

5 Questions on Innovation with Bill McIver, Centre for Applied Research in Mobile & Ubiquitous Computing, NBCC

1. How do you encourage innovation in your organization?

I have been trying to develop an environment in which people are comfortable generating or sharing ideas, especially the types of ideas that many would consider crazy. I am a proponent of the aphorism attributed to two-time Nobel laureate Linus Pauling: “To have a good idea you must first have lots of ideas.”¹ We face a key barrier in finding or generating lots of ideas this, however: our society somehow makes many people increasingly afraid to share and explore ideas as they mature into adulthood. This is particularly true for ideas that might be considered unorthodox. So, a major part of encouraging innovation for me is to encourage people to appreciate and use the so-called “beginner’s mind”, the mindset of a child who is unafraid to ask questions or propose crazy ideas. For these reasons, I try to listen to people’s needs and ideas with a beginner’s mind and to prioritize ways in which an idea might be doable rather why it might not be. A related part of encouraging innovation through idea generation is to avoid linear problem solving, the pursuit of only one line of thinking. I try to encourage the exploration of multiple solutions to the same problem at the same time.

In general, I favor a process that includes the following elements (which are not always feasible within a project due to funding or time):

- Immersion in the end-user’s environment,
- Observation of (or role playing as) typical users,
- Structured idea generation,
- Frequent user involvement throughout the design process,
- Frequent prototyping and evaluation of candidate solutions,
- Disciplined processing of and learning from design failures, and
- Refinement of everything above through as many iterations as possible.

¹ Linus Pauling, Barclay Kamb, Linda Pauling Kamb, et al., Linus Pauling: Selected Scientific Papers, Volume II - Biomolecular Sciences, London: World Scientific Publishing, 2001.

5 Questions on Innovation with Bill McIver, Centre for Applied Research in Mobile & Ubiquitous Computing, NBCC

2. What are some of the biggest barriers to innovation?

I discussed two fundamental barriers above, which shape the environment for innovation that we are trying to develop:

- The reticence by adults to share or generate ideas, and
- Linear problem solving.

Research and experience have taught me about other fundamental barriers to innovation:

- Functional fixedness, the state of only being able to see one way to use an object;
- Failure to recognize gaps within a problem statement, which prevents the development of complete solutions; and,
- Lack of user involvement, which results in solutions that are biased towards the designer's point of view and can prevent gaps from being identified (see above).

3. Why do you think innovation is important for Saint John and the province?

To innovate is to create a new or significantly improved solution to a problem. So, by definition, if we are to solve life-critical problems in Saint John and New Brunswick, we must innovate. The resulting solutions are also critically important to Saint John and New Brunswick in that they usually represent economic opportunities in the form of start-ups, licensing, and job creation.

4. What are some simple things you've done to drive change?

I have performed collaborative research in academic, federal, and industrial contexts. I am currently the Natural Sciences and Engineering Research Council (NSERC) Industrial Research Chair in Mobile & Ubiquitous Computing at the New Brunswick Community College (NBCC). My work over the past 20 years has covered the research in the interrelated areas of social and community informatics, technology policy, models of innovation, and user-centred design and software development methodologies; and the application of user-centred design and software development methodologies (e.g., design thinking) to produce technologies that address life-critical needs for communities and individuals. He is co-inventor on two U.S. patents, including one resulting from work performed in his current position: U.S. Patent No. 9699564 AUDIO ADAPTOR AND METHOD, July 4, 2017.

I lead the NBCC Centre for Applied Research in Mobile & Ubiquitous Computing (formerly the Mobile First Technology Initiative). In this position, I perform applied research, experimental development, and commercialization across a wide range of industrial and social use cases. My program conducts these activities in collaboration with industrial partners; students, faculty, and staff of NBCC; and public-sector organizations. To support this work and to foster innovation within the College, we created the Mobile Ideaspace, a physical and virtual environment that spans NBCC's six campuses across the province.

5 Questions on Innovation with Bill McIver, Centre for Applied Research in Mobile & Ubiquitous Computing, NBCC

The Ideospace supports collaborative design and development of technologies at pre-commercial stages by leveraging NBCC's competencies, tools, and infrastructure across the province.

My current research program includes (but is not limited to) the following technical areas: location-based services, 5G data communication standards, interconnected user experience, mixed reality (e.g., Microsoft HoloLens), Internet of Things, and cross-platform mobile app development frameworks (e.g., React Native & Polymer). My research program currently includes (but is not limited to) projects in the following domains: accessibility, entertainment, public works, public transit, educational games, personal learning environments, network hygiene (a sub-area of cyber security), wellness, and FinTech.

My program has supported the completion of over 50 applied research and innovation projects (including course-based projects) with 33 industrial partners, SMEs, public organizations, and NBCC itself, in areas including mobile systems development, technology evaluations, literature-based studies, development of hardware-based technology, and the design of experiments and experimental apparatus. To date, these projects have resulted in 18 product, technology, or process improvements and 23 new products, technologies, or processes. I identified mobile software engineering issues in the study *Software Engineering Processes for Mobile Application Development*. My program has leveraged NSERC IRCC funding to raise over \$1M in other grants and contracts to expand research capacity.

My program has developed competencies in: major software frameworks and hardware platforms for mobile systems development, including mobile apps and supporting Web/data management services and the construction/administration of systems to support analysis of very large data sets. I have developed a consulting/design practice within the program, including design thinking, software engineering processes, user interface design, and agile project management (PM). I have also identified new research directions, developed highly qualified personnel (HQP) who are now employed, and patented intellectual property (IP) that is now being commercialized.

I have also participated as a member of key R&D/innovation organizations: The Smart Cities Challenge Task Force in Fredericton, The Canadian Institutes of Health Research (CIHR)-funded New Brunswick Strategy for Patient-Oriented Research (SPOR) Primary and Integrated Care Innovations research network, CANARIE DAIR cloud services; Canadian Public Safety Operations Organization; New Brunswick Health Research Network (CIHR affiliate); developer programs for Apple, Android, Microsoft; IBM Academic Initiative; Advanced Computing Research in Atlantic Canada; and CyberNB.

To increase knowledge mobilization and technology transfer between the college and companies, I have written technical reports and annual reports about developments in the field of mobile technologies, including topics in science, technology, engineering, policy, and society. A public web site, <http://wiki.nbcc.mobi>, provides non-proprietary research results. I also helped establish a regular intake process to help companies, organizations, and people within NBCC to launch applied research projects.

I have contributed to the development of HQP by providing research opportunities to a significant number of people within NBCC, including over 50 students, over 30 paid assistantships – the majority of

5 Questions on Innovation with Bill McIver, Centre for Applied Research in Mobile & Ubiquitous Computing, NBCC

whom are now in industry jobs or other diploma/degree programs – two co-ops, and two Mitacs Global Link interns. I have hired seven alumni as full-time research technicians. Two of these students conducted capstone projects based on our patent; I subsequently hired them to work on commercialization of the device. Industry (Accreon, XploreNet, SyncDog) and GNB have hired three former research assistants and a co-op.

In working to enhance the teaching and learning environment at the College, I have fostered the development of publicly available tutorial content in mobile technology development. I obtained formal academic affiliations for NBCC with the Apple, Blackberry, and IBM while making mobile ICT software tools and tutorial resources available to the NBCC community. The membership in the CANARIE DAIR cloud services program allows NBCC to create teaching and experimentation sandboxes. I completed a survey of worldwide mobile curricula for NBCC's Dean of IT.

I have also enhanced the teaching and learning environment and increased faculty and staff participation in applied research activities through annual secondments and course-based projects. To date, over 80 faculty and staff and over 100 students have been engaged. I have helped the NBCC community launch applied research and innovation projects, resulting in several prototypes with commercial potential and the noted U.S. patent. A high proportion of the projects in my program involved student research assistants and almost all have presented students/staff with industrial problem-solving experience and other opportunities (survey research, experiment design, articulation of use cases, client interaction, etc.). I was also a co-supervisor (with Dr. Janet Light) of a UNB Computer Science Ph.D. student who successfully defended his thesis in body-area networks on September 28, 2017.

My previous research in e-government at the University at Albany led to an invitation to join the e-Citizen Group of the National Research Council of Canada – Institute for Information Technology (NRC-IIT) in Fredericton, New Brunswick as a Research Officer in 2004. In this role, I helped to develop and direct the *e-Citizen Studio*, a collaborative technology design space. I was responsible for supervising a group of professional research technicians, graduate students, and undergraduate students. Most of our work involved collaborations with companies and public organizations. Research projects included *Transit Info*, development of hardware and Web services technologies with Red Ball Internet that provided accessibility, bus tracking, and trip planning services for transit riders; and *Peer-Generated Video*, a collection of advanced prototypes demonstrating the use of Web-based video authoring for use cases involving remote healthcare, electronic health records, and interactive communication. NRC-IIT received the *2010 KIRA Award for Technological Advancement/Innovation – Private Sector* for the Transit Info project. Extending my earlier work at the University at Albany, I published a chapter on the relationships between the technical design of the Internet and communication rights in a book edited by Marc Raboy of McGill University and Jeremy Shtern of Ryerson University: *Media Divides: Communication Rights and the Right to Communicate in Canada*, UBC Press, 2010.

5. What success have you had with innovation in your organization?

Over the past twenty years, I have performed collaborative research in the broad area of information and communication technology (ICT) in academic, federal, and industrial contexts. This work has resulted in licensed technology, two U.S. Patents, and publications.

My research over the past 20 years has involved the following interrelated areas:

- **Social impacts of technology:** digital divide, e-government, and the role of public research organizations.
- **Models and dynamics of innovation:** Christensen's theory of disruptive innovation and contrasting types innovation, such as sustaining, economizing, architectural, and radical innovation; and Homer-Dixon's theory of social ingenuity.
- **User-centred design methodologies:** IDEO Deep Dive, International Development Design (Amy Smith, MIT), Basadur Applied Creativity, universal design, and business model generation.
- **Applied research and experimental development:** Production of technologies with a particular focus on life-critical use cases, such as accessibility, public transit, health care, and seniors.