

6.0 RESEARCH

“Thinking of a new building that would demonstrate [sustainability] was a way for us to think about making tangible our goals, we’d been doing all this research – a lot of participatory research and research out in the community - but we weren’t necessarily practicing what we were talking about on our own campus. A building seemed to be a tangible way to demonstrate some of these things. Since then, it has turned into ‘Campus as a Living Lab’ and so the original concept has gotten much bigger and even more exciting.”

– Dr. John Robinson, CIRS Project Sponsor UBC Sustainability Initiative



Image 6.1 Office/ Lab areas with views to the Living Roof
Photograph by Martin Tessler

6.1 Overview

CIRS is an interdisciplinary research facility that houses groups from a variety of different academic departments, administrative initiatives and industry partners. These groups collaborate on projects with each other, as well as with other departments and initiatives on campus, researchers at other academic institutions and professional and industry partners. CIRS was created to be a “Living Laboratory” for researchers interested in advancing sustainable development, design and construction. The original CFI grants for the CIRS project were written by a group of academics who organized themselves into three research groups interesting in the following topics:

- Sustainable building design and operation;
- Tools for modeling, visualisation and community engagement, and;
- Policy analysis and strategies.

LESSONS LEARNED

- Combine building infrastructure and research agendas
- Find dedicated research funds for building components

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23.0	Community
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AGENTS

Project Leadership, UBC Sustainability Institute

UBC Researchers: Faculties from Applied Science, Business, Engineering, Forestry and Psychology

Industry Partners: BCHydro, Honeywell, Haworth, Modern Green

UBC Building Operations

The overall focus of the CIRS research groups is on the disparity between the potential capabilities of sustainable design and technology and the actual performance when combined with inhabitant behaviour. All of the building systems and components of CIRS are part of the research infrastructure with mechanisms for monitoring and adjustments. The building inhabitants are also simultaneously researchers and research subjects.

6.2 System Description

Interdisciplinary Inhabitants

The CIRS inhabitants represent a variety of disciplines. The majority is part of the UBC academic community, but they belong to different faculties. Sustainability is the research focus of most of these groups. The initial groups inhabiting CIRS are:

- UBC Sustainability Initiative
- Transportation Planning
- Campus Sustainability Office
- Collaborative for Advanced Landscape Planning
- ISIS, the Centre for Sustainability and Social Innovation(Sauder School of Business)
- School of Architecture and Landscape Architecture
- Building Simulation Software Lab (Institute for Resources, Environment and Sustainability and Faculty of Applied Science)
- Indoor Environmental Quality Lab, Mechanical Engineering
- UBC Department of Psychology
- Institutional Programs Office

Some industry partners, including BC Hydro, have dedicated space within the building and will be both performing their own research and collaborating with other academic researchers. Other industry partners will engage researchers through collaborations, gain access to the data from the building systems, and work with students through teaching efforts and internship appointments. Also housed in the building is an external organization that is working in research partnership with UBC,, the National Resource Council Institute for Fuel Cell Innovation. It is expected that over time CIRS will facilitate the creation of new faculty positions, as well as attract additional Master and Doctoral researchers, from various disciplines working on projects focused on sustainability.

Sustainable Building Design and Operation

The first research group focuses on sustainable building design. The building concept was a process rather than a final product, which means that key building systems and components will be tested, evaluated, and adjusted or replaced over the lifetime of the building. Multiple labs associated with different research departments will be evaluating the data from the building and developing research programs to test components. These include the Building Monitoring and Assessment Lab, the Building Simulation Software Lab, and the Indoor Environmental Quality Lab. The Building Monitoring and Assessment Lab compiles data from the building and coordinates building system research to support the ongoing goal of optimizing performance and reducing the building's environmental footprint as much as possible.

Tools for Modelling, Visualisation and Community Engagement

While the first research group provides, collects and analyses data, the second group explores means of communicating data in clear and effective ways to a wide audience. Researchers study the relationship between information presentation and visualization and human decision-making and behavioural change. Often this research involves the paring of community engagement and research projects with local and regional governments to address sustainable development and community planning. The research is supported by high-powered computing tools to analyze and visualize complex sets of information, including three-dimensional modelling and simulations, as well as more traditional means of data display. The information collected from the building itself is displayed in the atrium lobby and on the website. High-tech communication infrastructure is also part of the building, including virtual servers and videoconferencing facilities, which allow for the transmission of large amounts of data as well as human communication.

Some of the CIRS facilities are built specifically for engaging with this branch of research. The BC Hydro Theatre provides a physical and computational infrastructure for real-time input and interaction with digital information displayed in a variety of formats. The computer framework supports a range of functions from standard presentations to three-dimensional models and complex virtual simulations. Interactive equipment, such as iPads and touch table interfaces, provide mechanisms for people to engage with the digital information and the integrated system allows the changing information to be displayed in different ways throughout the space. The room can be reconfigured to accommodate different types of uses including large presentations and demonstrations, multiple small groups working collaboratively and immersion setups.

PROCESS

Design Process:

Researcher provided expert knowledge on a range of sustainability related topics during the charrettes and integrated design process.

Construction:

Research funding tied to specific building elements, funded their construction and ensured their retention through the value engineering phase.

Commissioning:

Operations:

Research is being done on the operations of the building systems and the effect of inhabitants' behaviour on the design intents. There are potential research collaborations between building operations and researchers in the optimization of the building system.

COSTS

Costs will be added in a future update

Policy Analysis and Strategies

The third research group has a wider focus, implementing changes as the result of knowledge and experience learned from the other two branches of research at CIRS. This research involves the analysis of existing institutional policies, especially within UBC itself, for their effectiveness in accelerating sustainability and recommending changes and alternatives. Beyond CIRS and UBC, this branch includes work on commercialization and market transformation to shift the building industry and marketplace towards a more sustainability-oriented agenda. This effort involves research into replicable strategies for achieving sustainability targets, from development of new materials and new technology to more sustainable manufacturing practices and regulatory requirements.

Within CIRS, both the Policy Lab and the BC Hydro Theatre are facilities specifically created for partner and community engagement research activities, large scale presentation and discussion and remote collaborations.

Research Funding Agencies

The Canada Foundation for Innovation (CFI) and the British Columbia Knowledge Development Fund (BCKDF) provided significant amounts of funding for the creation of CIRS and its ongoing research. The purpose of the CFI is to build and support Canada's capacity for research and development of technology. The CFI typically funds up to 40 per cent of a research project's infrastructure costs and, in the case of CIRS, the construction of the building itself. BCKDF is an organization that invests in research infrastructure at post-secondary institutions to promote the economic and social benefits of cutting-edge research within BC. Smaller amounts of research money from other agencies funded specific components of the building and systems. For example, the grant from Sustainable Development Technology Canada (SDTC) funded the purchase of the photovoltaic.

6.3 Campus Context

Sustainability is one of UBC's key research focus areas. Through the Campus as a Living Lab program, operations and administration functions are paired with areas of teaching and research to form long-term collaborations to simultaneously move faculty research agendas forward, and build a sustainable campus. Relationships are also encouraged between University researchers and operations, and industrial and community partners. These partnerships include development of new technology, human health and social research and policy development. CIRS is a pilot project for the Campus as a Living Lab Initiative and for investing in building projects as research opportunities.

UBC Research Strategies, Vancouver campus, pg 11-18

6.4 Goals and Targets

Table 6.1 lists the project goals and targets specifically related to the research of CIRS. For a complete list of all the goals and targets for CIRS, refer to Section 4.0 Goals & Targets.

Category	Goals	Targets
2- LIFE CYCLE ASSESSMENT	Conduct a life cycle assessment of all building assemblies and products to examine environmental impact, including embodied energy and greenhouse gas emissions - minimize carbon dioxide emissions associated with construction.	
11 - RESOURCE EFFICIENT BUILDING	Produce a core building that exemplifies replicable, economical solutions.	
19 - BMA LAB	Utilize the building and resources in partnership with manufactures and authorities to advance knowledge of sustainable design strategies.	
20 - SOFTWARE LAB	CIRS will be a living lab for building researchers and software companies to test predictive software for thermal mass, ventilation models, indoor air quality and daylighting effectiveness.	
22 - PUBLIC EDUCATION	CIRS will disseminate sustainable design practices, knowledge and experience as widely as possible.	

Table 6.1 Goals & Targets for CIRS Research Groups.

RATING SYSTEMS

Expert advice provided by researchers during the design process, monetary support provided by research funding agencies and collaborations between building operations and research efforts help push the design of the building to achieve more LEED credits and Living Building Challenge petals.

For more information on the role of rating systems in the creation of CIRS refer to Section 19.0 Ratings Systems.

RELATED SECTIONS:

- 3.0 Vision & Leadership*
- 4.0 Goals & Targets*
- 5.0 Partnerships*
- 7.0 Building Design*
- 8.0 Design Process*
- 19.0 Monitoring & Measurement*
- 21.0 Commissioning & Performance Testing*
- 22.0 Inhabitants vs. Occupants*
- 23.0 Community*
- 24.0 Operations & Maintenance*
- 25.0 Continual Evaluations*

6.5 Benefits

The research agenda for CIRS benefitted the project in the following ways:

Led to Greater Understanding of Building Performance

- The ongoing research on the performance of the building components and systems as well as inhabitant evaluations (pre and post occupancy) provides rare and much needed data to design team members on the effectiveness of their design solutions to sustainability problems. The results will inform design decisions on future projects.

Generated the Living Laboratory Concept

- The living laboratory concept, as originally applied to the CIRS building, is being applied to the entire UBC Vancouver campus. Potential new research opportunities have been found in new projects, such as the Bio Energy Research and Demonstration Project.

Provided a Source of Project Funding

- The majority of the funding for the building construction came from federal and provincial research infrastructure grants, since the building itself is an integral part of the whole research program. The building design and operation goals were protected from value engineering as they were explicitly tied to the project funding.

Created Ongoing Opportunities for Interdisciplinary Research

- CIRS brings together researchers from many different disciplines as well as non-academic partners in one location. CIRS creates new opportunities for learning from collaborations between interdisciplinary groups.

Supported Ongoing Efforts to Facilitate Replication

- Through the testing and development of new products and technologies, the interaction with inhabitants and community groups and by influencing market practices and policies to support sustainable building and development, the research at CIRS is designed to make the development of similar projects easier.

6.6 Challenges

The research agenda of CIRS was challenging for the project in the following ways:

Coordinating Different Research Agendas

- Each faculty member has specific research priorities and individual funding sources as well as specific facility requirements. Extensive effort is required to coordinate research agendas as interests and priorities evolve, and as new applications for funding are approved or denied. Dealing with a variety of disciplines all with different objectives for, and approaches to, research adds an additional layer of coordination complexity.

Including All Research Facilities and Opportunities

- Some lab functions that were included in the original concepts of CIRS, such as a daylight simulation lab, could not be included in the final project.

Satisfying the Requirements of the Research Funding Agencies

- Research funding agencies have specific sets of requirements and restrictions that can be different from those of typical methods of funding for building projects and may be unfamiliar to project managers, contractors and manufacturers. For example, CFI requires that suppliers of research infrastructure purchased with their funding (in the case of CIRS, items such as building materials, components, equipment) to prepare complete documentation, including quotes explicitly stating special discounts for auditing by the Foundation.

6.7 Lessons Learned

The experience gained through the research agenda for CIRS provided valuable lesson to apply to future projects. Some of the key lessons are:

Combine Building Infrastructure and Research Agendas

- Combining research agendas with building infrastructure helps ensure that building project are completed as designed, provides additional research projects for faculty, taps into knowledge from both academic experts and operational experts and creates opportunities for new collaborations and learning that can positively impact both the academic and day-to-day operations of the institution.

Find Dedicated Research Funds for Building Components

- Find research funding that is dedicated to specific building and system components to ensure those components withstand budget constraints and the value engineering process.

6.8 Future Learning

Additional lessons learned over the operational life of the building will be added at periodic intervals

RESOURCES:

- *Canada Foundation for Innovation:*
www.innovation.ca
- *BC Knowledge Development Fund:*
www.cse.gov.bc.ca/TRI/research/funding/BCKDF
- *National Resource Council-Institute for Fuel Cell Innovation:*
www.nrc-cnrc.gc.ca/eng/ibp/ifci
- *UBC Sustainability Initiative:*
www.sustain.ubc.ca
- *UBC TREK Transportation Planning:*
trek.ubc.ca
- *UBC Design Centre for Sustainability:*
www.dcs.sala.ubc.ca
- *UBC Collaborative for Advanced Landscape Planning:*
www.calp.forestry.ubc.ca
- *UBC Centre for Sustainability and Social Innovation:*
isis.sauder.ubc.ca
- *UBC Mechanical Engineering:*
www.mech.ubc.ca
- *UBC Civil Engineering:*
www.civil.ubc.ca
- *UBC Psychology:*
www.psych.ubc.ca
- *BC Hydro:*
www.bchydro.com
- *Haworth:*
www.haworth.com
- *Honeywell:*
www.honeywell.com
- *Modern Green:*
www.mgreen.com.cn
- *UBC Building Operations:*
www.buildingoperations.ubc.ca