

## SFU Strategic Research Plan (SRP) Summary

The advancement of excellence in research is a defining feature of SFU, with leading individuals and groups engaged in a wide variety of key research activities. SFU researchers bring in about four times the research income that they did a decade ago, and have more than doubled their scholarly output in peer-reviewed publications. They are achieving national and international recognition through awards, research chairs, membership on grant selection committees, community outreach activities, and participation in high-profile collaborative initiatives. Embedded in local, national and international communities, our researchers are investigating issues relevant to today's societal and economic needs. We are preparing students for tomorrow's challenges and career opportunities, and employ new models to transfer knowledge through the pipeline of ideas, to innovation, to commercialization.

### Major objectives of the SRP

SFU seeks to become the most research-intensive comprehensive university in Canada, competing effectively in defined areas with the top tier institutions in the country, and internationally renowned for the excellence of our scholarship. Through the identification of research priority areas, the SRP guides decision-making in the allocation of resources, including Canada Research Chair appointments and Canada Foundation for Innovation projects. Developed through an extensive consultation process, the SRP represents the overall interests of the University, while also aligning with the priorities and sub-priorities of Canada's Science and Technology Strategy. Its major objectives are to:

- Maximize opportunities for discovery and innovation;
- Promote internationally competitive research and scholarship;
- Cultivate excellence through selective investment in emerging areas of research;
- Facilitate collaborations across disciplinary and institutional boundaries;
- Recruit and retain outstanding students, research fellows, and faculty;
- Encourage effective communication and dissemination of research results;
- Optimize use of our research and scholarship resources;
- Recognize the full value of intellectual property;
- Achieve thematic coherence in the expression of SFU's research interests; and
- Engage all our communities for the benefit of society.

### Priority areas for research and research training

The SRP takes a thematic approach to meeting these objectives, by articulating the University's distinctive strengths and identifying seven major areas where the strategic investment of resources could give us a competitive edge:

#### Origins

1. **The Nature, Origin, and Fate of the Universe:** Fundamental research questions are asked in many disciplines, e.g. math, physics, chemistry, and biology. SFU plays a key role in ATLAS, the world's largest particle physics experiment, which aims to reconstruct the first seconds of the universe.
2. **The RNA World and Molecular Evolution:** Understanding how molecular building blocks alter their structure, dynamics, and function is the foundation for the science of molecular evolution and is essential for designing antibacterial and antiviral drugs. Interdisciplinary research teams are working to correlate the foundations of evolution at organismal and societal levels.
3. **Biodiversity:** SFU research groups, including those in wildlife and behavioural ecology and salmon conservation, are focused on the ecology, evolution, and conservation of biodiversity. SFU also has complementary strength in applied research on the ecology and conservation of forests and fisheries.
4. **Human Evolution:** Evolution provides a powerful framework for understanding not only our genes and anatomy, but our cognition and behaviour. SFU researchers study the application of Darwinian Theory to economic behaviour, social history, and subsequent cultural conditions.
5. **The Development of Human Thought, Culture, and Institutions:** Culture and human development are explored in contemporary domains, such as social and cultural contexts that affect cognition, identity, values, artistic and literary creativity, and individual and social welfare.

#### Communication, Computation, and Technology

1. **Materials Science and Engineering:** SFU materials science encompasses research on new materials and their properties, and applied research leading to application-driven engineering and development. Working collaboratively across disciplines, biochemists, biologists, chemists, engineering scientists, molecular biologists, and physicists integrate new materials with existing technologies to create novel platforms and devices. SFU participates in national and international joint ventures, such as the Tri-University Meson Facility (TRIUMF) and Canadian Light Source (CLS).

2. **Intelligent Systems and Computer-Aided Design:** Interdisciplinary research strengths include artificial intelligence, data mining, computer-aided vision, sensors and sensor networks, robotics, mechatronics, microelectronics, embedded systems, and advanced instrumentation. Research in computer-aided design is explored using unified constraint and simulation-based modelling to create computer-aided designs adapted to context and the physical forces.
3. **Automotive Technologies:** Mechatronics integrates mechanical, electronic, control, software, and computer engineering to develop advanced electromechanical products and systems for a wide range of industrial applications. Research into next generation engine mounts, vibration-based energy harvesting, and intelligent systems for autonomous vehicles is complemented by expertise in polymer/electrochemistry, modelling of fuel cells, bio-fuel cells, and proton-conducting membranes. Strong connections with the NRC Institute for Fuel Cell Innovation will aid in the collaborative development of the next generation of nanostructured materials for fuel cell applications.
4. **Imaging Science and Visual Analytics:** SFU researchers study visual data presentation, perception, and use of this data for communication, analysis, and decision-making. Key applications include medical imaging, visual analytics, data mining, business intelligence, finance, manufacturing, transportation, public safety, health, and the environment.
5. **Information, Communication, and New Media Technologies:** Areas of excellence are multimedia, wireless communications, and RF/microwave communications; network systems and modelling; information retrieval and web-based systems; natural language; games, animation, and new media; and life and mission-critical ICT for disaster management, public safety, and disaster relief.
6. **Communication, Collaboration, and Computation:** SFU's Interdisciplinary Research in the Mathematical and Computational Sciences (IRMACS) Centre is a leader in the development and deployment of collaborative technologies supporting nation-wide research. Extensive expertise in fields such as computational security and safety is coupled with strengths in combinatorial algorithm development and qualitative and quantitative modelling of complex social systems using advanced mathematical, statistical, and computational methods.
7. **Technology and the Arts:** Media and computing technologies link interactive arts and technology with musicians, filmmakers, and dancers. SFU foci include the study and design of interactive media technologies, virtual environments, and development of computational systems that produce or simulate creativity.

### **Culture, Society, and Human Behaviour**

1. **Research in the Humanities:** Philosophers, historians, classicists, critics, and linguists investigate and describe the realities of contemporary life, teaching to question and critique the political, social, sexual, economic, and historical frameworks that we live and work in, as world citizens.
2. **Foundations of Ethical Evaluation and Ethical Implications of Research:** SFU has demonstrated strength both in the foundations of ethics and in applied ethics in areas such as business, criminology, education, environmental, political, health sciences, philosophy, and public policy. SFU's leadership role ensures that research positively impacts human welfare.
3. **Aboriginal Studies:** Research into Aboriginal issues encompasses anthropology, archaeology, education, health, history, linguistics, literature, psychology, resource management, and includes examination of contemporary urban and rural issues in the Aboriginal community, preservation of Aboriginal languages, and partnering with bands and communities in Aboriginal education.
4. **International Studies:** New endowed research chairs in religion and cultural change, and international law and human security have advanced research in international studies and policy.
5. **Safety, Security, Criminal Behaviour Assessment and Treatment, and Forensic Studies:** SFU is at the forefront in analysis of criminal behaviour and forensic studies. SFU researchers are breaking ground in areas of security-related research such as polymer chemistry, microelectronics, optics and nano-fabrication of new materials for new high-tech security technologies.
6. **Evolution, Cognition, and Culture:** SFU is poised to become a world leader in an interdisciplinary plan to integrate sciences, social sciences, and humanities in this theme. For example, researchers in archaeology, biology, business administration, linguistics, and psychology are using phylogenetic methods to understand the evolution of a range of social and cultural phenomena.
7. **Urban Communities:** Research strengths include urban design and planning, geography, mathematics, criminology, computing science, economics, and psychology. Researchers study issues of social cohesion, antiracist education, violence in society, multiculturalism, cultural adaptation, and citizenship. In particular, the 'Modelling of Complex Social Systems' program brings extensive

expertise to research the complex dynamics that link the epidemiologies of crime, disease, homelessness, and other social ills in urban neighborhoods.

8. **Intervention Impact Assessment:** Sophisticated research methods are needed to assess the impact of economic and technological changes on society. An interdisciplinary approach will bring together expertise in economics, sociology, psychology, and education, and will position SFU at the forefront of an emerging research need.

### **Economic Organization, Public Policy, and the Global Community**

1. **Economic Organization:** SFU has significant strengths in the analysis of firm organization, law and economics, capital and risk management, the study of economic institutions, strategic change, corporate governance, biotechnology management, and environmental, ethical, and sustainable management of organizations, as well as in computational, experimental, and evolutionary methods.
2. **Public Policy:** The role of the public sector in our economic and social lives has increased as our private wealth has grown over the past decades. This has spurred research on how policy is formed, what policies are good and in what contexts, and on the unintended consequences of policy decisions.
3. **The Global Community and Emerging Markets:** Research focuses on international economic relations, transnational organization, and global culture, including: trade, international finance, and economic development in low-income countries; management of global enterprises; and issues of knowledge, innovation, and technology.
4. **The Creative Economy:** The creative chain for core cultural goods and services, including their creation, production, manufacturing, distribution, and support, has emerged as a substantial and expanding sector of the Canadian economy. Strengths in contemporary and interactive arts, literary and publishing studies, and technology position SFU as a leader in this research area.

### **Environment, Resources, and Conservation**

1. **Planning, Development, Management, and Sustainability:** SFU has a strong record in research on the relationships between economic development, conservation, and biodiversity in terrestrial and aquatic ecosystems. Research will be pursued in areas related to the development, planning, management, and sustainability of human settlements and the impact of human and natural disturbances on environments and communities.
2. **Ecosystems and Resources:** SFU researchers conduct basic and applied research in: wildlife, fisheries, aquatic systems, terrestrial ecosystems, conservation, forest management, landscape ecology, energy and materials management, sustainability and policy models, natural hazards, and geological resources, health and environment, land use, land cover and urban growth.
3. **Climate Change Solutions:** As a founding member of the Pacific Institute for Climate Solutions (PICS), SFU researchers are well positioned to contribute to the development of innovative climate change solutions, seek new opportunities for positive adaptation to climate change solutions, and lead the way to a vibrant low-carbon economy in BC and globally.
4. **Alternative (Green/Clean) Energy Technology:** SFU is well positioned to become a leader in green energy technology research. Interdisciplinary initiatives focus on energy production, distribution, and utilization, along with related manufacturing technology and green IT. Current research includes fuel cell materials, design and diagnostics, energy management and harvesting, green IT technology and computing, new generation fuel injectors for hydrogen technology, smart grids, and smart houses.
5. **Aboriginal Communities and the Environment:** Research strengths are in applications of resource management and resource planning to Aboriginal communities, with a particular focus on Aboriginal and place-based community co-management, forest, fisheries and aquatic management, protected areas and heritage planning, geographic information systems, and strategic land-use planning.

### **Health and Biomedical Sciences**

1. **Genomics, Bioinformatics, Health Informatics, and Biomedical Technologies:** Research foci involve computer scientists, engineers, interactive arts researchers, biomedical scientists, kinesiologists, and psychologists working with clinicians to develop new tools and products. The combined effort will address issues of human health, ranging from molecular, cellular, and systems biology, to population health and modelling.
2. **GE3LS (genomics – ethics – environment – economics – law - society) Analysis:** Consequences of scientific and technological innovations are significant and have ethical, economic, environmental, legal, and social implications. Research will explore how society deals with these consequences and will inform and have an impact on legislation to control innovative growing practices in agriculture,

and economic and environmental practices in fisheries and forestry.

3. **Chronic and Infectious Diseases:** Research strengths are in genomics, bioinformatics, proteomics, biomolecular interactions, and psychological and psychiatric disorders. Two SFU-funded teams are capitalizing on SFU's unique strengths to discover and test potential new therapeutic targets, and to take novel molecules and nanomaterials from the lab to clinic and develop strategies for medical imaging, diagnostics, surgery, and drug delivery. Additional strengths exist in virtual reality therapy and training, and visualizations and accessible tools for pain management.
4. **Human Development and Aging:** From molecular genetics or epigenetics of cellular differentiation, to cognitive development, brain function and problem-solving, SFU's expertise includes mental health, children's health policy, youth crime and violence, gender and aggression, neurobiology of addiction, assistive technologies, age-related degenerative diseases, and longitudinal studies on aging. Strategic investments have enabled SFU to leverage expertise in imaging, psychology, neuroscience, genetics, epigenetics, and cellular physiology to improve health planning and delivery outcomes.
5. **Population and Public Health and Health Services:** A leader in the secure analysis of sensitive data (Population Data BC), SFU will expand research areas such as infectious diseases and global health, bridging biomedicine, health services, population and public health, environmental and occupational health, global and Aboriginal health, ethics, and health economics and policy, with the goal of improving health services models and uptake of best practices in primary health care.
6. **Health Systems:** Research strengths include comparative studies of international primary health care systems, chronic disease prevention and management approaches, forecasts of health care needs and health system responses, assessments of the impact of primary care interventions on indicators of population health, community assessments of the social determinants associated with chronic disease distribution, and the issues of health equity, social justice, and ethics in health care.

### **Pedagogy**

1. **Foundations for Success:** Research seeks to understand the impacts of foundational educational programs in academic literacy, mathematics, and technical literacy on success in academe and the workplace. SFU researchers are exploring mathematics education, the role of technology in teaching, and virtual worlds for course delivery.
2. **Education and Human Development:** Research looks at the role of education on focusing and fostering human growth and development across the lifespan from early childhood through later adulthood in a variety of settings within and beyond schools.
3. **Education for Diverse Populations:** SFU has significant expertise in second language acquisition and pedagogy, civics, and issues in international education. Research has also led to advances in our understanding of multicultural practices, and in the development and testing of innovations in the uses of media, technology, and pedagogical methods to support education for diverse populations.
4. **New Models for the Delivery of Medical Education:** Research focuses on integrated care built around clinical disciplines that reflect patient needs, such as acute care, chronic disease management, mental and developmental health, and rehabilitation, and builds on SFU's strengths, including e-health, cognitive and imaging sciences, molecular biology, biochemistry, immunology, epigenetics, epidemiology, mathematical modelling, virtual reality, social policy, and biomedical engineering.
5. **Technology and Education:** SFU is poised to take a leadership role in the research domain to understand the pedagogical basis of online and blended learning; topics include mechanisms of learning, models of teaching, designs for curricula, policy assessment and development, leadership, and professional conduct in technologically enhanced teaching and learning.
6. **Education for Sustainable Development:** Research focuses on the development, monitoring, and evaluation of environmental learning initiatives and the ongoing identification of sustainability indicators and evaluation tools.

### **Areas of research in which the university intends to deploy Chairs and/or CFI support:**

The CRCs and other prestigious Chairs at SFU serve to seed and catalyze new initiatives and strengthen existing programs. The CRCs primarily serve SFU's strategic research priorities and are used to attract and retain outstanding researchers. SFU recognizes the value of further investment in selected areas that complement the resources of the Chairs. The VPA and VPR jointly make decisions about CRC allocations after consultation with the Faculty Deans; they strive to increase the representation of females in Chair positions. The table on the following page shows the CRC appointments by funding agency, indicating where they fit within the SRP's thematic areas. Currently, 15 Tier 1 and 25 Tier 2 CRCs are filled; CRC positions that are awaiting nomination are not included.

Research Themes	NSERC		SSHRC		CIHR		Total	
	1	2	1	2	1	2	1	2
Tier (1 or 2)								
Origins	0.5	2	0	0.5	0	0	0.5	2.5
Communications, Computation & Technology	5	5	1	0.5	0	1	6	6.5
Culture, Society and Human Behaviour	0	0	0	3	0	0	0	3
Economic Organization, Public Policy, Global Community	0	0	2	2	0	0	2	2
Environment, Resources and Conservation	2	3.5	0	0	0	0.5	2	4
Health and Biomedical Sciences	1.5	3.5	0	1	1	2.5	2.5	7
Pedagogy	0	1	2	0	0	0	2	1
<b>Total by Tier</b>	<b>9</b>	<b>15</b>	<b>5</b>	<b>7</b>	<b>1</b>	<b>4</b>	<b>15</b>	<b>26</b>
<b>Total by Chair Type</b>	<b>24</b>		<b>12</b>		<b>5</b>		<b>41</b>	

**Development of research and research training in strategic research themes and plans for new areas of research:** SFU has made targeted investments in its strategic research themes through the allocation of endowed Chairs and CRCs, who in turn bolster recruitment and retention efforts. SFU has also allocated Community Trust Endowment Funds to seed interdisciplinary research teams working in strategic areas and has invested in industry liaison activities that expedite knowledge transfer, including spin-off companies and licensing agreements. Significant investments have been made to support researchers in our Faculty of Health Sciences, and in emergent research areas such as mechatronics. SFU has committed significant resources to expand graduate training through the provision of graduate fellowships in the Humanities, applications to NSERC's CREATE program, innovations such as the Modelling of Complex Social Systems Graduate Certificate Program, and investing in emerging CIHR teams. We attempt to enrich the undergraduate research experience through the provision of research assistantships. New multi-university training initiatives link SFU with partner institutions worldwide.

**Planned inter-institutional and inter-sectoral collaborations:** SFU has a number of established inter-institutional collaborations with other research facilities, such as TRIUMF, Bamfield, Canadian Design Research Network, Centre for Drug Research & Development, Metropolis British Columbia, and the Pacific Institute for the Mathematical Sciences (PIMS). Researchers from SFU are participating in two new National Centres of Excellence: the NeuroDev Network; and Graphics, Animation and New Media (GRAND). We also have collaborations with other universities and research institutions for specific projects, including WestGrid, ATLAS (CERN large hadron collider), ALPHA Antihydrogen Project, BCAT-5 Project, Canadian Longitudinal Study on Aging, Canada's World Project, Canadians Abroad Project, Canada-Sub Saharan Africa HIV/AIDS network, Human Security Report Project, Intellectual Property Issues in Cultural Heritage (iPINch), the Canadian Multi-site Research Demonstration Project in Mental Health and Addiction, the Canadian Observational Cohort Collaboration research network, Synergies, and Service-oriented Programmable Smart Environments for Older Europeans, (SOPRANO Project). SFU is also playing an important role in harmonizing national research ethics protocols.

**Describe how the university will assess its success in meeting its objectives:** SFU will undertake a periodic evaluation of research outputs using metrics appropriate to the diverse individual and interdisciplinary activities. These data may include journal and conference publications, books, chapters, monographs, patents, workshops, policy papers, performances, exhibitions, awards, and honours. Data will be solicited annually through Deans' offices at the time of faculty review. A common framework for reporting will establish a baseline from which we can gauge advancement in a particular discipline. Measures of output will also be obtained through the use of bibliometric analysis tools, such as Thomson-Reuters' *InCites* using data from *Web of Science*. Annual data from ReSearch Infosource and CAUBO will be used to evaluate SFU's research performance relative to other Canadian universities. Data to evaluate the growth of SFU's internationalization efforts as they pertain to research will also be solicited. Together, these data will be used to monitor SFU's progress towards achieving our SRP objectives and to evaluate overall research performance and research capacity.

**Planning and Approval Process:** In 2009, the VPR began a six-month consultative process to optimize the SRP to guide SFU through 2015. All SFU community members could provide input, which enabled articulation of SFU's strengths by amplifying original integrative research themes from the 2005-2010 SRP and adding new themes/subthemes. This SRP was finalized in 2010 enabling SFU to coordinate strategic investment in thematic areas through major grants, strategic faculty hires, seed funding for workshops/conferences, distinguished scholar visits, research support for students, and other initiatives.