

Review of the University of Saskatchewan Toxicology Centre 20 December 2012

The University of Saskatchewan Policy on centres, the *Task Force on the Management of Centres* Report and the Report of the *Implementation Team for the Management of Centres*, require that all centres at the University undergo a review process. At the request of the Vice President Research, a review of the Toxicology Centre was initiated in the fall of 2012. A panel was formed as part of this process and a site visit occurred November 29-30, 2012. The review team consisted of three members, two external to the University (Mark Servos, University of Waterloo and Robert Clark, Environment Canada) and one internal (Ken Van Rees, Department of Soil Science). This team had the opportunity to review the Centre's Self-Assessment Document and to meet with faculty, students (undergraduate and graduate), Centre staff, including research fellows and scientists, partners from industry and government, representatives from the Centre's Advisory Board, and representatives from other academic units and senior administration at the University of Saskatchewan. The following report was prepared by the Review Panel and provided to the Vice-President Research.

Key Messages

- The Toxicology Centre is a unique and highly effective centre that is contributing to the overall programs of the University. The Panel was very impressed with the accomplishments of the Centre, a unit that has become an international leader in toxicology research, scholarship and education over the last decade.
- The Centre and its associated faculty, staff and students represent excellence in numerous ways and bring significant international recognition and profile to the University.
- The program is an example of effective interdisciplinary collaboration that creates synergies and opportunity to solve some of the most pressing environmental issues at local, national and global scales. In particular, the Panel was impressed by the collegiality of the Toxicology Centre Group (including faculty and stakeholders). This tremendous success is related to the strong leadership of the centre director (K. Liber), the mentorship of senior faculty, and the dedication of the faculty and staff to the vision of the Centre.
- The operation of an interdisciplinary centre within a University is a major challenge. This was recognized widely by the Faculty and stakeholders of the Toxicology Centre. The success of the Centre was attributed by many participants to the strong central support from the University and the strong relationships and "good will" the Centre enjoys from the participating administrative units.
- Areas that require *careful* consideration in the future are the succession of leadership, renewal and maintenance of human and hard infrastructure, rejuvenation of training curricula, the impact of the TABBS financial model, and governance.
- The Panel fully endorses the University's continued support of the Centre, and feels confident that it will continue to advance the goals of the Third Integrated Plan and Signature Areas of the University and contribute to the broader goals of promoting the prosperity and well-being of Canadian society.

The Panel has provided additional observations and suggestions below with the intent of continuing to advance the effectiveness and impact of the Toxicology Centre.

Mandate and Performance

The primary mandate of the Toxicology Centre essentially remains very similar to when the Centre was created:

- (i) to promote research in toxicology, including interdisciplinary research amongst faculty and with external organizations;
- (ii) to oversee and advance the U of S academic programs in toxicology; and
- (iii) to promote growth of toxicology as a discipline on and off campus.

The Toxicology Centre is effectively fulfilling its mandate and goals. The Centre is promoting research collaboration across the University of Saskatchewan Colleges and Schools in ways that advance interdisciplinary approaches in Toxicology. The Toxicology Centre has become a hub and catalyst, supporting the University's toxicology research and teaching activities. The research has also built strong collaborations with numerous external organizations that include local and national governments, and diverse industry and international organizations. The Centre has representation from numerous academic units that are linked to many disciplines including natural sciences, engineering, veterinary medicine and social sciences. It has created a dynamic undergraduate and graduate program in toxicology that is delivered through cooperation of many individuals and units from across the campus. The Centre has promoted the recognition and growth of the discipline of toxicology across the University and amongst a wide array of stakeholders in the environmental and resource-user sectors across Canada. In addition, it is well on track to becoming one of the top interdisciplinary toxicology research groups globally, especially in the field of ecotoxicology. However, no metrics were presented to track or report progress on attaining this goal. We strongly encourage the Centre to develop metrics and benchmarks to substantiate this in the future as we believe it to be true, but we had no objective way of fully substantiating this claim.

Recent emphasis of the Toxicology Centre has been in environmental applications, especially in aquatic toxicology. This builds on the strengths of the established and recently hired faculty, and reflects the growing needs and priorities of Canadian society. The Centre has been effective at seizing opportunities and redirecting its focus on emerging issues of importance while ensuring excellence in research. The Centre has been very proactive in adapting its programs and directions. However, there are considerable opportunities for the Centre to explore that may develop additional strengths and collaborations in other areas of toxicology at the University of Saskatchewan. These include initiatives occurring in pharmacy, nutrition, mining, nuclear, food and water security. The decisions of the Centre have made it a leader in environmental toxicology but careful consideration should be given in the future to the tradeoffs between building excellence/recognition in one area versus maintaining a sufficiently broader representation of disciplines in the Centre and its programs; both approaches have merit.

The Toxicology Centre has been very good at identifying and capitalizing on a variety of research and scholarly opportunities. In particular, the Centre has built considerable strength in northern and environmental research. The University of Saskatchewan, including the Toxicology Centre, has a potentially important role in supporting the sustainable development of resources in northern regions. This can also complement the University's strategic priority to enhance opportunities to support aboriginal communities. Several examples were given, including the

work of Prof. Paul Jones that highlighted the strong relationships that are being forged with these communities. Although the level of outreach programs within the Centre appears to be minimal this perception is countered by the strong direct working relationships that many of the researchers and research programs have with a diverse suite of stakeholders.

The Centre and its work are well known internationally. This is supported by the high number and quality of publications in leading scientific journals. Stakeholders confirmed that the work is having a meaningful impact in the field of toxicology in Canada and internationally. In addition, the Centre is contributing to addressing a wide variety of problems and issues faced by Saskatchewan and Canadian resource industries. Their work also has impacted provincial and federal government regulations and policy. The development of partnerships in industry and government are a true strength of the Centre.

The Centre also has established very strong linkages internationally, especially in Europe and China. The level of international linkages and activities is impressive and many of the Centre's faculty members have strong international linkages. These include recently-developed opportunities for partnerships for student and faculty exchanges, and efforts to foster relationships among young faculty and strategically selected institutions/people in other countries. For example, a senior faculty member, John Giesy, who has numerous strong contacts in China has strategically linked junior faculty to key institutions and people in China and other countries. This approach has tremendous potential. Countries such as China, are key future players in the world and are facing numerous toxicology-related issues that the Centre is well situated to address and help resolve. The Panel wanted to highlight these international efforts and encourage their development, as the approach fits into the University strategy/plan and is likely to be very productive.

The Toxicology Centre has the potential to contribute to all of the University's Signature Areas identified in the current Strategic Plan. The research directly relates strongly to at least three of these areas and there is potential to make significant contributions to the others. In addition the Centre has demonstrated a commitment to research and scholarly activities that are consistent with national trends and expectations. The Centre adds value by promoting interdisciplinary research and training across the University. This creates opportunities for many other academic units and has enhanced the success of its members in their pursuit of external research support and training of HQP. The Centre is clearly recognized as a critical component of recruitment and retention of excellent researchers and graduate students to the University.

Training

The Centre is serving the needs of graduate and undergraduate students with an interest in toxicology and environmental sciences. Through the Centre and the related toxicology academic programs, world-class toxicologists are trained who are sought-after by employers. Students at the graduate level are receiving opportunities for very high quality experiences that position them well for future employment in the sector. Most graduates secure employment in toxicology or closely-related fields. The stakeholders (potential employers) indicated a high level of satisfaction with the students graduating from the toxicology programs. Both the undergraduate and graduate students demonstrated strong cohesion and a real sense of community and belonging. The graduate students were content with their levels of support and appreciative of the opportunities provided for research and travel to international meetings to present their work.

The undergraduate program is functioning very well and the students expressed a very high degree of satisfaction with their program. They felt a sense of belonging with the Centre and the other toxicology students. The Panel was genuinely impressed by how articulate and enthusiastic this group of young people was. The Centre needs to strengthen the awareness of its program to 1st and 2nd year students through some form of outreach or introducing toxicology concepts into 2nd year classes when they are making decisions on their specializations. The undergraduate students indicated that their academic advising in the toxicology program was done very well but were frustrated by the apparent disconnect to the College of Arts and Sciences advisors where their course selection is approved. We wonder if greater efficiencies could occur if the Toxicology Centre had more control over running its own undergraduate program.

The student seminar course is a good idea and highly valued by the undergraduate students. However, students expressed a desire to have more direct training on presentation and writing skills as part of this. They are also eager to have opportunities to meet with senior faculty in toxicology. The Centre should consider simple things to have these people “talk and meet” with undergraduates (e.g., coffee breaks, lunch and learn, etc.). Since the Toxicology Centre’s building is a short distance from the central campus, and few activities/courses are taken at the Centre’s building, there is desire by the undergraduates to spend time associated with the Centre. The students need a common area (room) to be able to enhance the sense of community they clearly already have. This would also provide opportunities for them to interact among themselves as well as with graduate students, staff and Toxicology Centre faculty.

The Centre plays a pivotal role in the recruitment of highly qualified graduate students, post-docs and other research staff across campus. A wide variety of courses are offered that have an emphasis on interdisciplinary perspectives. The Centre needs to consider the availability and balance of course offerings each year in the Graduate Program. Although there was a desire expressed to increase the size of the graduate population to create a critical mass, the graduate program is functioning very well and graduate students do appear to have a strong affiliation with the Centre, and are successful after graduation. The academic programs related to toxicology at both the undergraduate and graduate levels are enhanced by the presence and activities of Centre.

Although the number of students enrolled in the graduate program has not increased much in the past few years it is expected that with the new faculty hires there will be an increase in graduate enrolment. Although not a specific criticism of the toxicology programs, the stakeholders (industry and government) indicated a desire for graduates who have enhanced communication skills, especially written skills. They valued experiential learning and the hands-on practical experience represented by many of the graduates of the toxicology program (i.e., graduate students). The CREATE-HERA (Human and Ecological Risk Assessment) program is offering some of this and perhaps it could be opened up to include more students not enrolled directly in that program. The employers stated that they are looking for people who can understand project management and study design, and can handle and interpret data based on practical experience. Interestingly, we also heard the same request from both undergraduate and graduate students. The students at both levels also felt that a course (or other opportunities) to explore study design and statistics directly related to toxicology would be an asset. Unfortunately the lack of experiential opportunities for learning in the undergraduate program was recognized as a current weakness (by the Centre as well as the students). The undergraduate students felt so strongly

about this that they told us they would pay additional funds to be able to have this incorporated into their programs. Apart from normal models of course development and delivery the “short course” model might also provide a vehicle for delivering intensive, focused courses to address these needs. Despite the challenges to implement experiential learning within undergraduate courses, and to some extent graduate programs, the Panel felt that the Centre should continue to seek opportunities to provide this kind of learning that is consistent with the university’s overall strategy.

Governance

The Centre’s governance model seems to be working well despite its complexity, but this is at least in part due to the “good will” and strong relationships among the administrative units. Thus, although currently working well, the governance structure may not enable the Centre to reach its full potential. There is concern that indiscriminant implementation of the TABBS financial structure may be a threat to the continued success and performance of the Centre. If the Centre is not recognized fully for its contributions to research, teaching and leadership, a change in financial allocations may destroy a successful Centre, remove the benefits of the past investments and reduce the ability of the University of Saskatchewan to deliver effective interdisciplinary programs in toxicology that impact society. Indeed, the TABBS structure could hinder or prevent the successful delivery of high-quality, interdisciplinary science.

The strong leadership of the director, Prof. Karsten Liber, was identified as a key component of the success of the Centre. His enthusiasm and dedication (to the vision) resonant strongly with other faculty, staff and students. Therefore, the Panel felt that appropriate succession planning is important to ensure resilience and continuity of the Centre. Key senior faculty members, including Dr. John Giesy, currently play important roles in the impact and sustainability of the Centre. Academic programs are well served by Dr. Mark Wickstrom and others who are very committed to the teaching programs. The Centre should therefore review and plan for the inevitable retirement of these senior people. There is a need to nurture future academic and scientific leadership. However, the science capacity is strong and has been enhanced by the exceptional quality of the new hires associated with the Centre. There needs to be a supportive environment for these young people so they are able to flourish and allow this interdisciplinary program to remain an international leader. Strong leadership is essential and the Centre needs to carefully plan and develop a strategy to ensure continued success.

The Centre is well managed and it is supported by a very enthusiastic and dedicated staff. We were very impressed by the staff and their commitment to the Centre and its vision. Students also commented on the quality and helpful nature of administrative staff. They are all well trained, have opportunities for advancement and are cross-trained in key work tasks. The staff position for the aquatic facility was identified as critical to maintain the infrastructure and ensure the quality of the research.

The Advisory Board has not been used in an effective manner in the last few years. The functions of how meetings are conducted and the mandate of this board should be reviewed. Board members indicated that they could participate more directly and offer considerably more to the Centre. This could include participation in long-term visioning, highlighting trends and needs in the industry for HQP and research. They suggested that they need to be engaged in a meaningful way in order to build an understanding and allow them to make a meaningful

contribution. The Advisory Board Terms of Reference, the composition of the board, and how this (potentially) powerful group can be best utilized needs to be reviewed to reflect changing “terrain”, and therefore both research and training priorities.

The sustainability of the Centre will be a challenge in the future and it may be vulnerable to changing attitudes (good will) as financial resource allocations become more competitive, sudden changes in leadership occur, and key faculty that bring in major resources to support the research infrastructure either retire or assume new duties. To address these vulnerabilities, the Centre may need more control over its operations and resource allocations. The Centre needs to have greater direct authority over decisions that affect its development and operation of its programs (e.g., undergraduate teaching, appointments). This would also facilitate partnership development in the research programs by allowing more flexibility and direct control of decisions. The Toxicology Centre should consider becoming an academic unit that is able to control its development more directly, such as a School. This would enable the Centre to more effectively implement its strategic plans and achieve its goals. However, options need to be identified and examined carefully.

Infrastructure and Resources

One of the current strengths of the Centre is the leading-edge scientific infrastructure. This includes advanced instrumentation for measurement of trace contaminants and biochemical responses. The aquatic facility provides a regional facility to conduct unique experimentation on aquatic species. There is a need to have adequate human and financial resources to make full use of the equipment available within the Centre. The technical staff (including several research scientists) is well trained but need opportunities to continue to have access to advanced training and professional development. Current staff indicated that they were very happy with the professional development opportunities being provided but there is a need for a human resources plan to ensure equipment is maintained and used to its full potential and capacity. There are concerns about the future costs of maintenance and renewal of the infrastructure to keep the Centre at the leading edge. The cost-recovery model is working well and should be continued for each of the facilities and instruments, but will also need to be supplemented with additional infrastructure support to keep the Centre at the leading edge of technologies.

The Centre needs to maintain a significant contingency fund to ensure the operation of advanced analytical and aquatic toxicology laboratories. Instrumentation and facilities were identified specifically by the stakeholders as well as researchers as critical to their research and collaboration. It takes a continuous investment to remain at the leading edge of this rapidly-evolving field. Thus, a plan should be developed to explicitly identify how this need will be addressed.

Currently, there are adequate resources to meet program needs but both financial and space resources may limit future development of the program. The financial resources are primarily directed to salaries of key personnel. A tour of the lab facilities suggested that the lab space is very efficiently used and allocated. However, the Centre does not have adequate teaching labs to fully support its undergraduate teaching responsibilities and, as discussed above, this limits the Centre's ability to provide experiential learning opportunities. In addition there is limited ability to accommodate additional graduate students in the current space available.

Long-Term Vision

The Toxicology Centre operations are strongly aligned with the Third Integrated Plan of the University of Saskatchewan, and it will contribute to all six of the Signature Areas in at least some way. The Centre is well positioned to remain an international leader in the field of environmental toxicology. This is an important area of research, nationally and internationally. This research helps to understand our natural world and the variability and resiliency we can expect in natural and stressed ecosystems. It supports Canada's resource-intensive industries, especially in the north, to minimize their environmental footprint while enabling them to compete internationally. The Centre has established extensive and very strong collaborations. This includes collaboration with numerous leading international institutions related to toxicology and a wide range of industrial and government partners. The Centre is catalyzing real interdisciplinary collaborations from across the campus, and creating a critical mass of researchers to train the innovators of tomorrow, individuals who will be able to address some of the most critical emerging issues faced by Canadian society.

The transition to alternative financial models at the University of Saskatchewan may represent a challenge for the Toxicology Centre. The University should take special care to ensure these changes do not undermine the future potential of the Centre to contribute to the University's strategic goals. Experiential learning was identified by stakeholders as important to them as well as the ability of graduates they hire to integrate complex information. The Centre is training students in its graduate program who have these skills because of the interdisciplinary nature of the Centre and its participants, and their effective approaches to teaching and research. The interdisciplinary nature and foundations of the Centre are among its many strengths. Ironically, this is also the source of diverse challenges it will face in the future. It has attracted many top scientists to the University and the Centre was a major factor in their recruitment. The leading edge infrastructure is essential to supporting and retaining these talented people. In addition, several new young faculty members have the potential to make major future contributions that can be facilitated by the Centre.

The Centre needs to clarify the breadth of its future programs (undergraduate and graduate) as there is currently a major focus in environmental toxicology. Some concerns were raised by the undergrads that the biomedical components were not well-represented in the program. However, the Centre also needs to consider the tradeoffs of building critical mass and expertise in one area (such as environmental toxicology) versus being more diverse in its research efforts. Interest was also expressed by stakeholders and students about the area of risk assessment and management and whether the Centre would branch out into this area. The Centre needs to make hard decisions about where it will focus so that it can plan for the future.

The long-term vision of the Centre has remained consistent with its roots, although it has adapted to address emerging scientific and societal issues. It has demonstrated that it is a flexible organization that can adapt quickly and exploit opportunities as they arise. The Centre has become a leader internationally and is likely to continue to enhance its impact internationally in the field of toxicology. Although it currently has a strong focus in environmental toxicology because of the large national interest and need in this area, it is positioned with broad collaborations and relationships to contribute and respond to a diversity of toxicology issues in many areas, including global water and food security challenges. Natural resource development

in Saskatchewan and the Canadian north will continue to provide opportunities to which the Centre could contribute. However, the contribution to the mechanistic understanding of how organisms respond to environmental stressors will also impact numerous national and international programs and initiatives. We currently have a poor understanding of how stressors such as (interacting) contaminants and other stressors (e.g., changing climate variability) alter diverse ecosystems. This understanding is critical in assessing risk and formulating effective risk management options to protect the environment and promote sustainable resource development. The Toxicology Centre is well positioned to have a continuing impact in these areas critical to the Canadian economy and society.

Key Recommendations:

- The Toxicology Centre creates considerable opportunity and impact for the University of Saskatchewan, and the current level of support for this activity should continue as it will bring direct and indirect benefits that are aligned with the University's strategic plans.
- The Toxicology Centre is widely recognized for excellence in research and training. However, metrics and benchmarks should be implemented to substantiate the claims that the Centre is recognized as a national and international leader in the fields it has selected in which to excel.
- The Toxicology Centre should review its decision to focus on environmental toxicology (which has been very effective) and consideration given to the tradeoffs for achieving critical mass in one area vs. maintaining broader representation of disciplines in the Centre and its programs (including the undergraduate teaching).
- Continued efforts should be made to enhance the experiential learning opportunities at all levels of training. This may require additional resources to allow the Toxicology Centre to implement it effectively.
- Given the many challenges facing northern communities, direct working relationships with a diverse suite of stakeholders in Canada's north should be continued and, where appropriate, expanded to address known and anticipated needs.
- Likewise, development of international relationships (e.g., China, Europe) should be continued, as the approach fits nicely with University's strategy/plan and is likely to be very productive.
- Succession of leadership should be considered as it is essential to the success of a complex interdisciplinary centre.
- The renewal and maintenance of human and hard infrastructure will need the support of the University to ensure the Toxicology Centre remains competitive and remains at the leading-edge of its field. For example, a significant contingency fund may be needed to ensure the operation of advanced analytical and aquatic toxicology laboratories.
- The TABBS financial model has the potential to have a very negative impact on the Toxicology Centre and its implementation should take into account the unique situation of centres.

- The governance of the Toxicology Centre should be reviewed. The Advisory Board terms of reference should be reviewed and mechanisms put in place to utilize this group more effectively.
- Consideration should be given to allowing the Toxicology Centre to have greater direct authority over decisions that affect its development and operation of its programs (e.g., undergraduate teaching, appointments).

Mark R. Servos

Professor and Canada Research Chair in Water Quality Protection
Department of Biology, University of Waterloo
200 University Ave. W, Waterloo, ON N2L 3G1
Email: mservos@uwaterloo.ca

Robert Clark

Research Scientist
Prairie and Northern Wildlife Research Centre
Science and Technology Branch, Environment Canada
115 Perimeter Road, Saskatoon, SK S7N 0X4
Email: bob.clark@ec.gc.ca

Ken Van Rees

Professor
Department of Soil Science, University of Saskatchewan
51 Campus Drive, Saskatoon, SK S7N 5A8
Email: ken.vanrees@usask.ca