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**Addressing Major Global Challenges through Science and Public Policy: Transdisciplinary and Multidimensional Approaches**

Organized by: Gordon McBean and Anne Ballantyne | International Council for Science and Centre for the Study of Science and Innovation Policy (CSIP), JSGS, and University of Saskatchewan

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**Takeaways and recommendations**

* All stakeholders need to recognize the importance of working across scientific disciplines and in partnership with policymakers, civil society and industry to develop evidence-based policies that address “wicked” problems related to the management and sustainability of environment, natural resources, health and economic systems. The World Economic Forum’s 2017 Global Risks assessment put extreme weather events, natural disasters and large-scale involuntary migration as 3 of the most likely high impacts risks and linked these and others to governance failures at the global to national levels.
* Transdisciplinary research needs to be multi-sectoral, multi-dimensional and have multi-level governance. Internationally, the International Council for Science and the International Social Sciences Council are merging to create the International Science Council, for all sciences, to address the global challenges and to advance all sciences as a global public good. Transdisciplinary research should:
  + Be guided by a clear identification of the problem being addressed.
  + Integrate the social and human dimensions, bridging cultural, linguistic and methodological differences.
  + Recognize the different time lines of policy (short) and research (long).
  + Engage all players, researchers and partners, at the beginning, not as an add-on.
* There should be an integrated approach to tackling global issues at international, national and local levels.
  + Canada needs to be more involved in in important international groups (e.g. new International Science Council; Paris climate accord; UN Sustainable Development Goals; Sendai Framework for Disaster Risk Reduction; the New Urban Agenda; Global Development Network’s Global Research Agenda).
  + Consider creating a Canadian national committee for integrated science involving all levels of government, indigenous communities, private sector and academia.
  + Institutions can play a leadership role in fostering cross-disciplinary collaboration and the inclusion of non-traditional partners in research.
* The three ingredients for an effective science-policy/society interface are:
  + People: The research needs to address the needs and values of diverse stakeholders. Establishing those stakeholder networks is critical. Partnerships in research must be built on trust and solid, ongoing relationships.
  + Problem: Researchers tend to start with questions. Instead, start with the problem you want to address, and then frame the research questions around that problem.
  + Process: How knowledge is produced and how it is transmitted in society. For example, Future Earth is developing Knowledge Action Networks of people across disciplines and across sectors who focus on solving problems that matter to society. This is done through workshops and meetings, and co-designing and co-creating research and innovation agendas.
* Overall – tackling wicked problems requires new ways of thinking and new ways of working, with a commitment to co-design and co-development of research and policy.

**Case study: Future Earth**

* Future Earth, a global research program aimed at accelerating transformations to   
  global sustainability through research and innovation, is experimenting with new processes that bring together stakeholders from various sectors to co-design research projects on how climate and global environmental change might influence human security in the future. The goal is to build enduring collaborative networks.
* Future Earth has a secretariat with Global Hubs in Montreal, Paris, Stockholm, Tokyo and Boulder, Colorado, and works with teams of scientists from around the world and across 20 core research projects and now a dozen Knowledge Action Networks.
* Work is needed to bring aboard southern countries as the negative impacts of climate and environmental change will disproportionately affect the south.
* Montreal ’s Global Hub has strong backing from the Quebec government and City of Montreal. However, more funding is needed from the Canadian government for support for Canadian scientists across all disciplines to participate as researchers in the global research program.

**Case study: Innovation Saskatchewan**

* Innovation Saskatchewan (IS) advises the Saskatchewan government on the R&D, demonstration, and the commercialization of new technologies. It was tasked with developing an innovation strategy that would be integrated into the Saskatchewan Plan for Growth.
* A Jurisdictional Advantage Assessment was undertaken to provide both IS and the provincial government with an evidence-based approach for making defendable innovation investment decisions that were environmentally and economically sustainable. The assessment identified three core engines that would have the biggest long-term impact on the province’s economy: agriculture; oil and gas; and mining and minerals.
* The strategy also needed to address food security, societal issues, health issues and climate change. Government, industry and academia partnered to develop institutions that take a multidisciplinary approach to those global issues: International Minerals Innovation Institute, Global Institute for Food Security, Petroleum Technology Research Centre and the Sylvia Fedoruk Canadian Centre for Nuclear Innovation.
* Challenges associated with these institutional models included:
  + Competitiveness, confidentiality, intellectual property, and trust made information sharing, project selection and extension difficult.
  + Metrics need improving. (e.g. It is difficult to get industry to share competitive data.)
  + Consensus on priorities and strategies often difficult to achieve between government, industry and academia.
  + Political timelines for outcomes need to be managed.
* The benefits of these institutional models included:
  + Industry investment was mandatory and industrial leadership was built into governance model. Thus, industrial relevance and utilization of research was assured.
  + Programs and research were based on industrial priorities in collaboration with partners.
  + There was good leverage of government funds.
* Social scientists need to be engaged earlier in development of these programs, and with adequate resources, to address issues of social responsibility and the resulting ‘social licence’.

**Case study: GEOIDE Network**

* The GEOIDE Network (1998-2012) was a tri-council funded national Network of Centres of Excellence that assembled researchers from geomatics, environmental sciences, engineering, public health and the social sciences, as well as government, industry and communities partners.
* One project developed analytic tools to study and manage Canada’s forests, particularly in mitigating forest fires. The project team included was wide and varied (e.g. indigenous communities, climate and atmospheric scientists, ecologists, insurance companies, lumber companies, firefighters, etc.). The project’s strength’s included:
  + That the problem had clear social impact and team members were passionate about solving the issues; they valued the social and scientific contributions of the team’s research as well as how the research contributed to enhancing each team member’s research agenda
  + That team members were committed to creating novel solutions and to understanding the different perspectives at the table, rather than utilizing their favourite research hammers and tools they worked together to create new ones specific to the issue
  + Recognizing the importance of bridging the timing gap; research and technology development operate on a different timescale than policymakers need.
  + Training workshops were held to ensure all participants understood the variety of perspectives at the table and therefore had greater insight into the problem being addressed and what types of solutions would be required as well as which ones would be unacceptable.
  + Top-level support from government bureaucrats and elected officials.
* Approaches that proved successful included:
  + dedicated leadership with all stakeholders engaged from the start
  + agreement on goals (science and policy goals should align)
  + evaluations that recognize the efforts of researchers and other team members
  + identification of potential tension
  + commitment to communication
  + examination of the problem from a variety of perspectives
  + communicating impact in ways that are relevant to decision-makers

**Case study: The academy and big science**

* Large research facilities or major science initiatives and the huge investments that keep them running are part of the policy mix for governments looking for solutions to complex problems. But they cannot solve these problems alone.
* In a recent study at four Canadian universities entitled, “Collision and Convergence: Assessing and Maximizing the Mutual Benefits of Collaboration between ‘Big Science’, Social Sciences and the Humanities” (publication pending), natural science participants spoke the most often about collaboration across disciplines. The most cited disciplines for collaboration with big science were the combined fields of arts music, drama, journalism and writing.
* Barriers to collaboration include:
  + Funding and resource limitations
  + A perceived disconnect between science and culture, society and humanities
  + Negative attitudes or lack of interest’ “researchers should humbly admit that their own disciplines don’t have all the answers”
* Enablers and suggestions to support collaboration include:
  + An interest and willingness to collaborate (social scientists, humanists and administrators)
  + Education and outreach programs (natural scientists)
  + The right environment and language that cuts across disciplines
  + Funding and resources
  + Reaching out and learning from other disciplines
* Recommendations include:
  + public policies and funding should reflect broad holistic approaches to problems and not just focus on industrial or economic impacts
  + new researchers must be trained to respond to complex policy questions that build on diverse modes of thinking
  + science facility governing bodies should include members from across the academy
  + access fees and criteria should be adapted to encourage non-traditional users
  + spaces are needed for diverse researchers to gather and imagine new ways of thinking
  + tenure and promotion should recognize multidisciplinary collaboration
* Examples of successful models include:
  + TRIUMF’s collaboration with artists
  + Training opportunities for criminologists and forensic scientists at NEPTUNE Canada
  + The connection to northern communities for sociologists and health professionals enabled by the Amundsen research icebreaker
* Going forward, initiatives will need to recognize that researchers from the social science and humanities (SSH) fear being treated as add-ons to what is often viewed as the more important foundational work of big science.

**Case study: Collaborative science and climate change**

* As a first step, develop a robust conceptual framework that integrates researchers from diverse disciplines while recognizing each science’s differences and limitations.
* Include scientists skilled in interdisciplinary and transdisciplinary science.
* Don’t ignore the conflicts. Interdisciplinary teams need people who can manage conflict, manage projects and facilitate meetings. This may require an outside facilitator.
* Don’t leave evaluation to the end, particularly for long-term projects. Conduct annual anonymous surveys of natural and social scientists to see how well they are integrating their science. Metrics could include publications and/or impactful policy measures.
* Solicit feedback from citizens, particularly ones who are interested in the outcomes of the research. Is it meeting their needs?