

THE UNIVERSITY OF MANITOBA – STRATEGIC RESEARCH PLAN 2015-2020

INTRODUCTION AND CONTEXT

The University of Manitoba is steeped in a tradition of excellence that stems back over 135 years, and which supports and affirms the value of discovery-driven and applied research, scholarly activities and creative works. Fueled by innate curiosity and the determination to pursue innovation, our researchers decipher the inner workings of our natural environment on all scales, from identifying the biological and chemical workings of life to imaging the outer reaches of our universe. By doing so, they inform, grow and enhance the fundamental relationships between civilization, society and our natural world. In applied sciences, our researchers use existing and new knowledge to generate insights that deliver practical solutions to modern-day problems. As Manitoba's research university (and only medical-doctoral university), we serve a broad community of students and researchers with diverse academic and research programs. Our connection to the agricultural and natural landscapes of the Canadian West, to the Arctic, and to local and Indigenous communities has shaped the research focus at the University of Manitoba. Our research therefore addresses both local and global questions of importance, enhancing the lives of Manitobans, Canadians and citizens of the world through new ideas, processes and technologies. This Strategic Research Plan will serve as a roadmap over the next five years for the University of Manitoba to champion research excellence. Through identification of "thematic" and "signature" areas of research based on our established and emerging strengths, we will address the most pressing issues facing Canadians as well as global society.

STRUCTURE OF THE PLAN

While the Strategic Research Plan recognizes and supports the importance of a full spectrum of impactful research, scholarly activities and creative works, it also reflects a number of core thematic and signature areas for enhancement. These were determined through intensive consultations and chosen based on their uniqueness, their potential to draw on strengths from across the University that combine teaching, research, scholarly activities and creative works, public service activities, and their relevance to Provincial priorities in today's rapidly changing society. Signature areas related to themes were identified based on established strengths and were assessed by metrics such as: i) relevance to issues of priority provincially, nationally, and internationally; ii) impact on society; iii) contributions to discovery and innovation; iv) attraction of resources; v) prominent research leadership; and vi) significant collaboration and engagement. These signature areas will drive institutional initiatives and investment, ensuring the research enterprise continues to be at the leading-edge of discovery and translates these discoveries to benefit society.

Within the core strategic research areas of this Strategic Research Plan, described below, three research themes have been identified as cross-cutting: **UNDERSTANDING AND COMMUNICATING INFORMATION; INDIGENOUS RESEARCH; SUSTAINABLE SYSTEMS FOR RESILIENT COMMUNITIES**. These areas of inquiry transcend the boundaries of multiple themes, bringing together researchers across disciplines and Faculties/Schools to address pressing questions facing Canadian and global societies. Researchers in the area of Understanding and Communicating Information are taking on research questions relating to large-scale, complex and multi-dimensional data in new and innovative ways. Their research addresses all aspects of complex data, including collection, movement, extraction and representation, analysis, visualization, and application. University researchers working on research questions in areas such as sensing, data mining and human-computer interaction are revolutionizing the way we acquire, engage with, and understand information. The future will require robust research to develop new mathematical, statistical, and computational techniques and new sensing systems that have a wide variety of applications.

Research for, with, and by Indigenous peoples is an important cross-cutting dimension of scholarship at the University of Manitoba and is an area of great contemporary relevance given the historical and developmental consciousness shared by Indigenous and non-Indigenous peoples and communities in Manitoba, Canada and the world. University researchers engaging in Indigenous scholarship disseminate knowledge in innovative ways, employing cutting-edge methodologies while cultivating relationships with external stakeholders. Researchers engage with their respective work in ways that honour the opportunities to improve the lives of Indigenous peoples locally, nationally and globally, and strengthen the way in which Indigenous and non-Indigenous peoples interface.

Fundamental research on Sustainable Systems for Resilient Communities is crucial to the future of Manitoba and Canada in the context of changing climate and increasing resource scarcity. University researchers examine questions of sustainability with three main foci: economic, social or equity-based and environmental; each with unique perspectives, along with key overlaps that allow for interdisciplinary investigations. This commitment to building sustainable communities within our region bridges the University's strengths in discovery-driven scientific research and interdisciplinary areas including water systems, Arctic research, sustainable food production, and research into sustainable buildings and energy systems. Noteworthy strength in the interdisciplinary area of community resilience exists at the University's Natural Resources Institute.

RESEARCH THEMES

ARCTIC SYSTEM SCIENCE AND TECHNOLOGY: Over the past 20 years, the University of Manitoba has emerged as one of the leading research institutions in the world in the field of Arctic System Science and Technology. At the core of this development is the Centre for Earth Observation Science (CEOS). CEOS has earned national and international recognition in fundamental research and technological development focusing on the physical, biological, geological and biogeochemical processes operating within a rapidly changing Arctic system. University researchers in Arctic System Science and Technology bring a holistic perspective to research which increasingly emphasizes the interconnectivity of the natural environment, resource development, people, and policy in the Canadian and circumpolar Arctic, as well as teleconnections to temperate regions on the Earth. Increasing political and economic interest in the Arctic, including the rapid expansion of development and resource extraction, demands such an integrated research vision that takes into account both the human and natural environments. Research in this area at the University has an immediacy generated by our province's geographic connection with the Canadian Arctic. Supporting the sustainability of northern communities is a concern at the heart of Arctic System Science and Technology research. Collaborative relationships with Arctic Indigenous communities and peoples who carry the knowledge needed to guide research in culturally sensitive and effective directions are central to the practice of research in the region. By connecting researchers in areas such as Arctic governance, policy and security and the culture and traditional knowledge of Arctic Indigenous people with our team of researchers in climate change, sea ice and oceanography, the University is ideally placed to provide the interdisciplinary expertise needed to effectively carry forward Canada's vision and role in the Arctic into the future.

CULTURE AND CREATIVE WORKS: Living in a city widely known for its vibrant creative community and cultural diversity, researchers at the University deepen our knowledge of the human enterprise. By asking who we are, where we come from and where we are going, researchers search for meaning in our histories, and seek critical awareness in and of our cultural differences. The search is accomplished through investigation, intuitive findings, historical research, critique and reflective action that inspire us to invent, innovate, design, compose, perform and transform. The creative process invites collaborations, which cross over disciplines, and involves close working relationships among academics, students, organizations and communities locally, nationally and globally. At the University, collaborative research, scholarly and creative works are at the heart of activities in the Faculties of Architecture, Arts, and Music, the School of Art, and also reaches into the Asper School of Business and Faculties of Engineering, Kinesiology and Recreation Management, Law, Science and Social Work. The new 70,000 square foot ARTlab is central to creative growth at the University by providing researchers with access to specialized studios and digital technologies for experimentation and study. The rich collections of the Gallery in the School of Art and of the Architecture and Art Library provide a strong basis for research in art and architectural history. The Taché Arts Project, a new state-of-the-art 158,000 square foot facility, will soon be the heart of a new visual and performing arts hub with dedicated studios, exhibition and concert spaces.

FUNDAMENTAL RESEARCH: Fundamental research underpins many of the results from applied disciplines that directly impact our daily lives. Researchers ask critical questions such as what are the origins of the universe and all forms of life in it? They build on the tradition of the classical sciences to enhance the ability to fathom our place in the world and our interactions with it. They use a multitude of modern tools and techniques, including experimental, qualitative, archival, analytical and computational to explore and understand phenomena from the incredibly large to the exceptionally small, from the concrete to the abstract. Researchers at the University have garnered widespread recognition for their extensive accomplishments, as well as for international collaborations and leadership in many areas of fundamental research ranging from molecular and structural biology, sub-atomic and astrophysics to ecology, predictive modelling and simulation and archaeology, Canadian history and linguistics. Fundamental research at the University of Manitoba has much to offer including its perspectives and contributions to the University's other specific and cross-cutting research themes, and three identified research signature areas. Our researchers have expertise across areas such as environmental chemistry and biochemistry, indigenous history and culture, Arctic ecology, host-pathogen relationships and the understanding and modelling of disease spread, to name a few, which provide the holistic

foundation to address complex problems. Never has this been more important than it is now, as we must face the challenge of fully understanding human activities from multiple perspectives to ensure that they are of benefit to all, are collectively sustainable and do not negatively impact the viability of the planet.

HIGH PERFORMANCE MATERIALS, STRUCTURES AND PROCESSES: Materials and materials processing are major components of the Canadian manufacturing sector, contributing half of the business research and development to its economy. In keeping with its importance to Canada, researchers at the University are major contributors to established, multi-disciplinary research on areas of materials science and materials processing that cover the entire spectrum of research and technology development from basic sciences to industrial applications. Innovative infrastructure at the University supports research surrounding the chemical, structural and morphological nature of surfaces and bulk materials, as well as provides tools for microsystems fabrication. The University is also home to a Compute Canada/Westgrid node, housed in the High Performance Computing Centre, which is a powerful tool for rapid complex calculations and simulations and is now the centre for computational chemistry for Western Canada. These facilities, along with the Manitoba Institute for Materials, which fosters networking and engagement among researchers in different disciplines, are foci of collaboration within the University and with other academic institutions and industry. From characterization of minerals to materials physics, nano-materials, biomaterials, bioprocessing, advanced manufacturing, microelectronics, sensors and medical textiles, University researchers are collaborating with local, national and international colleagues, industries and governments to improve materials and processes used in aerospace, health, biomedical engineering, manufacturing and sustainable resource processing. Researchers in this area are also creating innovative technologies that conserve resources, reduce harm to the natural environment, and create a healthy built environment. Research into energy and power production systems, clean technology, sustainable infrastructure, structural health monitoring, efficient transportation, low carbon environments and high performance designs for energy efficiency and efficient waste management systems will continue to improve the sustainability of local communities. Collaborative research on sensors, applied electromagnetics and telecommunications supports the University's cross-cutting theme of understanding and communicating information.

HUMAN RIGHTS AND SOCIAL JUSTICE: Winnipeg and Manitoba have a deep history of social justice and human rights activism, with the influence of the social gospel movement, the struggle for women's suffrage, the impact and legacy of the Winnipeg General Strike, and efforts to address issues of Indigenous justice and reconciliation all contributing to a contemporary focus on this critical research area. With national and international attention currently focused on the Canadian Museum for Human Rights, the University is well placed to encourage research, scholarly work and creative activities around human rights in Canada and abroad. It will also soon be home to the National Research Centre on Truth and Reconciliation, which will house the archives of the Truth and Reconciliation Commission, and become a national site for human rights research and engagement with Indigenous communities. The focus of University researchers on human rights and social justice crosses departmental and disciplinary boundaries. These collaborations find home in and are supported by the Arthur V. Mauro Centre for Peace and Justice, the Centre for Professional and Applied Ethics, the Centre for Human Rights Research, RESOLVE, the Manitoba First Nations Centre for Aboriginal Health Research, the Centre for Environmental Health Equity, the Health, Leisure and Human Performance Research Institute, and the Canadian Journal of Human Rights. Researchers working on *human rights* are interested in individual and collective rights, and domestic and global applications of rights; they examine the tensions that arise from competing rights, theories of rights and rights norms, contestation of rights, and efforts to address violations of human rights. Specific areas of research at the University include gender and sexuality, disability, migration, citizenship, genocide, environmental rights such as water stewardship, Indigenous rights, race and ethnicity. Researchers working on issues of *social justice* explore equity and access to social opportunities, including work, health care, education and other social benefits, the continuum of marginalization and oppression to societal inclusion and participation, social movements, socially just and safe organizations and markets, applied ethics, peace building, conflict resolution, and violence and redress.

INTEGRATIVE RESEARCH IN HEALTH AND WELL-BEING: Improvements to the health and well-being of individuals, communities and diverse populations are achieved by weaving together disciplinary and community knowledge in an iterative process of synthesis and evolution. Engaged in this process are governments, university faculties, government-funded organizations (e.g., health authorities and hospitals, the public education system), industry, research institutes, not-for-profit organizations, and communities. At its foundation, the health and well-being of the population is critically dependent on basic, clinical, health system and population-based research and on effective integration of the knowledge it generates into healthcare practice. In this regard, the University of Manitoba is a leader in fostering such integration of knowledge, driven by the principle of collaboration across all faculties and with our partners. To realize the vision of leading integrative research in health and well-being, the University created the "Cores" and "Clusters" Programs. The Cores Program is intended to provide University faculty and partners with access to state-of-the-art infrastructure to support all four of the research pillars of the

Canadian Institutes for Health Research. The University is actively investing in research within these cores to constantly evolve their science. The Clusters Program is our engine for the integration of health and well-being research within a given field of study. Clusters are comprised of multidisciplinary, multi-pillar researchers who consolidate their strengths, and engage patients and decision makers, to address a specific gap in health research. They are intended to emerge, evolve and end as specific issues are identified and addressed, thus creating a flexible and responsive mechanism for researchers to participate in teams that benefit from and expand their expertise. By creating teams of researchers focused on an overarching theme in an interdisciplinary and multi-institutional manner, we are supporting transformational research that advances Manitoba researchers as national/international experts in a field.

SAFE, HEALTHY, JUST AND SUSTAINABLE FOOD SYSTEMS: Effective local and global food systems must yield safe, nutritious, culturally-appropriate and affordable food for all in a manner that addresses the health of our agricultural and other ecosystems, minimizes negative impacts on the environment and contributes to developing strong communities and economies. This vision is challenged by the changing climate, demography, and widening inequalities in domestic and international markets. The University possesses and cultivates the expertise to help build safe, healthy, just and sustainable food systems that are economically viable and can adapt to the rapid change our province, nation and the world are experiencing today. Our researchers in this area are nationally and internationally recognized for contributions made to an improved understanding of the intimate connection of food systems to the environment. University researchers seek to understand the social, cultural, political, ecological and economic factors that shape our diverse food systems and to optimize nutrition for the health of individuals and communities. The University researchers working in this area link fields in the natural and social sciences, engineering and health research to address issues related to food and nutritional security and food sovereignty. Research into sustainable food systems is supported by the National Centre for Livestock and the Environment, which provides a national resource and sample and data archive related to the interactions of crop and livestock production and the environment. A safe, healthy food supply is essential for maintaining societal and economic well-being and stability. Food safety and nutrition research at the University occurs at the Richardson Centre for Functional Foods and Nutraceuticals, and the Canadian Centre for Agri-Food Research in Health and Medicine. The Canadian Wheat Board Centre for Grain Storage Research supports research into grain quality and safety, including research on machine vision for grain imaging and quality monitoring.

SUSTAINABLE WATER MANAGEMENT SYSTEMS: The University's expertise in the management of water quantity and quality at the regional-, watershed-, and farm-scales is contributing to the long-term sustainability of our land, rivers, and lakes. Researchers are generating new knowledge and technology critical to Manitoba's agricultural, energy and fishing sectors, community development and sensitive ecosystems with the support of government and industry. By participating in national climate networks, water researchers contribute to the physical understanding and modeling of the water cycle and extreme weather at various scales of time and space. This higher resolution climate modeling, coupled with expertise in water management systems at farm and watershed-scales, will reduce vulnerability to climate change and extreme weather events through the generation of novel technologies to mitigate flood risks, drought conditions and acute water pollution problems, and through the improved ability to anticipate changes and their impact. Sustainable water management practices draw on research addressing the interface of land and water, river ice engineering, turbulence, fluid movement and dynamics, building design as well as the hydrologic, biological and atmospheric sciences. Our institutional leadership in combining technical expertise in water and wastewater expertise with Indigenous knowledge, language, law and methodological skills training, will address the growing needs of remote and aboriginal communities striving to improve living standards. Water resources in Canada and Manitoba play a crucial role in driving the economy, advancing social welfare and quality of life. The provincial government and other stakeholders are working towards an effective long-term integrated watershed management plan that reflects the province's diverse landscape, in order to maintain a healthy and sustainable watershed community. Environmental areas encompassed by this research include energy and power production systems, emerging or clean technology, biotechnology, the integration of performance systems, extreme weather environments and climate hazards, sustainable materials, water systems and flooding, and the exploration of bio-regions in Northern and Southern Manitoba. The impacts that these important emerging research, environmental and industrial activities may have on ecological systems and the diverse organisms found within them are critical to the ongoing sustainability of Manitoba's prairies and the northern communities.

SIGNATURE AREAS (ESTABLISHED AREAS OF EXCELLENCE)

Arctic System Science and Climate Change: The University is home to internationally renowned programs of research in Arctic science, climate change and its effects on Arctic sea ice. Ongoing major investments and partnerships in this area, including a Canada Excellence Research Chair in Arctic Geomicrobiology and Climate Change, the Amundsen research vessel,

the Sea-Ice Environmental Research Facility, co-leadership in the ArcticNet Networks of Centres of Excellence and the Arctic Science Partnership, have cemented the University's place as a world leader in this field. As the realities of global temperature increase and melting sea ice become increasingly apparent, research in this area is crucial to understanding, mitigating and adapting to the effects of a changing climate on Canada's Arctic and the world.

Immunity, Inflammation and Infectious Disease: Bolstered by the presence of the CIHR Institute of Musculoskeletal Health and Arthritis, the National Microbiology Laboratory and two national training programs in immunology and infectious disease, University researchers are receiving international recognition for their leadership in immunity, inflammation and infectious disease research. Basic and translational research related to allergy and asthma, inflammatory bowel disease, multiple sclerosis, rheumatoid arthritis, transplant immunology, sexually transmitted diseases, human immunodeficiency virus (HIV), sepsis, emerging infections and antimicrobial resistance is transforming our understanding of the relationship of the immune system and inflammation to disease, and is leading the way to new treatments and vaccines for existing and emerging infectious diseases.

Population and Global Health: The University has built a world-leading team of researchers in the areas of population and global health, with highly developed networks of international partnerships and collaborations. The Centre for Global Public Health has been at the forefront of basic and applied research in HIV prevention with an established reputation of innovative work in maternal, neonatal and child health, including the health of Indigenous populations, both in Canada and globally. The Manitoba Centre for Health Policy has been an international leader in the development of health services and population health research, including the impact of social, economic, and regional factors on health and social outcomes. University researchers are working within Manitoba, Canada and across continents to better understand the effects that the actions and characteristics of individuals, communities and populations have on health, and are engaged in the development of effective public health strategies and interventions for communicable and chronic disease prevention.

MEASURING THE PLAN'S SUCCESS: Given the outline of the Plan's objectives, measures of success will include indicators of: (a) research capacity-building through recruitment and retention of outstanding faculty; (b) networking, partnership and collaboration (local, national, international, within and between disciplines/sectors); (c) recruiting top students and providing outstanding training opportunities; and (d) knowledge dissemination and translation.

DEPLOYMENT OF CANADA RESEARCH CHAIRS AND CANADA FOUNDATION FOR INNOVATION ALLOCATIONS: Calls for chair proposals are issued jointly by the Vice-President (Academic) and Provost and the Vice-President (Research and International). Calls for infrastructure proposals are issued by the Office of the Vice-President (Research and International) to deans and directors of faculties and schools, and affiliated institutions. Units submit proposals based on their research strategic plans, taking into account the University's Strategic Plan 2015-20 and the research and research training themes and signature areas outlined in this Plan. Based on the submissions received, as well as other institution-wide planning initiatives, the University's senior executive committee approves proposals and strategies. The University recognizes the significance of these resources in its ability to attract and retain outstanding faculty and to establish world-class facilities in its continuing pursuit of research excellence.

PLANNING AND APPROVAL PROCESS OF THE PLAN: The University's Senate Committee on University Research endorses the Strategic Research Plan, which is then forwarded to Senate for discussion. The Plan is subsequently approved by the University's President, who, as stipulated in the Canada Research Chair (CRC) Program Guide, is accountable for the Plan. This Strategic Research Plan was developed through a process of extensive consultation with the University of Manitoba's faculties and schools, and the research community, including the network of Associate Deans (Research)/Research Liaison Officers.

DESIGNATED GROUPS IN RELATION TO CRC NOMINATIONS: The issue of excellence and equity will be addressed by ensuring that recruitment and retention processes are free of barriers to nominating members within the designated groups of women, persons with a disability, Aboriginal Peoples and visible minorities to CRC positions particularly in disciplines/fields where they are under-represented in terms of these positions. This includes: ensuring efforts are made to have an appropriate balance of designated groups on all search committees; including a statement in CRC advertisements that particularly encourages members of designated groups to apply; mandatory training of all search committee chairs on processes and issues related to equity and diversity; the appointment of the Associate Vice-President (Research) to all search committees; and the review by the Office of the Vice-President (Academic) and Provost of all search processes to ensure that each has adopted a proactive approach to the identification of qualified members of designated groups for CRC positions.