



CRC Tier II – Incorporating Social and Cultural Decision Making in Engineering Design

In engineering, “Triple Bottom Line” (TBL) analysis includes the consideration of economic, environmental, and **social** aspects of a design. TBL has been adopted in legislation and strives to produce the most fiscally responsible design while protecting the environment **and** considering desirable social and cultural outcomes. Accounting for fiscal aspects of design is relatively straightforward, and engineers are continually developing and improving standards to protect, or even enhance, the environment. By contrast, analysis of social enhancement through design is a noble cause, but tools and standards for engineers to meet the demands of this third pillar are limited. Furthermore, neglect of the third pillar of the triple bottom line has real consequences for people’s mental health and social wellbeing, and it is incumbent on engineers to take responsibility and develop the tools needed to raise the social pillar to equal status with fiscal and environmental considerations in design.

Considering the typical Canadian metropolitan area, for example, planners have used vehicle access, zoning, and other tools to layout city plans while engineers have dictated transportation routes and lot configurations based on the most economical method to supply services such as water, sewer, energy, and telecommunications. People have adapted, trading higher-cost social and emotional benefits for lower-cost services. Meanwhile municipal governments spend endless hours producing and enforcing bylaws to combat the conflict between human behaviour, driven by complex social and emotional needs, and the designed infrastructure. Canadians spend millions of dollars dealing with social problems that may, in no small part, be a consequence of the design of our communities.

New thinking in engineering and design is just beginning to look more carefully at the impact of this third pillar. Engineering schools are incorporating and expanding the concept of human-centred design, a framework that helps designers understand human factors by involving the people impacted in the design process. International collaborations are examining the impact of engineering and urban design on mental health in traditional, metropolitan communities. Case studies have focussed on major centres like Toronto, Vancouver, and Montreal. For Canada, an even more obvious application is the development of remote and Indigenous communities. The traditional engineering approach has disrupted the cultural norms that have grown over millennia to meet the social and emotional needs of specific communities. What positive impacts would be achieved if the people living together and sharing a culture had the ability to layout their own community with service costs as a secondary consideration to social and cultural needs?

A major gap in effecting social change lies in the challenge of the engineering profession to translate knowledge gained from research conducted in social science and policy fields into engineering design practice. Triple Bottom Line in engineering design needs tools and standards that will enable social and cultural considerations and human mental health needs to drive engineering design at the same level that fiscal responsibility and environmental stewardship do. Developing these tools and standards requires broad, evidence-based, multi-disciplinary research **in engineering** at a level well suited to a CRC.



Enhancement of College Goals and Performance

The College of Engineering recently undertook significant consultation with both internal and external stakeholders to inform our new strategic plan. Adaptation to climate change; energy, water, and food security; changing demographics; aging population; and Indigenous engagement and community development emerged as important themes for the college to focus on in the next 10 or more years. The College also recently undertook a first-year redesign process that examined how to integrate more design-based learning and Indigenousization into our first-year engineering curriculum. An advanced research program in design principles would provide research leadership in an area identified by many stakeholders as critical for this College and the University of Saskatchewan. In addition, it would provide a rich body of knowledge to help inform our engineering curriculum, and curricula across Canada and beyond, to produce engineers with the skills and knowledge to work closely with clients and communities to achieve their social and culture priorities. The aim is to develop evidence-based tools to train “engineers the world needs.”

This CRC would work closely with several existing leaders and advanced research programs. The CRC would work with **Dr. C. Y. (Tony) Chung’s IRC in Smart Grids and the new CRC Tier II: Technology Solutions for Energy Security in Remote, and Indigenous Communities** to ensure their work on designing energy infrastructure is informed by the best, most up-to-date practices in TBL engineering, while their work would provide a rich platform to develop and test new cultural- and human-centred design principles. The proposed CRC would help transition clean and green technologies developed through **Dr. Ajay Dalai’s CRC Tier I: Bio-energy and Environmentally Friendly Chemical Processing** to commercial adoption by fostering community engagement and buy-in. **Dr. Kerry McPhedran, Centennial Enhancement Chair in Water Stewardship for Indigenous Communities** is emerging as leader within the college and university on research related to water security and Indigenous community development, and the proposed CRC would work closely with him in some major community-based initiatives with First Nations and Métis communities. The proposed chair would also work closely with **Dr. Sean Maw, Jerry G. Huff Chair in Innovative Teaching**, on translation of knowledge generated through the research into teaching and learning in the college.

Nurturing Cross-Unit Activity

Endowed chair in Renewable Energy in Northern, Remote and Indigenous Communities (Dr. Greg Poelzer) and proposed CRC I Community Energy Planning in Northern, Remote and Indigenous Communities (School of Environment and Sustainability): In collaboration with SENS, we have identified four key research pillars essential to understanding and ensuring energy security: 1) Energy Policy and Regulation; 2) Science and Technology; 3) Social and Economic Value of Energy; and 4) Translating Knowledge into Practice. Currently, the institution has proven strength and leadership in pillars 1 and 2 (Dr. Poelzer et al. on pillar 1; Dr. Chung and CRC II in Technology Solutions for Energy Security on pillar 2). Part of making the case for the transition to alternative, clean,



and distributed energy requires the ability to make the economic case, a critical component of which is the ability to place an actual dollar value on the human and social costs and benefits. The College of Engineering recognizes this as an important aspect required to move technology-based research toward commercial adoption. This is a pillar the institution requires leadership in, and the CRC proposal by SENS would fill this gap. Meanwhile, the fourth pillar of Energy Security involves developing best practices for engineers and community designers to work with communities on technology adoption. This pillar involves concepts of urban planning and community design, impact of design on social and mental health, and frameworks like Triple Bottom Line, all of which require broad, high-level research to be conducted in Engineering. Communities will be better served with engineering knowledge and practices that help design energy systems to support the social and cultural needs of the community seeking to adopt new technologies.

Geography and Planning: We expect strong synergies and close collaboration with the Department of Geography and Planning, particularly in their **Planning and Management of the Built and Natural Environment** focus area. Specific synergies would be in: Indigenous health policy network analysis of northern Saskatchewan: linking climate change, youth suicide, decision making and policy gaps; Indigenizing city planning processes in Canada's large Prairie cities; Examining the role of citizens, artists, community-organizations, businesses and decision makers in approaches to urban change that honour diversity.

Public Health, Saskatchewan Centre for Patient-Oriented Research (SCPOR), Indigenous Peoples Health Research Centre (IPHRC): Until engineers have the knowledge, tools, and frameworks to consider the social and mental health implications of their designs along with the environmental and economic implications, engineering remains, at best, an untapped source of social health intervention and, at worst, a perpetuator of social and mental health problems in society. A critical aspect of this CRC will be to work with the public health researchers and organization like SCPOR to help develop evidence-based solutions to social problems through engineering design.

Potential to recruit an excellent candidate from the four designated groups (FDGs) – Women, Visible Minorities, Persons with Disabilities, and Indigenous Peoples

There are numerous international organizations and journals devoted to urban planning and engineering that can be used to identify and recruit candidates (e.g., *Journal of Urban Planning and Development*; *Proceedings of the Institution of Civil Engineers - Urban Design and Planning*). Research centres for urban design devoted to examining the social impacts are common internationally, and many leading universities have training programs in this area (e.g., Stanford). A review of literature and expertise shows a high proportion of women working in this field. It also shows that architects and urban planners are more common, indicating there is an international role for engineering research and leadership in this field.

Additionally, a review of recent papers from the American Society for Engineering Education (ASEE) reveals a growing body of science and HQP training in this area at a number of US schools.