offers a point of collaboration for R&D centres (universities, labs, testing centres, etc.) to gather the latest information about R&D in development and for industry to feedback lessons from the field and on R&D needs. It can also raise funds for R&D projects for companies or can commission research itself. It can provide a regular R&D "Round-up" of what is going on across various research centres in Canada and around the world.

- **Research and consulting services** can support businesses seeking specialized one-off assistance to identify, develop and adopt innovative processes and technologies. Although the priority will always to be to leverage existing R&D capacity, where none exists the Centre can also conduct its own research and produce technical / policy reports on innovation & best practice. The Centre will need to generate revenues to support other activities while reinforcing its in-house expertise. Fee based services are a good way to build professional credibility. However, while government funding is in place, consulting service fees should ideally be charged at a discounted rate to reduce barriers to access (and while the value proposition may not be clear to industry). Note that many NGO's operate a consulting arm to augment funding, demonstrate market expertise and attract qualified personnel. Examples include, the British Research Establishment (BRE), Pembina Institute.

- **Technology incubators** identify and catalyze "classes" of technology that are important to BC companies (BIM, HRVs, heat pumps, pre-cast foundations, etc.). They can help businesses bring new products and solutions to market that deliver supply chain improvements. Support could also be aimed at delivering prototyping or testing/certification (UBC CIRS, FP Innovations, etc.). The Centre can assist businesses (directly or by facilitating access to specialist partners) to develop transition to modern methods of construction, adopt new processes or technologies, etc. Client companies would developers of targeted technologies and also businesses that are keen to adapt and improve traditional processes.

- **Project & technology "demonstrator"** will comprise case studies, team interviews and video tours to help to identify "ideas worth spreading" and build an evidence base for change. There are many organizations that have a significant library of case studies and technical information to which the Centre can provide access.

- **An entrepreneur portal** opens new markets for start-ups by offering a range of incubator services including business development, mentoring and advisory services and facilitated access to capital through assistance with funding applications and/or connection to the investment community. The Centre can run engagement events for entrepreneurs, investors and industry. It is possible that the Centre could receive fees for incubator services, participate in early stage ventures in the form of equity or take a commission on funds raised.

2.6 Centre configuration

The Centre could be as substantial as a fully serviced office, training centre and gallery with a presence in multiple locations or as simple as a website. The more programs services it offers, the more effective it will be at transforming BC's construction industry.

Three options ("Basic", "Select" and "All" activities) are summarized in Figure 7 and discussed in detail below.

Figure 7 Summary of three options for developing an innovation Centre

	1. Basic activities	2. Select activities	3. All activities
Scope of activities	• Research and evaluation of new approaches sufficient to provide technical bulletins, training and education • Web based and physical information "first stop shop" • Establishment and development of industry networks • R&D hub, documentation of BC's innovation assets and "clearing house" of information, studies and reports	**Basic programs plus:** • Project and process technical assistance • Business assistance and support • Training and education hub • Outreach and communication • Project and technology demonstration • Research and consulting services	**Select activities plus**: • Regional presence • Benchmarking and reporting • Best practice assistance • Innovation awards • Technical taskforces • Technology incubator • Entrepreneur portal
Number of locations	1	1	4

Option 1: Basic programs and services

The basic option includes the minimum package of programs and activities to be of interest to funders and be useful to industry. It offers a cautious investment for a host organization and allows industry time to become familiar with the basics of innovation. The activities would comprise:

- Research and evaluation of new approaches sufficient to provide technical bulletins, training and education
- Web based and physical information "first stop shop"
- Establishment and development of industry networks
- R&D hub, documentation of BC's innovation assets and "clearing house" of information, studies and reports

This work could be the responsibility of one staff member hosted within a larger organization with a budget for retaining experts to undertake gap-filling research as required. This model will primarily serve as an information resource centre with very limited opportunity to provide hands-on support for companies.

The degree to which this model could deliver the breadth, depth and scale of solutions to fulfill industry needs in the timeframes described is low. This model relies on the expertise of one staff member who may not be able to offer sufficient technical depth on all innovation issues.

Option 2: Select activities

Building on the basic activities, this model proposes the addition of the following "select" activities:

- Project and process technical assistance
- Business assistance and support
- Training and education hub
- Outreach and communication
- Project and technology demonstration
- Research and consulting services

These services are still offered out of a single centralized location but extends to provide hands-on technical and business support – from 'eyes and ears" on a construction project to deep, professional guidance as a key member of the project team. The Centre could sustain at least 5 staff members who can leverage their expertise into fee-based services to not only demonstrate their market value, but also help to reduce the reliance on government funding. A small office and meeting room would be required.

The degree to which this model could deliver the breadth, depth and scale of solutions to fulfill industry needs in the timeframes described is good in the urban centre where the Centre is located. However, it may not have the capacity to support other regional centres or fully connect with innovation assets in other regions. A centralized solution may limit access to regional funding.

Option 3: All activities

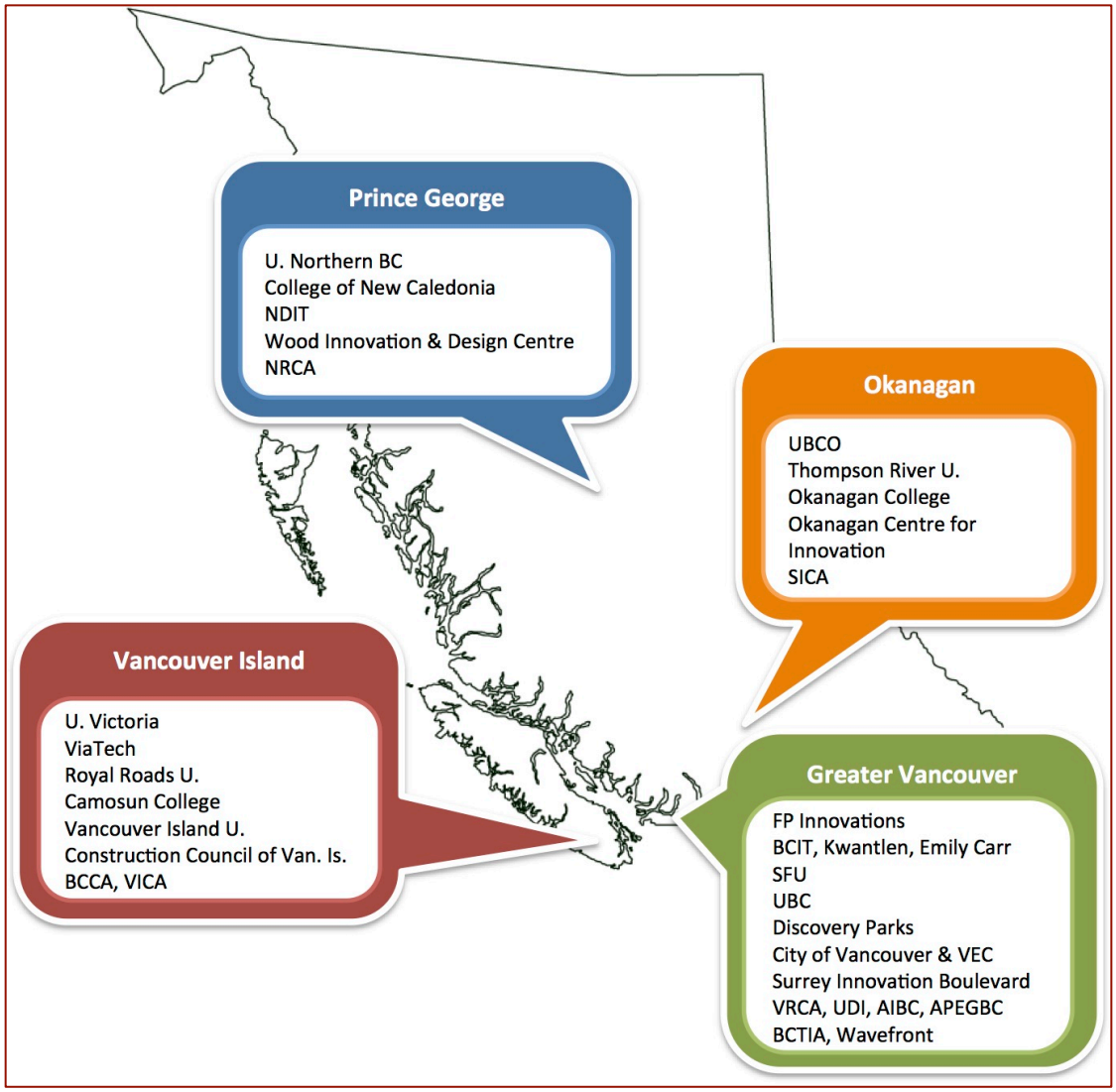
To fulfill the demands identified during the industry consultation process requires a multi-pronged approach that leverages on-the-ground support and a comprehensive virtual presence. In addition to all the programs and services described in the "Select Activities", this option includes:

- Benchmarking and reporting
- Best practice assistance
- Innovation awards
- Technical taskforces
- Technology incubator
- Entrepreneur portal

This model is best positioned to be flexible, and respond to the rapidly evolving needs of industry and stakeholders. While services and programs will be clearly defined at the strategic level, facilitating their delivery will require Centre staff to be able to move seamlessly across all aspects of construction to tighten up the value chain, improve communication and enhance opportunities for collaboration. The scale of this operation allows for several seasoned professional staff to be available to industry (business, engineering, construction, etc.) and for the services described at the "Basic" and "Select" levels to be delivered to a far greater level of breadth and depth.

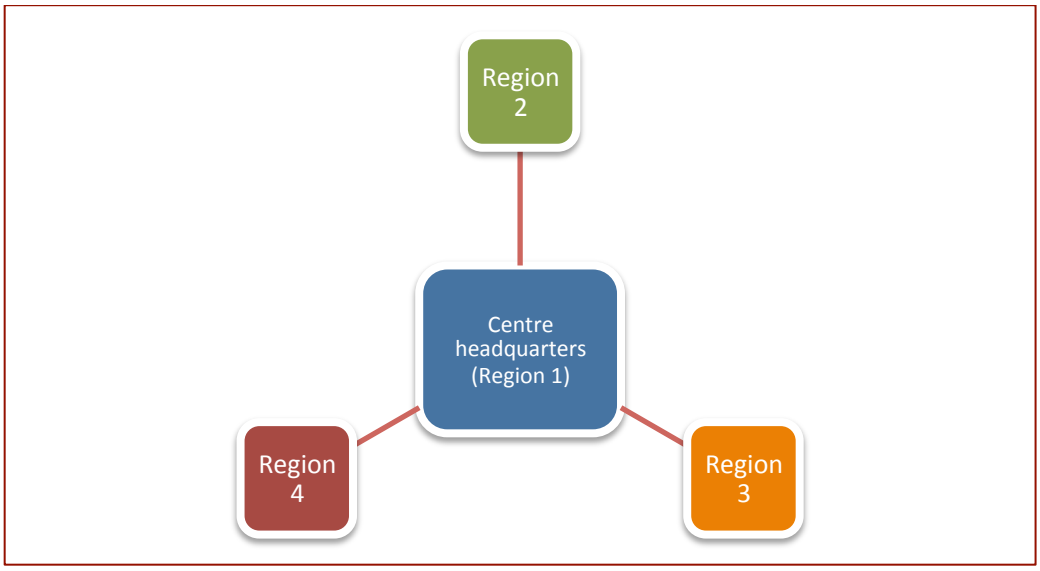
BC has four regional clusters in which innovation investment is concentrated and where research into specialized areas of construction is taking place (Figure 8). This model therefore includes for a regional presence in up to 4 urban centres in BC. One regional manager will work out of the Centre headquarters. The others are assumed to co-locate within a complimentary organization or in a co-working space. The value of these managers is that they will be able to establish connections with local innovators while providing an on-the-ground presence to local companies. For the purpose of budgeting, it is assumed that two managers will join in the first year (so one complementary organization needs to be identified in the first year) and two in the subsequent year.

Figure 8 Examples of BC's construction innovation assets



A "hub and spoke" system of closely interconnected centres in Prince George, Kelowna, Victoria and Vancouver (Figure 9) not only ensures a close connection with BC's major construction-related R&D centres, but can also leverage the networks of BC's four regional construction association offices which are also located in each of these regions. **Given the City of Vancouver's Zero Emission Building code timeline, it is likely that a Vancouver location would be one of the first to be developed, focussing on carbon neutral building and serve as the Centre headquarters.**

Figure 9 Centre "hub and spoke" model



This distributed model follows a similar approach to the UK Catapult programme[6] and could also complement a large scale Fraunhofer network model that could be applied across the country. Fraunhofer Gesellschaft is an integrated network of intermediate research institutions in Germany that support industry and technology transfer as part of a national innovation eco-system[7].

This model also includes for a pool of "best practice advisors" who are well-respected subject matter experts that can go into companies and onto project sites and provide hands-on expertise. The model assumes that 1,000hrs of free expertise will be provided annually in person or over the phone on a first come basis.

In terms of space, the Centre headquarters is estimated to require 3,500sf comprising an office to accommodate at least 8 staff, a 20 person training / boardroom and small meeting room. It is assumed that during the pilot phase, large training events would be held elsewhere. The Centre will need to be fully equipped with video conferencing capabilities. A large reception area with space for displays is desirable.

Office space	1,500 sf
Training room / boardroom	1,000 sf
Small meeting room	500 sf
Gallery / display	500 sf
Total area	**3,500 sf**

Referencing the CBRE office fit-out guide[8], the model budget assumes $100/sf fit-out costs for the Centre headquarters for a total one-time cost of $350,000. It is assumed that the three regional managers will rent serviced offices and no fit-out costs will be necessary.

This model best delivers the breadth, depth and scale of solutions to fulfill industry needs in the timeframes described. With regional managers, it will have the capacity to support major regional centres and fully connect with innovation assets at a tactical level. This is important for supporting regional initiatives such as the City of Vancouver's interest in developing a low carbon building centre of excellence.

2.7 Centre staff

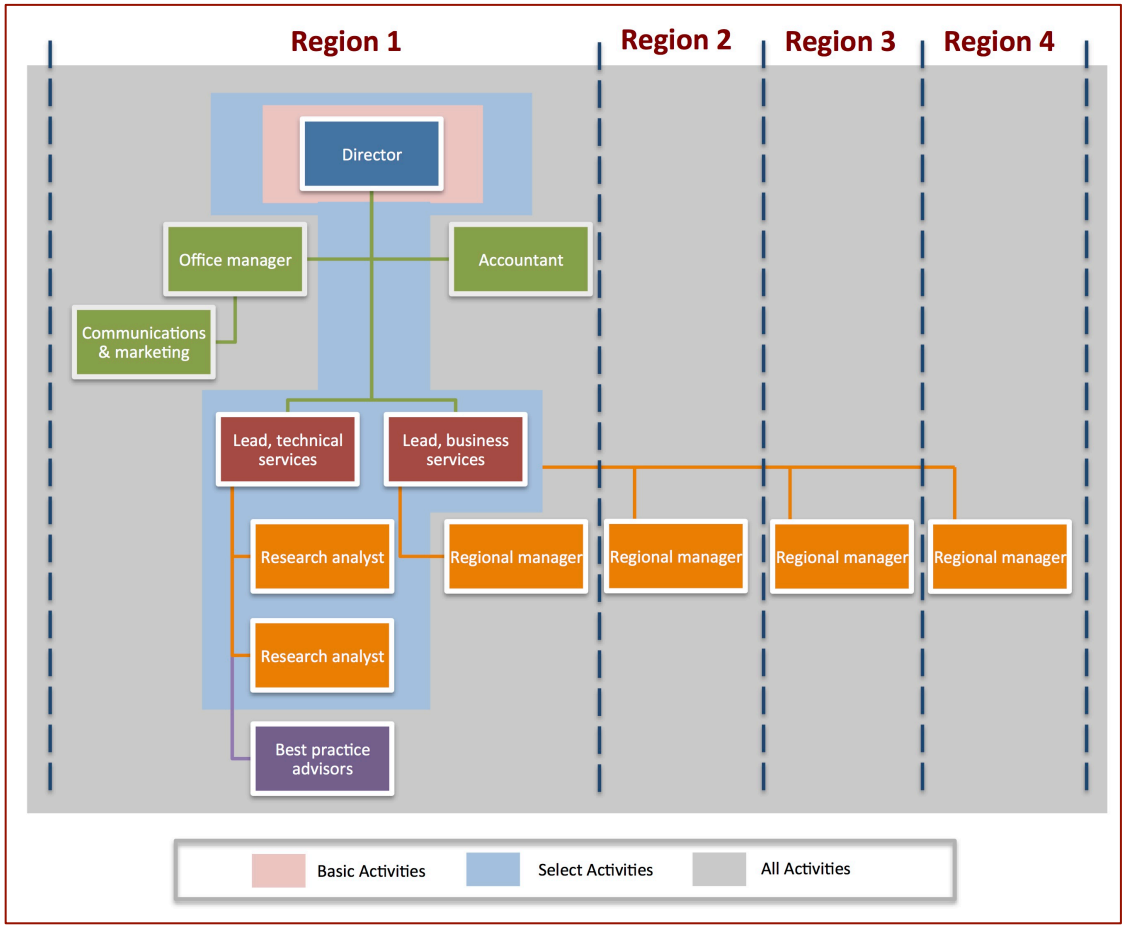
The objective is to retain world-class business and technical expertise so that the Centre itself contributes to BC's leadership in construction innovation.

To deliver the proposed activities, industry professionals will be brought on over a period of 3 years to staff the Centre. Depending on the model adopted, Figure 10 outlines the staff that will be working for the Centre. A proposed org chart describing the staffing required for the three levels of service is illustrated in Figure 11 and detailed roles and responsibilities are presented in **Appendix D.**

Figure 10 Innovation Centre staff

	1. Basic activities	2. Select activities	3. All activities
Staff	Project director	Project director Lead technical services Lead business services Research analyst Communications	Select activities plus: 4 Regional managers Office manager Accountant
Number of locations	1	1	4

Figure 11 Centre organization chart



2.8 Centre leadership

The Centre needs to be led by an action-oriented “innovation council” that will serve as the "voice" of innovation in construction in BC

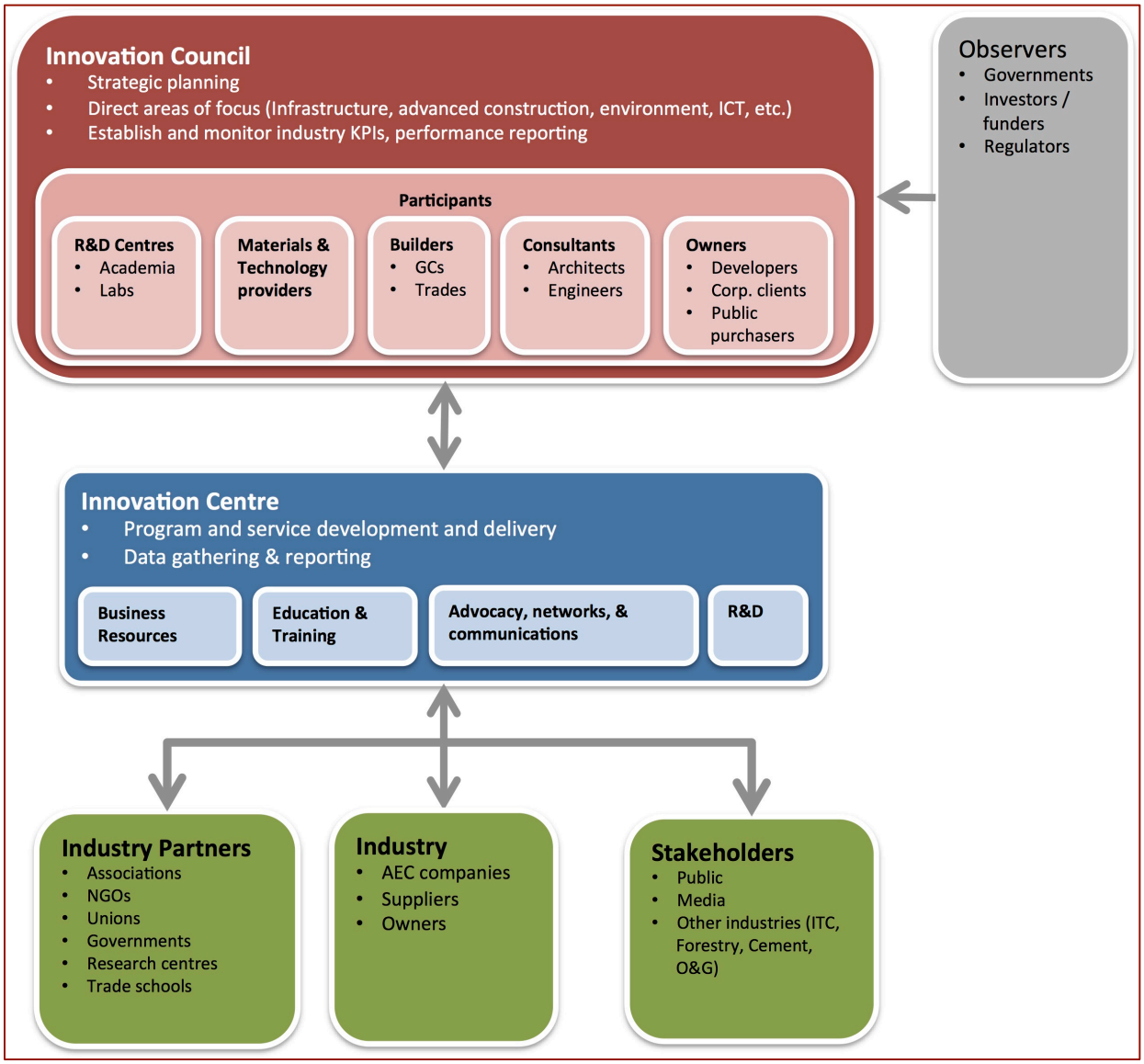
It is proposed that a leadership body is set up to oversee the Centre. This body or “Council” will comprise industry leaders from the construction industry plus owners, researchers and, potentially major materials and technology providers. Examples from elsewhere suggest that either a partnership between industry and government or an industry led / government supported model are most effective. For example:

- **UK Constructing Excellence** developed a joint government / industry strategy, “Construction 2025” which established goals and objectives for the UK construction industry. To implement the findings, the Constructing Excellence Board was set up comprising industry and owner representatives. Public sector funding to enable innovation, supported by major contributions from industry have resulted in the establishment of 9 Regional innovation centres (Industry, Academic).

- **Construction Scotland** is industry-led and government supported. It is led by a 20 seat Industry Leadership Group to which prospective members must apply. Selection is based on individual track record of “getting things done” although representation from industry, owners and academia is required. Because they are industry led, they are recognized as a capable delivery agency. “Building the Future” is the strategy developed for 2013 – 16 within which they articulate need for support for certain things and promote the necessary culture change in businesses necessary for them to embrace innovation.

Because government funders in BC and Canada tend to take a “hands off” approach to the projects they invest in, an industry-led model will make the most sense while offering governments full access as observers (Figure 12).

Figure 12 Centre leadership structure



CHAPTER 3 Financial strategy

The objective of the Centre is to demonstrate the business case for innovation to BC construction companies and provide the necessary support to them while they adopt innovative practices. Financial barriers to accessing innovation support must therefore be eliminated wherever possible, particularly for small businesses.

The cost to develop, implement and sustain an innovation Centre will vary depending on its size and scope. The following financial strategy takes into consideration the funding landscape and the potential for it to provide diversified income to the host organization while aiming to not compete with other fund-raising activities (e.g. at the national level).

The three options (basic, select and full scale) are summarized in Figure 13 and illustrative 5 year budgets for "Select activities" and "All activities" options are in **Appendix E**.

Figure 13 Summary of three 5yr budget options for developing an innovation Centre

	1. Basic activities	2. Select activities	3. All activities
Number of locations	1	1	4
Estimated 5yr budget			
Funding	$1,000,000	$2.4m	$5.0 - $6.3m
Self-generated	-	$1.6m	$2.9 - $4.2m
Total	**$1,000,000**	**$4.0m**	**$9.0m**

Financial case study: Construction Scotland Innovation Centre (CSIC)

In 2014, CSIC received funding of £7.5m is from the Scottish government and a further £1.8m in equipment funding. Industry contributes 50% to all project activity, some of which covers project management and supervisory elements. Sometimes companies just need a pair of eyes to oversee project. Industry has to support a lot of other activity. They do not charge for services directly or for info on website which has lots of database info and reports that had never previously been centralized. They see themselves as the "front door" for this information and don't charge for it. They also do not charge for use of their premises.

To build their reputation and earn value in the market, they are offering as much as possible for free at the start and then they will start to charge in 18 months time for deeper services. Funders are committed to support the centre for 10 years, they expect funding expected to drop after 5 years seed funding. They are not a membership organization because they do want to cannibalize the membership of other partner associations and unions and the value of what they seek to accomplish not clear yet. They want to offer additional benefits to members of trade organizations in order to get access to membership.

3.1 Income sources

The following sections describe the various sources of income and assumptions made for budgeting purposes.

- Government funding
- Project grants and sponsorships
- Self-generated revenues

Unfortunately, support for innovation investment is quite fractured in Canada and it can be not only difficult to access but also difficult to sustain. Further, there is no single federal or provincial government entity responsible for construction and it can be extremely challenging to make construction innovation investment fit under a specific department's priorities. The funding strategy is therefore built upon a combination of 1) government funding, 2) project-based grants and 3) fees for programs, events and "deep", customized technical or business services. A summary of the proposed activities and how they meet funders' priorities is illustrated in Figure 14 and each funding source is discussed in more detail below. A list of potential funders is provided in **Appendix C.**

Figure 14 Summary of proposed activities and how they may meet funding objectives

Activity	Government funding	Grants and sponsorship	Fees (programs & services)
Research and evaluation of new approaches	Technology development and capacity (IRAP).	Approaches for improving environmental performance of buildings (HPO, City of Vancouver, REFBC).	Deep, project specific or corporate services for construction companies.
Business support and technical assistance for businesses to adopt new technologies and business processes	Companies can access technical assistance to improve economic prospects (WD, NDIT). Encourages technology development and capacity building (WD, NDIT).	Equipment, expertise and resources for specific activities (Construction Foundation of BC, corporate donors).	Deep, project specific or corporate services for construction companies. Administration fees for facilitation access to capital, skills, etc.
Benchmarking and reporting	All funders need to see how their investments deliver economic, environmental and social benefits (All).	All funders need to see how their investments deliver economic, environmental and social benefits (All).	Fees for in-depth / custom reports.
Web-based and physical information "first-stop shop"	Improves innovation readiness and primes new markets for construction SMEs (WD). Industry-specific networks (real and virtual) provide the information and resources to help businesses adopt innovation successfully (WD).	Access to innovative solutions to improve the quality and performance of buildings (HPO).	N/A

Activity	Government funding	Grants and sponsorship	Fees (programs & services)
Training and education hub	Incentives to build industry low carbon construction capacity (City of Vancouver).	Curriculum development, program delivery for green building (HPO, Foundations).	Tailored curriculum for specific businesses or consortia. Education and event fees.
Best Practice assistance	Incentives to build industry low carbon construction capacity (e.g. City of Vancouver, BC government). Business support and technical assistance to companies helps them to adopt new technologies and business processes (WD).	Research and resources for improving the performance and applicability of wood buildings (Wood First) Best Practice assistance helps SMEs engage in the low carbon economy (municipalities, Foundations)	Deep, project specific services for construction companies provided by Best Practice advisors.
Industry-specific networks (real and virtual)	Information and resources to help businesses adopt innovation successfully (WD).	Improving opportunities for BC researchers (MITACs).	
Outreach and communication	Communication and engagement plan to ensure their project investments reach the right audience (All).	Communication and engagement plan to ensure their project investments reach the right audience (All).	Training and event fees.
Innovation awards		Promoting BC's innovation champions (Industry associations, trade & export agencies, corporate donors).	Registration fees.
Technical taskforces	Convene discussion on innovation issues of consequence (Prov. Gov, municipalities).	Convene discussion on innovation issues of consequence (agencies, utilities).	Custom market research and consultation (focus groups, surveys, etc.).
R&D hub and clearing house	Improve access to technical solutions for companies building low carbon projects (CoV, WD). Improving access for SMEs to innovation support (WD).	Improving opportunities for BC researchers (MITACs).	Training and event fees.
Research and consulting services	Subsidized / free technical assistance and advice to support SMEs (WD).	Research and evaluation of new approaches (HPO).	Fee-based deep, project specific or corporate services.
Technology incubator	Access to new markets for BC entrepreneurs (BCIC) New green jobs (BC government, City of Vancouver). Improving access to technical solutions for low carbon buildings (City of Vancouver).	Incubators focussing on technologies such as intelligent controls, digital fabrication, etc. enable access to new markets for BC entrepreneurs (corporate sponsors, public agencies seeking to advance specific technologies).	Provide technical and business support for SMEs to validate ideas. Administration fees for facilitating access to capital / expertise.

Activity	Government funding	Grants and sponsorship	Fees (programs & services)
Entrepreneur portal	Access to new markets for BC entrepreneurs (WD, BCIC). New green jobs (BC government, City of Vancouver).	Sector specific connections and support for other incubators (BCTIA, Discovery Parks, ViaTec).	Administration fees for facilitating access to capital / expertise.

1.1.1 Government funding

Feedback from prospective government funders was positive for the concept of an innovation Centre in general terms. Innovation is a hot topic and various levels of government are working hard to promote Canada's technology prowess. However, because the industry has not been visible in Canada's R&D funding world, governments may be unfamiliar with the potential scope and scale of impacts and benefits that investment in construction innovation can bring. For example, at a national level, Canada's portfolio of LEED buildings certified between 2005 –2015 will[9]:

- Generate $62.4 billion in total GDP over their lifetime (direct, indirect, and induced)
- Create 702,400 jobs over their lifetime (direct, indirect, and induced)
- Provide $128.1 billion in gross output (direct, indirect, and induced)

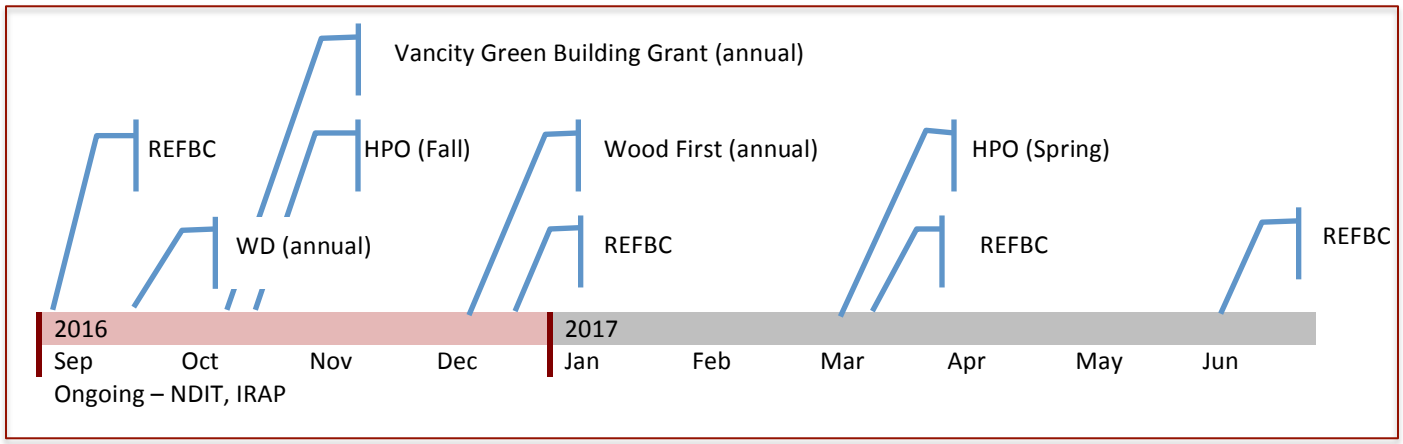
Governments are focussed on improving infrastructure, the environmental performance of buildings and the quality and availability of social housing. The challenge for fund-raising for construction innovation is that these two priorities are not linked. Innovation agencies rarely (if ever) refer to construction in the context of innovation investments. Overall, the objective for any viable funding model must be to:

- Provide sufficient diversity of income to protect against changing economic impacts
- Be flexible so that the Centre can grow and adapt quickly to industry needs
- Not compete head on with important industry partners
- Minimize barriers to industry engagement with the accelerator.

There are several funding programs that are only available in specific regions of the province (such as the Northern Development Initiatives Trust).

The Centre's financial strategy is therefore based on "front-end loading" with such funding as is possible to secure and moving as quickly as possible to increased reliance on self-generated revenues (such as fee-based advisory and consulting services). Timing of major 2016/17 grant submissions is illustrated in Figure 15.

Figure 15 Anticipated schedule of major grant supplication deadlines



To get started, the Centre should try to source funding from a diversity of grants, programs and activities. Government funding will be targeted to assist with the setting up of core operations (wages, incremental operating costs, etc.) of an initiative that is run within a "host" organization. To leverage government support for the launch of the Accelerator means that it needs to be incubated by a host organization that will run it as a "project". Key potential funders may be:

- **Western Economic Diversification Canada (WD)** makes contributions to multi-year "projects" that support the development and diversification of the western Canadian economy, and activities where economic and/or employment benefits accrue primarily within Western Canada. The next proposal call is anticipated in the autumn of 2016.[10] Projects may be multi-year and WD may contribute up to 50% of eligible costs with the expectation of commensurate support from other levels of government and industry. WD looks for contributions from provincial government agencies as well as the private sector. Advancing innovation is one of WD's strategic priorities. Figure 16 illustrates how the Centre can fulfill some of WD funding priorities:

Figure 16 Relevant WD funding priorities and how the Centre activities might fit

Relevant WD funding priorities	How the Centre delivers on WD priorities
1. Advancing economic priorities in Western Canada e.g., helping manufacturers and businesses succeed in the global economy; supporting entrepreneurs, innovators and world-class research; connecting Canadians with available jobs; infrastructure; and responsible resource development.	• Business support and technical assistance helps companies to adopt new technologies and processes • Companies can access technical assistance to improve economic prospects • R&D hub and clearing house will improve opportunities for BC researchers and Improve access to technical solutions for low carbon building companies • Entrepreneur portal will connect start-ups with new markets

Relevant WD funding priorities	How the Centre delivers on WD priorities
2. Supporting priorities that industry sectors have identified as being critical to their success over the longer term (e.g., ten years). This could include expanding western Canadian small-and medium-sized enterprises' (SMEs) strengths in commercializing and producing new technologies and services; and promoting growth and development in established and emerging sectors.	• Research and evaluation of new approaches • Encourages technology development and capacity building • Benchmarking and reporting shows how their investments deliver economic, environmental and social benefits • Communication and engagement ensures programs and services reach the right audience
3. Helping western Canadian SMEs complement their existing global market penetration with a solid presence in emerging markets, e.g., helping companies in various sectors identify new markets, supporting investment attraction opportunities, fostering trade hubs.	• Web-based and physical information "first-stop shop" improves innovation readiness and primes new markets for construction SMEs • Incubators focussing on technologies such as intelligent control systems, digital fabrication, Passive House products enable access to new markets for BC entrepreneurs • Industry-specific networks (real and virtual) provide the information and resources to help businesses adopt innovation successfully
4. Helping to promote skills training opportunities in key sectors across Western Canada.	• Training and education hub helps industry increase their capacity to deliver low carbon buildings • Best Practice assistance helps SMEs engage in the low carbon economy

- **NRC Industrial Research Assistance Program (IRAP)** provides financial support to qualified small and medium-sized enterprises in Canada to help them undertake technology innovation.[11] They also offer a youth employment assistance program and administer the Canada Accelerator and Incubator Program (CAIP) which provides funding over a five year period in the form of non-repayable contributions to a limited number of outstanding accelerators and incubators that meet strict eligibility and selection criteria. Contributions are targeted towards incremental activities that expand the overall service offerings to early-stage firms and entrepreneurs, and promote a higher output of SMEs that are investment-ready and able to develop into sustainable, high-growth businesses.

- **City of Vancouver Zero Emissions Building Centre of Excellence:** In July, Council "adopted with consent" a plan to invest $700,000 over three years ($300K in 2017, $200K in 2018, and $200K in 2019 from the City's 2017 Innovation Fund, subject to Council approval of the 2017 Innovation Fund budget) towards establishing a non-governmental Zero Emissions Building Centre of Excellence[12] with the mission to facilitate the compilation and dissemination of the knowledge and skills required to design, permit, build and operate zero emission buildings in BC, and direct staff to engage partners, secure matching funding, consult with stakeholders and report back with recommendations for implementation in 2017. There are numerous areas of R&D, prototyping and testing of Passive House products and components for application in BC as well as training and education for consultants, contractors and trades that align with the Centre's mandate. A contribution from the city can contribute towards matched funds from WD.

- **Northern Development Initiatives Trust:** The Economic Diversification Infrastructure program provides up to $250,000 in funding for non-profit organizations in Northern Development's service area for projects that significantly strengthen the local economy via a major capital investment. The program specifically targets funding for capital investments that drive revenue and job creation and provide a long-term asset for the community. Application is via Northern Development's four regional development accounts – Prince George is in the north central region[13].

1.1.2 Grants and corporate sponsorship

There are several granting organizations (government agencies, Foundations, etc.) that target small discrete projects (less than $100,000). They need to see a robust "business case" in terms of a quantifiable return on investment such as jobs, new businesses created, patents registered, GHG emissions reduced, etc. The key potential partners who are specifically focussed on advancing innovation are:

- **Homeowner Protection Office (HPO) Building Excellence Grant:** HPO (part of BC Housing) is a provincial agency that supports and encourages projects and initiatives that improve the quality of residential construction and consumer protection for buyers of new homes in BC. Industry and consumer organizations, education providers and independent researchers have the opportunity to identify projects and apply for funding. Eligible projects may receive up to $40,000 in funding.[14]

- **BC Innovation Council Ignite:** provides funding to accelerate commercialization of new technologies and innovations in the natural resources and applied sciences in British Columbia. The program provides awards of up to $300,000 to consortia that are conducting research projects that address a significant demonstrated problem faced by industry and will commercialize a proposed innovation within a 3-year time frame. It is not sector-specific. Projects must secure matching funds from industry or government sources at a ratio of 2:1 matching dollars to Ignite dollars.[15]

- **Real Estate Foundation of BC (REFBC)** provides funding for projects (up to $50,000) that support sustainable building and land use in BC.[16] In the spring of 2015, REFBC began the Sustainable Built Environment Initiative in order to better understand the state of the built environment in BC and develop a more effective approach to supporting lasting, transformative change. Five priorities emerged:

    - Align the financial rules of the real estate and construction system with sustainability objectives
    - Support and coordinate NGOs and others
    - Secure consistent senior government funding
    - Build public awareness of and support for the sustainable built environment
    - Support Smart Growth principles through improved integration of transportation and land use planning, regulation and implementation

    During 2016 and 2017, REFBC plans to meet with individuals and groups to discuss building a collaborative initiative around key specific actions. To do this they anticipate:

    - Exploring a governance and leadership structure;
    - Mapping out a vision, framework and key interventions; and

- Determining resources, coordination and monitoring.

- **Forestry Innovations Investment Ltd** runs a variety of funding programs designed to identify and pursue opportunities that generate demand for BC forest products, further diversifying and strengthening the BC economy. The Wood First program[17] aims to advance the use of wood building systems and technologies, and raise awareness of the province as a world leader in advanced wood construction and design. Increased structural and architectural uses of wood offer economic, environmental and social benefits to BC. Greater use of wood from BC supports the provincial forest sector through increased employment and revenues, while increasing the use of wood products fosters innovation and the growth of value-added manufacturers. Funding normally does not exceed $100,000 per project, and contributions from other partners are strongly encouraged. Wood First focuses on:

    - Growing a culture of living and building with wood in BC and beyond;
    - Maximizing the appropriate use of wood in public and private projects;
    - Strengthening BC's capability to produce competitive wood-based products and building systems that create and respond to market demand;
    - Accelerating adoption of existing and emerging wood-based products and building systems; and
    - Positioning BC as a world leader in sustainable and innovative wood-based products and building systems in design, production and application.

These grants cannot be used to support core operations but may facilitate important stand-alone activities and initiatives that fill gaps and advance the Centre's mandate.

There are also some companies related to the construction industry that operate philanthropy programs.

1.1.3 Fees for programs and services

Charging market rates for "premium" services reinforces the technical competence of Centre staff in the market place and generates profits that can be used to support other Centre activities such as the innovation networks and information and training activities.

To reduce barriers to access, it is suggested that, for both the "Select Activities " and "All Activities" options, the rates for research and consulting services be discounted heavily to start and gradually raised based on proven value as follows. The rate of discount will be determined by availability of other funding.

	Year 1	Year 2	Year 3	Year 4	Year 5
Discount rate for research & consulting services	50%	40%	30%	20%	10%

Depending on the level of government funding and grants, the timing of the introduction fee-paying services may be delayed in order to build appreciation of value in the market place. A detailed breakdown of the proposed revenues for both the "Select Activities" and "All Activities" options are provided in **Appendix E**.

Revenue generating activities may include:

- Technical and business research and consulting services to help businesses province-wide identify and address their innovation challenges.
- Administration fees for facilitating partnerships and assisting with securing funding and investment for companies seeking to undertake R&D.
- Education, training and event fees including royalties on educational materials or publications delivered by partner organizations A modest amount of income is expected from the rights to use Centre educational materials and other training income (such as honoraria for Centre staff to participate in outside events).
- ("All Activities" only) Best Practice technical, business advice and coaching (start charging at a discounted rate in year 3). External Best Practice Advisors will be brought on in year 3 and provide a total of 1,000 hours of technical and business advice, annually. These well-respected industry experts may serve as an "executive in residence" or hands-on advice over the phone or in the field. The model assumes that they will charge their time at a reduced rate ($50/hr plus travel) ramping up to a less subsidized rate $150/hr in year 5.

3.2 A new building

It should come as no surprise that many innovation leaders in BC's construction industry desire nothing more than a state-of-the-art building with which to showcase their expertise and creativity.

There are examples of incubators such as Discovery Parks, Vancouver Island Technology Park and the Kelowna Innovation Centre (see case study below) dedicated to nurturing BC's tech start-up community. However an industry-specific innovation centre would be different. Two models exist (described in **Appendix A**):

- **The Construction Scotland Innovation Centre** has built an offsite construction facility that serves as a training, capacity building and research centre. Income is generated from businesses and researchers that pay to use the space.
- T**he London Building Centre**, located in a retrofitted building in central London, is open to the public. It receives rents from 6 floors of commercial office space to support Centre activities on the ground floor and two basement levels.

The purpose of this study has been to explore the programs and services required to support BC's construction industry as it gets to grip with innovative approaches. On the strength of industry agreement with the study's findings, a prospective host organization may wish to consider and explore the viability of a new building.

Fund-raising case study: Kelowna innovation Centre

The Okanagan Centre for Innovation (OCI) is a 9,728 m2 (104,715 s.f.) facility being constructed on a 2,025 m2 (21,800 s.f.) lot at the corner of Doyle and Ellis in the heart of Kelowna's Cultural District. Aimed at supporting Kelowna's growing tech community, the building will house everything from two-person start-ups to large technology and innovation firms. Publicly-supported space and services will also be available for early-stage companies, non-profits, community groups, and social enterprises.

Conceived by a group of entrepreneurs and community and civic leaders, this partnership seeks to solve the challenge of diversifying from resource and manufacturing-based economies to knowledge-based economies. The Kelowna Innovation Society is creating a space that would be accessible to fledgling innovators, who traditionally have an abundance of ideas and initiative but limited access to cash or infrastructure. The second floor of the OCI has been designed to support high growth early-stage technology companies, non-profits and social enterprises, and will provide the infrastructure necessary to help accelerate their business ideas.

The project recently received a $3.4 million investment from Western Economic Diversification to will build out, equip, and operate 24,000 sq. ft. of publicly funded space at the OCI. With this contribution from WD, the OCI now enjoys support from all three levels of government: municipal, provincial and federal. Combined with the solid backing of private enterprise and the academic community, Kelowna's new tech centre has tremendous

CHAPTER 4 Success factors

Construction innovation is a new concept in Canada and measuring the progress and success of an innovation centre can be challenging.

A summary of proposed outcomes and key long-term benefits of the centre are illustrated in Figure 17.

Figure 17 Summary of proposed Centre outcomes and key long-term benefits

Centre outcomes	Long-term benefits
• Industry understands and appreciates the potential of new technologies and processes • Construction businesses of all sizes have access to and can deploy the tools and technologies they need to be innovative and competitive • Companies and industry as a whole reports on key performance indicators for construction excellence and demonstrates performance improvement over time • Educational resources are in place to develop an engaged and informed workforce • Businesses of all sizes can acquire the full spectrum of skills necessary to create and implement innovative ideas successfully • Improved project team collaboration • BC construction companies appear in international trade missions, promotional materials, etc. • A common language exists for how “innovation” should be described in the bid process • Best practices are in place to mitigate adversarial behaviour • Industry training equipment needs assessment (e.g. potential for a shared off-site hub) • BC’s innovation “champions” are celebrated • Construction companies stay ahead of regulatory and business requirements • Construction companies are familiar with sustainable materials, technologies and processes such as off-site construction and lean construction • Well established feed loops from the field into the R&D community • The Centre is known for its world-class technical and business team • Connection into BC’s established venture capital capacity and start-up community	• Industry confidence to deploy innovative technologies and processes • Improved productivity and profitability for construction companies • Improved economic, safety, and environmental performance of projects • An educated workforce that is able to deploy innovative design and construction methods that put quality first • Increase in the number green and technology jobs in construction companies in BC • Improved integration across the supply chain • Increased presence of BC construction companies in new markets • Public misperceptions of the industry are shifted • Owners seek a “quality-first” approach to procurement where life cycle costs and the value of design are recognized. • BC extends its proven track record of “being first” when it comes to innovative projects and as an international "shop window" for construction innovation • Procurement structures meet client and industry needs and provide an equitable framework within which companies can innovate safely • BC SMEs achieve sufficient scale to compete on large projects • Increased public spending on construction R&D • BC's reputation for construction innovation is a source of major competitive advantage • Strong supply chains so new ideas can be realized cost effectively and in a timely manner • Improved VC and start-up investment for BC entrepreneurs. • Access for BC entrepreneurs to new markets.

4.1 Key performance indicators

It is imperative for the Centre to demonstrate how it is fulfilling its mandate to bring about the transformational change required by industry and society by catalyzing the adoption of innovative construction processes, technologies, materials and business strategies.

> "We set our own KPIs – more about economic development, export, new products, new jobs, etc. We don't care about happy participants of events are.
> We want to measure how well we are doing turning "ideas into invoices". We have to demonstrate a clear link between innovation and business value."
>
> **Stephen Good, CEO Construction Scotland Innovation Centre**

The major benefits of innovation are primarily long term and the transfer of new ideas into building projects can take much longer than for other industries. They can be imprecise, the paths to success may be unknown, involve undefined or poorly understood technologies, unspecified business models, underdeveloped markets, and oftentimes all of the above.

Key Performance Indicators (KPIs) are used to benchmark performance and demonstrate improvement over time. Performance metrics would be easier for the Centre to create and follow if KPIs were already in place in Canada or BC for the industry as a whole. The British Research Establishment (BRE) has developed a KPI engine[18] for UK construction companies that includes over 200 KPIs, a small sample of which might include:

- Client Satisfaction
- Defects
- Construction Time & Cost
- Productivity
- Profitability
- H&S
- Employee Satisfaction
- Staff Turnover
- Sickness Absence
- Working Hours
- Qualifications & Skills
- Impact on Environment
- Whole Life Performance
- Waste
- Commercial Vehicle Movements

An important role for the Centre will be to assist industry leaders in establishing appropriate KPIs for the industry, against which individual companies can benchmark their performance.

The Centre will need to remain agile in order to best respond to industries needs. Getting an idea into the market quickly is very important so metrics need to measure how well it is helping construction companies participate in the "acceleration process". However, too many predetermined performance indicators (drawn from other industry examples) may constrain performance and be ill suited to the characteristics of construction. Nevertheless, metrics are important. All funders look for measurable outcomes and industry is keen to understand how innovation translates into business improvements. The Centre's success is therefore built upon meaningful and trackable key performance indicators. Important overall KPIs include:

- Number of technology/knowledge jobs in construction facilitated
- Number of projects assisted that have delivered measurable performance improvement (GHG emission reductions, solid waste diverted, etc.)
- Number of ideas brought to life
- Improved profitability and performance of construction projects assisted (survey)

Figure 18 summarizes a range of indicators that would provide important reporting to funders and the BC industry as a whole:

Figure 18 Centre key performance indicators

Area	Outputs	Indicators
1. Networks & Communications	**Industry leadership group**	• # Industry disciplines represented • # Meetings per year
	Inventory of construction innovation assets	• List and # of R&D centres, demonstration projects, funding programs, innovation intermediaries, events, innovation "champions" (organizations and individuals)
	Industry outreach	• # Interactions with construction industry members
	Innovation network	• # Construction companies and individuals assisted • # B2B, B2G, B2R&D connections made • # BC start-ups provided access to new markets
2. Education & Training	**Interactive website**	• # Page views • # Social media posts • # Media mentions
	Tracking and analysis of market trends	• # Articles • # Technical reports
	Access to training	• # Events promoted • # Events delivered • # Participants in training programs • # Education materials used (by others)
3. Business resources	**Business improvement services**	• # Businesses and # individuals assisted • # SMEs assisted
	Technical services	• # Businesses and # individuals assisted • # Projects assisted • # New ideas generated • # Ideas brought to life
	Partnerships	• # Partnerships formed with industry • # Partnerships facilitated between industry & R&D centres
	Jobs	• # Knowledge & technology jobs created / facilitated (5yr)
5. R&D Support	**Technology validation**	• # Technologies assessed
	Research projects	• # Custom research projects completed
	Access to funding	• # Companies assisted • $ Raised
	Technologies	• # Innovative technologies or practices deployed as a result of contact with Centre
	Projects	• # Projects assisted (5yr)

The budget excludes any major investments in equipment and facilities, which would be part of a separate funding application once the Centre is up and running. For example, the Construction Scotland Innovation Centre secured £1.8m in equipment funding so industry can come and play with toys before buying themselves. £800,000 micro offsite manufacturing cell – allow companies to either use for proto-typing, training, commercial "try before you buy" model so they can do this with supervision and see if they can do it themselves. While such a model may be very compelling to BC businesses as means to meaningfully advance offsite construction, further research is needed to determine the business model, location and R&D support.

4.2 Host organization role and responsibility

This study is intended as guidance for any organization that may consider taking on the role of host to BC's construction innovation Centre.

The success of the Centre will rest primarily on the capabilities, structure and engagement of the host organization. Potential candidates might be academic institutions, industry associations or NGOs. The qualities and characteristics of a good host might be:

- Held in high regard by BC's construction industry
- Solid understanding of BC's construction market trends, issues and challenges
- Proven track record of fund-raising and managing multi-million dollar, multi-year projects
- Presence in major urban centres in BC close to R&D centres
- Non-competitive position within the industry
- Substantial industry network, especially those that are active in innovative projects.
- An ability to move and make decisions quickly

There is no question that a provincial reach will not only provide greatest value to industry, raising awareness of and providing access to BC's dispersed innovation assets. However, there are several funders that target regional economic development that would also value a local presence and services optimized for a regional audience.

A host organization can approach its role as innovation advocate and "owner" of the Centre in two ways:

- An arms length innovation service centre that complements but is operated separately from to core business. This approach will be easier to implement but may end up with competing messaging about mission and mandate.
- A strategic framework that is integrated into core business. This could shift the organization's mission to becoming an innovation "centre of excellence" which may require far greater involvement from stakeholders / members, branding, etc.

The BC Construction Association (BCCA) and the four regional associations that it supports would, together, make a compelling host organization.

- BCCA is the provincial voice of BC's construction industry.

- BCCA is a non-profit organization, which provides leadership and excellence in the representation of – and service to – over 2,000 construction employers active in the industrial, commercial, institutional and multi-family residential sector of the industry.
- BCCA and regional associations are intimately familiar with BC's construction market, issues & challenges
- The four regional associations (VRCA in Vancouver, VICA in Victoria, SICA in Kelowna and NRCA in Prince George) are located in urban centres close to BC's R&D centres.
- Together, the construction associations have a proven track record fund-raising and managing multi-million dollar, multi-year projects

4.3 Next steps

The recommendation is to aim for Option 3 - All Activities as it best suits the scale of need and timeline for industry and holds out the best chance for funding by government, corporate sponsors and foundations. It can link in with national efforts and provide a replicable role model for the rest of the country. However, it is important to move quickly to capitalize on industry momentum and funding timelines.

The scope of the Centre can be designed to suit the host organization's mandate, reach and capabilities, starting from a simple web-based information clearing-house. However, to best meet the needs of industry in the context of BC's localized industry and decentralized R&D resources, the Centre needs to have a presence in multiple locations in order to tighten up local value chains, deliver regionally appropriate, deep technical and business solutions. At the same time, the concept of an inter-connected network of R&D resources, expertise and technical horsepower will enable companies in all parts of the province gain access to the right R&D support – no matter where it might be.

There is little appetite among funders to create a new NGO and industry associations, in particular, are best positioned to leverage an extensive membership base, and are present in multiple locations. Several industry associations have expressed interest in supporting innovation-oriented activities. However, they will need to undertake a strategic planning exercise to look at the extent to which the programs and services are integrated into the host organization's own mandate. For example, a construction association might consider how it transforms into a "centre of excellence" leveraging local innovation assets, member expertise, etc.

The next step is for a host organization to gather letters of support from key stakeholders and prepare funding applications to federal government (WD), provincial government and agencies (NDIT, FII, HPO) as well as foundations (BC Construction Foundation, REFBC) and municipalities (City of Vancouver). The critical timeline may be for WD, which is expected to launch its 2016 proposal call in September.

The timing of the development of a Construction Innovation Centre is good. There is momentum at the national level to raise the profile of construction innovation led by CCInnovations. In BC, innovation is a hot topic. Companies of all sizes are discussing how they can capture the benefits of new ideas and solutions to produce better buildings, faster and cheaper while improving their bottom lines.

Appendix A: Best practice examples

Construction Scotland Innovation Centre (CSIC)

Figure 19: Offsite construction facility at the Construction Scotland Innovation Centre

Governance	• Associated with Construction Scotland (Industry Association) • Its **Governance Board** members are i) Industry leaders, ii) Academic leaders and iii) Government representatives. • It also has a **Technical Advisory Group** comprised of industry and academic experts.
Funding and Size	• The Centre launched in 2014 and is hosted at an academic institution. • Initial 5-year funding from Scottish Funding Council (£7.5m) plus £1.8m in equipment funding from government. It is one of 8 Innovation Centres funded by the government and supported by 13 university partners. • No members or membership fees. For projects, industry partner contributes 50%. • Currently 7 staff (CEO, 4 business development, 1 Commercial, 1 Technical)

Objectives	**Focus is connecting industry and researchers to increase innovation and get research into industry.** ("Translating ideas into invoices") • *Provide businesses with a one-stop-shop for all aspects of innovation funding and support.* • *Our job is to make your job simpler. We are here to be your arms-length R&D team as we appreciate how busy you are.* **Vision** To create a networked community of industry, academic and public sector talent, channelled towards providing necessary, effective and appropriate innovation support to industry in order to deliver a paradigm shift in the sector's approach to innovation and drive transformational change within the industry. **Objectives** • Uncover and develop with industry the value that lies in innovating; • Drive future demand for the innovation support available from Scotland's leading universities; • Empower industry to take ownership of the innovation process; • Align academic expertise and public sector agency support; • Bridge existing gaps by matching industry need to appropriate innovation support packages; and • Deliver support from inception to commercialisation.
How they work	CSIC is here to support all construction related businesses across Scotland from architects to product manufacturers to facilities management. They will work with businesses to connect them to the expertise and services the business requires. They offer: • An entry point to the innovation support landscape • To match business needs with academic and public sector expertise • Access to potential funding • Access to prototyping and testing facilities • Facilitation of training and education • Collaboration, networking, partnering and knowledge sharing

Services Provided	• **One-stop-shop**: Free information, general support, advice on who to contact, where to go for funding, some publications, some events.
	  ○ Database of funding programs, researchers etc.
	• **Exploratory Sessions** (free or fee-based) to explore specific ideas or trends around future of construction: figuring out what you need before you apply for funding.
	• **Access to equipment and testing facilities ("try before you buy")**
	• **Project Support** (free, cost-shared or fee-based). Industry applies to CSIC to solve an innovation problem. CSIC deals with the back-end and funds university team. Industry funds remaining total cost of the project.
	  ○ **Business Innovation Support:** Assisting businesses to collaborate with academia, public sector and other industry partners to seek out support and training to allow them to evolve an innovative culture. Helping businesses adopt or create innovative business models and or processes that will capture or create new opportunities.
	  ○ **Product innovation support:** Helping businesses develop new construction products, components and solutions that deliver innovation to the supply chain. Support could be with entire supply chain partners or individual companies and aimed at delivering prototyping or testing/certification.
	  ○ **Process innovation support**: Assisting businesses to develop new manufacturing

	or assembly systems. Clients will typically be businesses that are keen to adapt traditional processes, but the introduction of new processes and market solutions are encouraged. ○ **Service innovation support:** Helping businesses to access new market opportunities locally, nationally and internationally. Assisting businesses seeking to develop innovative marketing models, new ways of engaging with customers, or monitoring impact.
Themes / Focus Areas	• **Infrastructure** • **Design and Performance** • **Advanced Construction** • **Energy and ICT** • **Environment**
Website	www.cs-ic.org/innovationcentre

The London Building Centre

Figure 20 The Building Centre in London, UK

Governance	• Owned and operated by the Built Environment Trust, an independent non-profit and charity
Funding and Size	• ~ 14 staff members • Membership (free = Bronze, Silver, Gold = fee (for manufacturers) - £700-1800) • Revenue from space and services (office space rent, venue rent, exhibitions etc.) • No information available on funding sources, budget etc. but they are landlord of a 7 storey office building which they lease to like-minded companies
Objectives	• Promoting innovation in the built environment (planning, design, construction) • Providing education, information and inspiration
How they work	The Centre is a physical space that allows for i) co-location, ii) information centre (2,000 visitors per week), iii) event and exhibit space, and iv) delivery of services to consumers, manufacturers, design industry
Services Provided	• **Office space** - Co-location of like-minded organizations • **Café**

	• **Product showroom** (2,000 visitors per week)
	• **Events and exhibitions**
	  ○ Range of speakers and trainers (some technical)
	  ○ Exhibitions on the built environment
	  ○ Conference room space
	• **Manufacturer's services:**
	  ○ Specfinder product database (used by Architects and designers),
	  ○ Ska Rating Product Compliance Label (100 good practice measures)
	  ○ Market research,
	  ○ Overseas Exhibitions,
	  ○ Contact databases,
	  ○ Sales and Marketing Training for construction
	  ○ Email and newsletter advertising (Building Centre Product Alerts)
	• **Information Centre (online and in-person)** with
	  ○ Stocks of catalogues and brochures
	  ○ Trade journal library
	  ○ Information consultant services (to source building products)
	  ○ Connecting to specialist organizations and trade bodies to answer questions
	  ○ Online - Projects, Products, events, news, case studies, Inspiration
	  ○ Communications – Newsletter, Email alerts (new products)

Website	www.buildingcentre.co.uk

Centre for Construction Innovation (North West UK)

Governance	• One of 9 Regional Centres of Construction Excellence (Constructing Excellence Regional Network) all with MOU with national body. Some regional centres are independent organizations and others are governed by universities. • NW UK is governed by University of Salford; No information on its board
Funding and Size	• No information available on funding • ~10 staff
Objectives	• Exchanging, demonstrating and implementing best practice, • Promoting and managing cultural change, and, • Ultimately, delivering a safe, sustainable and continuously improving building sector.
How they work	• Embedded within the university, so with access to meeting and research space • Work closely with and for public, private and third-sector bodies throughout the Northwest and across the United Kingdom, delivering improvements in procurement, collaborative working, leadership and management, construction and the built environment. • Combination of fee-based, subsidized and free programs and services
Services Provided	• **Construction partnering services** (for bids and P3s) • **Knowledge Transfer partnerships** - Collaborations between University academics, a company

	that needs their expertise and a graduate recruited to work on a project central to the needs of the business and its development advising clients (purchasers) and industry (bidders) on value-based procurement
	• **Sustainability** - Advising on adopting sustainable construction practices in business
	• **Corporate Social Responsibility -** CSR guide and assessment tool plus advice
	• **Assessment** - Access to environmental assessment of buildings (e.g. BREEAM)
	• **KPIs** - Performance indicators and benchmarking (software, training)
	• **Training** -Training and mentoring programs (e.g. sustainability, supply chain management, Bid Coaching, Carbon Accounting, Waste Management, Lean Construction, Performance Measurement)
	• **Best practice clubs, networks and events** (conferences, showcases). Includes
	  ○ Local best practice clubs (local networks w/ monthly events)
	  ○ Women in Construction Action Network,
	  ○ Heritage Skills Hub,
	  ○ Construction Knowledge Hub,
	  ○ Construction Waste Innovation Network
	• **Research and guidance** (e.g. sustainability, equality and diversity guide, CSR)

Website	www.ccinw.com

Sustainable Built Environment National Research Centre, Australia

Governance	• Board is mix of industry, government and post-secondary (universities) • Has Partners, Core Members and project-based research partners (no information on their role or how to become one)
Funding and Size	• No information on funding. • Only 1 staff listed (CEO)
Objectives	• SBEnrc is a key research broker between industry, government and research organisations servicing the built environment industry. **Vision** • To be an enduring world-class research and knowledge broker in sustainable infrastructure and building design, construction and management to enhance the performance of Australia's built environment industry. **Objectives** • Implement a unique collaborative and strategic approach to built environment research in Australia • Collaborate across organisational, state and national boundaries to develop a strong network of built environment research stakeholders (industry professionals, clients, regulators and researchers) • Establish members as international leaders in sustainable built environment research and practice and lead the international research agenda; build collaborative industry research teams and apply cross-disciplinary approaches in areas of digital modelling, sustainability, safety, and procurement fields, providing opportunities for new value-adding collaborations

	between industry and researchers • Attract new research students to study at member universities and provide research training and linkage opportunities for members.
How they work	Appears to be fully focussed on conducting research projects, driven by the Board and its three theme areas. Each project has a fact sheet and contact. No information on other activities. Some of the initiatives in the last 5 years include: • Creation of BIM National Guidelines and a National Portal. • Creation of the Australian Sustainable Built Environment Council (ASBEC) • Creation of www.YourBuilding.org a portal to the best advice on greening the performance of commercial property.
Themes / Focus Areas	The three research streams focus on environmental, social and economic sustainability, areas identified by national industry stakeholders as the key areas that will drive productivity and industry development in the built environment industry.
Website	www.sbenrc.com.au

Other examples

A number of public sector agencies, industry consortia and NGOs are emerging to offer solutions to construction companies, entrepreneurs and investors. The following organizations represent excellent examples of the range of potential models for a construction innovation accelerator for BC.

- T**he Green Action Plan for SMEs in Europe**[19], which supports SMEs with information, training and advice, and facilitates access to finance.

- **iBridge.Network**[20] is a US-based online community and clearing house of technologies seeking application. The mission of the Innovation Accelerator (IA) is to promote America's economic competitiveness in the global economy by promoting American innovation. The IA is a vertically integrated innovation practice with a focus on commercialization, intellectual property, and venture capital. The website allows users to discover and connect to game-changing technologies and technology professionals. Relevant technology sectors include engineering, energy, environment and civil engineering but does not specifically list "construction".

- **Canadian Oil Sands Innovation Alliance** (COSIA)[21] was formed to help oil sands companies collectively solve problems that were common to all companies – e.g. environmental assessments. What problems are common to all companies that a collective solution would benefit all? COSEA demonstrates the power of collaboration – amplifies the industry voice, leverages R&D dollars, etc.

- **Canada Mining Innovation Council's** zero waste initiative[22], which prioritizes innovation that is expected to lead to significant reductions in mining waste.

Appendix B: List of industry leaders consulted

Over 400 members of BC's construction industry were engaged in the creation of the BCCA Construction Innovation project, which resulted in a key recommendation to develop a construction innovation "point of service" for BC. The 30 leaders below offered their thoughts and advice on the concept of a construction innovation Centre for BC.

Brad Badelt, City of Vancouver

Greg Baynton, VICA

Bryan Buggey, Vancouver Economic Commission

Alberto Cayeula, UBC CIRS

Bob Cooke, Division 15 Mechanical

Bill Everitt, SICA

Fiona Famulak, VRCA

Oscar Faoro, wood industry consultant

Michael Fawcett, Brock White Canada

Prof. Thomas Froese, Civil Engineering, UBC

Cory Klein, Klein Group

Wilma Leung, BC Housing, Homeowner Protection Office

Keir Lewis, Lewis Sheet Metal Ltd

Mark Liudzius, Kinetic Ellis Don

Phil Long, Maple Reinders

Peter Moonen, WoodWORKs BC

Jennie Moore, BCIT

Sean Pander, City of Vancouver

Warren Perks, BCCA

Dean Prelazzi, BC Innovation Council

David Redfern, Lafarge

Jennifer Sanguinetti, UBC

Susan Schooley, Western Economic Diversification, Canada

Richard Shipway, Ledcor Industries

Roger Smith, Olson Projects Ltd. | Olson Construction

Dr. Sheryl Staub French, Civil Engineering, UBC

Clint Undseth, Stuart Olson

Patrick Waunch, Rambow Mechanical

Dr. Guido Wimmers, Engineering, Integrated Wood Design, UNBC

Sonya Zeitler Fletcher, Forestry Innovation investment Ltd

Appendix C: Summary of potential funding support

Funder	Eligible organizations	Applicable activities
BC Hydro	Architects Owners	Design assistance program to implement electricity saving solutions In the past have funded various energy conservation programs and activities. Projects have to demonstrate how they will reduce electricity consumption. Some strategic research projects Have funded around $25K in the past
BC Government	TBD	Aiming for "net-zero ready" buildings by 2030 with public buildings all new public sector buildings increase the use of materials that sequester carbon, and have the capacity of meeting most of their annual energy needs by on-site renewable energy commencing 2016. Interested in innovation and technical support for low carbon building. Best approach is likely via the Deputy ministers and Industry Infrastructure Forum (DMIIF) with support from the Office of Housing and Construction Standards. The Ministry of Forests, Land and Range also interested in seeing the advancement of innovative BC forest products. Letter of support may be possible.
Built It Canada	Start-ups Developers of new technologies	Marketplace where Govt. Canada will purchase pre-commercial technologies for testing in projects
Bullitt Foundation	NGOs	US / Canadian projects that improve the sustainability of the built environment
Canadian Environmental Grantmakers Network	NGOs	A database of Foundations and grantmakers dedicated to supporting a range of environmental initiatives. The majority offer relatively small project-based grants <$50,000.
City of Vancouver (Sustainability Group)	Companies, NGOs and associations	Aiming for carbon neutral new construction and interested in how it can provide capacity building support and associated resources to builders. Training, education and capacity building related to high performance building.
Columbia Basin Trust	NGOs	Focuses on Columbia Basin region in SE BC (Kootenays) Total of >$3m available for grants for a range of environmental, community impact, economic development projects

Funder	Eligible organizations	Applicable activities
Construction Foundation of BC	Companies, NGOs and associations	Research and education projects that advance the social benefits of construction
Forestry Innovation Investment and BC Wood First	Companies Researchers NGOs and associations	Project based R&D funding to advance the use of innovative wood technologies A total of $2.4m available that is best allocated in the $50,000 - $150,000 range depending on focus. FII may team up with Canada Wood, FPAC, the BLSLC and others to co-fund larger projects.
HPO Building Excellence Grant	Companies Researchers	Research and education projects that improve the quality and affordability of housing Strategic investment a possibility based on solid business case Max $40K with applications accepted twice a year.
Innovation Council of BC	Start-ups Developers of new technologies	Innovation support – access to capital, expertise, business incubation - cleantech, agri-foud, bio-tech, digital, ICT (not sector specific) Letter of support may be available based on robust business case (No. jobs created, No. BC entrepreneurs provided with access to new markets, etc.)
IRAP	Start-ups Developers of new technologies Accelerators & incubators	Incremental funding for accelerators / incubators Assistance with the costs of employing young tech / knowledge workers
MITACS	Established companies NGOs and associations	Support business access to researchers Matched funding starting at $7,000 per project
NSERC	Academics / researchers (may be in partnership with industry)	Any research project in collaboration with an academic research centre
Northern Development Initiatives Trust	Municipalities, regional districts First Nations NGOs	Up to $250,000. Capital investments that drive revenue and job creation and provide a long-term asset for the community. Incremental to government (local, provincial, federal) mandate and funding.
Real Estate Foundation	NGOs	Projects that advance sustainable real estate and land use planning Currently undertaking a review of progress in advancing sustainable buildings. Primary focus is on sustainable building and land use practices Up to $20K can be applied for 4 times a year. Up to $50K twice a year

Funder	Eligible organizations	Applicable activities
SDTC	Start-ups Developers of new technologies	Funding and resources to advance sustainable technologies developed in Canada
SR&ED	Start-ups Developers of new technologies	Assistance with R&D costs
Vancity Green Building Grant	NGOs	Projects that improve the sustainability of the built environment
Vancouver Green and Digital Demonstration program	Start-ups Developers of new technologies	Administered by Vancouver Economic Commission, City of Vancouver offers city-owned buildings and real estate assets for new technologies developed by Vancouver based companies to be installed and tested
Western Economic Diversification (WED) program	NGOs and associations	Funding call "likely" in September 2016 Innovation leading to tangible economics development (jobs, etc.) – focus on renewable energy, sustainability, technology, defence. Matched funding up to 50% eligible costs for defined multi-year projects (up to 5 years) Sweet spot is $250K - $5m over 3 – 5 yrs as a portion (max. 50%) of total budget.

Appendix D: Staff roles

Director

- Drives the Centre's vision and strategy as it focuses on helping deliver growth to businesses through their adoption of new innovative solutions.
- Realizes Centre's ambition to deliver an innovation revolution within the Scottish construction industry, and help position those businesses globally as respected leaders of construction innovation.
- Experienced industry professional (trained Architect with 18 years construction industry experience spanning sustainability consultancy, architectural design, offsite manufacturing and construction management sectors).

Head of technical services

- An experienced industry professional (qualified engineer, architect, construction director)
- Leads on the technical aspects of the innovation centre, including supporting the regional business development team with the technical review of projects and co-ordinating large-scale research bids between academic partners and industry.
- Works closely with the Director to create strategy, processes and procedures.
- Leads the technical projects related to advanced construction, supporting industries needs for physical prototyping and testing of new products and the development of new processes and skills.
- Leads on the development of training including digital skills and BIM awareness.

Head of business services and regional outreach

- Responsible for the regional outreach team and the development and management of projects.
- Oversees the marketing and support functions and tasked with developing a commercial strategy for the Centre.
- Responsible for establishing and organizing the Industry Leadership Group
- Professional background in construction-related and public sector Economic and Business Development in a range of roles covering research, strategy and sector development. Experience overseeing the delivery of a wide range of projects, engaging directly with ambitious businesses and working collaboratively with partners in the private, public and academic sectors on strategic initiatives.
- Responsible for developing strong connections with chambers of commerce, industry associations and government.

Four regional managers

- Seasoned project managers and industry professionals with experience in areas such as:
    - Private sector construction
    - Public sector construction
    - Advanced/ offsite construction
    - Business improvement and strategy
    - Delivering marketing, business development and client relationship roles at a strategic level.
- Located in regional offices (assumed to be co-hosted with regional partners)

- Dedicated to supporting innovation projects at a regional level and coordinating support from the Centre and other networks where necessary.
- Develop strong connections with regional innovation assets such as universities, research centres, start-up communities, etc.

- Manage customer relationships and works closely with companies to encourage them to be open about the challenges they face whilst always thinking of ways to help them be more innovative.

Office Manager

- Responsible for the day-to-day running of the office and administration functions.
- Supports the operations team through effective scheduling of meetings, minute taking, reception and administration functions.
- The first point of contact for all enquiries to the Centre and works closely with the Director to support implementation of the Centre's goals & aspirations.

Communications & Marketing Manager

- Responsible for the strategic and day-to-day delivery of the Centre's communication, marketing and PR requirements.
- Works closely with the Director, Office Manager and Regional outreach team to develop, establish, maintain and raise the profile of the newly formed Centre
- Takes responsibility for delivering the communications strategy across its many channels.

Appendix E: Budget

Select activity	5yr total	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
EXPENDITURES						
Wages and benefits (all, including regions)	**$6,114,084**	$610,500	$643,170	$656,033	$669,154	$682,537
Set up (one-time) costs	**$535,000**	$237,500	$30,000			
Operations						
Gross rent		$61,250	$62,475	$63,725	$64,999	$66,299
Operating costs (tel, web, cleaning, utilities, computer & IT support, hardware & software)		$11,750	$11,985	$12,225	$12,469	$12,719
Office equipment, IT and computers (ongoing)		$0	$2,500	$2,550	$2,601	$2,653
Meetings, events, advertising, printing, supplies, professional development, travel		$33,000	$33,660	$34,333	$35,020	$35,720
Insurance, legal, accounting and association fees		$21,000	$21,420	$21,848	$22,285	$22,731
Total operations	**$671,217**	**$127,000**	**$132,040**	**$134,681**	**$137,374**	**$140,122**
Total expenditures	**$4,200,112**	**$975,000**	**$805,210**	**$790,714**	**$806,528**	**$822,659**
INCOME						
Self-generated revenues						
Research projects & advisory services	**$1,428,660**	$130,500	$168,480	$232,470	$305,280	$387,990
Project facilitation	**$175,000**		$25,000	$50,000	$50,000	$50,000
Training fees	**$45,000**		$7,500	$10,000	$12,500	$15,000
Total self-generated revenues	**$1,648,660**	**$130,500**	**$200,980**	**$292,470**	**$367,780**	**$452,990**
Funding, grants and sponsorship						
Municipalities	**$150,000**	$50,000	$50,000	$50,000		
Corporate sponsors and non-profit partners	**$250,000**	$50,000	$50,000	$50,000	$50,000	$50,000
Provincial Government and Agencies	**$250,000**	$50,000	$50,000	$50,000	$50,000	$50,000
Federal government (IRAP & WD)	**$1,901,452**	$694,500	$454,230	$348,244	$338,748	$269,669
Total funding	**$2,551,452**	**$844,500**	**$604,230**	**$498,244**	**$438,748**	**$369,669**
Total Income	**$4,200,112**	**$975,000**	**$805,210**	**$790,714**	**$806,528**	**$822,659**

5 year budget for All Activities

All activities	5yr total	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
EXPENDITURES						
Wages and benefits (all, including regions)	**$6,114,084**	$946,000	$1,205,380	$1,229,488	$1,353,077	$1,380,139
Set up (one-time) costs	**$535,000**	$475,000	$60,000			
Operations						
Gross rent		$122,500	$124,950	$127,449	$129,998	$132,598
Operating costs (tel, web, cleaning, utilities, computer & IT support, hardware & software)		$23,500	$23,970	$24,449	$24,938	$25,437
Office equipment, IT and computers (ongoing)			$5,000	$5,100	$5,202	$5,306
Meetings, events, advertising, printing, supplies, professional development, travel		$66,000	$67,320	$68,666	$70,040	$71,441
Insurance, legal, accounting and association fees		$42,000	$42,840	$43,697	$44,571	$45,462
External consultants (BP advisors)		$35,000	$35,700	$36,414	$37,142	$37,885
Regional operations		$13,800	$41,676	$42,510	$43,360	$44,227
Total operations	**$1,710,148**	**$302,800**	**$341,456**	**$348,285**	**$355,251**	**$362,356**
Total expenditures	**$9,217,898**	**$1,888,800**	**$1,775,136**	**$1,749,439**	**$1,883,427**	**$1,921,096**
INCOME						
Self-generated revenues						
Research projects & advisory services	**$2,500,560**	$198,000	$346,680	$459,270	$643,680	$852,930
Project facilitation	**$250,000**	$50,000	$50,000	$50,000	$50,000	$50,000
Training fees	**$100,000**	$10,000	$15,000	$20,000	$25,000	$30,000
BP advisors	**$300,000**			$50,000	$100,000	$150,000
Total self-generated revenues	**$2,850,560**	**$258,000**	**$411,680**	**$529,270**	**$718,680**	**$932,930**
Funding, grants and sponsorship						
Municipalities	**$150,000**	$50,000	$50,000	$50,000		
Corporate sponsors and non-profit partners	**$500,000**	$100,000	$100,000	$100,000	$100,000	$100,000
Provincial Government and Agencies	**$350,000**	$100,000	$100,000	$75,000	$75,000	
Federal government (IRAP & WD)	**$5,367,338**	$1,380,800	$1,113,456	$995,169	$989,747	$888,166
Total funding	**$6,367,338**	**$1,630,800**	**$1,363,456**	**$1,220,169**	**$1,164,747**	**$988,166**
Total Income	**$9,217,898**	**$1,888,800**	**$1,775,136**	**$1,749,439**	**$1,883,427**	**$1,921,096**

Breakdown of self-earned revenues - select activity

The following table describes the estimated amount of time that each staff member works on billable projects

	Market rate ($/hr)	Year 1	Year 2	Year 3	Year 4	Year 5
Director	200	10%	10%	10%	10%	10%
Lead, technical operations	175	20%	20%	25%	25%	30%
Lead, business improvement	175	20%	20%	25%	25%	30%
Research analyst	110	50%	60%	70%	70%	70%

	Year 1	Year 2	Year 3	Year 4	Year 5
Discount rate for consulting services	50%	40%	30%	20%	10%

Based on the amount of time for billable work and the discounted rates, the following table presents the annual consulting earnings assuming a total number of 1,800 available hours per year.

	Year 1	Year 2	Year 3	Year 4	Year 5
Director	$18,000	$21,600	$25,200	$43,200	$64,800
Lead, technical operations	$31,500	$37,800	$55,125	$75,600	$99,225
Lead, business improvement	$31,500	$37,800	$55,125	$75,600	$99,225
Research analyst	$49,500	$71,280	$97,020	$110,880	$124,740
Total advisory services	$130,500	$168,480	$232,470	$305,280	$387,990

Fees from education and other events assumes a blended average of $50 per person that includes event fees, royalties, and education sessions.

Education and events	Year 1	Year 2	Year 3	Year 4	Year 5
No. participants		150	200	250	300
Total income from events		**$7,500**	**$10,000**	**$12,500**	**$15,000**

Breakdown of self-earned revenues - full activity

The following table describes the estimated amount of time that each staff member works on billable projects

	Market rate ($/hr)	Year 1	Year 2	Year 3	Year 4	Year 5
Director	200	10%	10%	10%	10%	10%
Lead, technical operations	175	20%	20%	25%	25%	30%
Lead, business improvement	175	20%	20%	25%	25%	30%
Region 1 manager	150	25%	30%	30%	30%	35%
Region 2 manager	150	25%	30%	30%	30%	35%
Region 3 manager	150		25%	30%	30%	35%
Region 4 manager	150		25%	30%	30%	35%
Research analyst	110			50%	70%	75%
Research analyst	110	50%	60%	70%	70%	70%

	Year 1	Year 2	Year 3	Year 4	Year 5
Discount rate for consulting services	50%	40%	30%	20%	10%

Based on the amount of time for billable work and the discounted rates, the following table presents the annual consulting earnings assuming a total number of 1,800 available hours per year.

	Year 1	Year 2	Year 3	Year 4	Year 5
Director	$18,000	$21,600	$25,200	$43,200	$64,800
Lead, technical operations	$31,500	$37,800	$55,125	$75,600	$99,225
Lead, business improvement	$31,500	$37,800	$55,125	$75,600	$99,225
Region 1 manager	$33,750	$48,600	$56,700	$64,800	$85,050
Region 2 manager	$33,750	$48,600	$56,700	$64,800	$85,050
Region 3 manager		$40,500	$56,700	$64,800	$85,050
Region 4 manager		$40,500	$56,700	$64,800	$85,050
Research analyst				$79,200	$124,740
Research analyst	$49,500	$71,280	$97,020	$110,880	$124,740
Total advisory services	**$198,000**	**$346,680**	**$459,270**	**$643,680**	**$852,930**

Fees from education and other events assumes a blended average of $50 per person that includes event fees, royalties, and education sessions.

Education and events	Year 1	Year 2	Year 3	Year 4	Year 5
No. participants	200	300	400	500	600
Total income from events	**$10,000**	**$15,000**	**$20,000**	**$25,000**	**$30,000**

References and notes

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3 Brantwood et al, for BC Construction Association "Construction Innovation Project", 2016 www.bccassn.com/resources/innovation

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5 World Economic Forum – see above

6 www.catapult.org.uk

7 The Fraunhofer Gesellschaft network is a major player within the German innovation eco-system, the primary independent applied research body in the country, and the largest organisation for applied research in Europe. Deploying a model that has developed over more than 60 years, Fraunhofer Gesellschaft comprises more than 60 semi-autonomous institutes linked by a single over-arching governance structure. Seven content 'groups' – for example 'microelectronics', and 'ICT' – link the research activity across institutions. It undertakes applied research of direct utility to private and public enterprise and of wide benefit to society. Customers span industry, service sectors and public administration. These Fraunhofer Institutes develop and exploit new technologies by creating an infrastructure bridging the needs of applied research with those of technology commercialisation. The Fraunhofer Gesellschaft network has over 17,000 employees, including more than 11,000 research staff, and generated an income of more than €1.6bn in 2009. An assessment of the Fraunhofer model for application in the UK is available here: www.theworkfoundation.com/assets/docs/knowledgeeconomy%20newsletters/tics%20-%20applying%20the%20fraunhofer%20model%20to%20create%20an%20effective%20innovation%20ecosystem%20in%20the%20uk.pdf

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