

# Richard Boudreault

Executive Chairman and CTO at Sigma Energy Storage Inc.

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## Summary

Richard is a creative, successful serial entrepreneur and innovative C-level general & innovation management, product development, sustainability and commercialization executive with professional board director/chairman governance training and experience and a 40 year track record of achievements in leadership roles.

A problem solver, he held CEO, CRO (turnaround management), and top corporate finance positions with large and small entrepreneurial organisations, in both private and public sectors. He is an authority in Materials/Nanotechnology, Energy, Oil and Gas, Natural Resources/Mining/Metallurgy, Clean Tech, Medical Device and Aerospace sectors. It includes the authorship of 15 patents, 70 pending. He founded 6 private and 6 public ventures as a principal, as well as three national-level centers of excellence.

He sat on 30 boards of directors, including public, private and governmental/crown corporation and NGO boards, and currently sits on 5. The average tenure growth rate of portfolio is 49.7% CAGR with 55% reaching liquidity events.

On top of proven multidisciplinary expertise in finance, corporate governance, science, technology, environment and business development. Richard is dynamic, passionate, resilient, multilingual, engaging and result-oriented. He has an exceptional contact networks in Canada and abroad.

- Proven ability to deliver innovative and commercially successful solutions in record time and attracting financing while ensuring stakeholders and public acceptance.
- Business acumen, strategic decisional skills and for structuring profitable business ventures, in particular energy and technology-based ventures.
- Strong coaching-based leadership style with ability to learn quickly and communicate effectively.

Richard has lived, studied and worked in the US, Japan, and France and has taught at universities around the globe: The U. of Sherbrooke, Ottawa, Royal Military College, Michigan Tech, Cornell, Louis-Pasteur, MIT, York and ISU.

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## Experience

**Executive Chairman at Sigma Energy Storage Inc.**

March 2014 - Present

## **Chairman Of The Board**

July 2015 - Present

The Minister of Aboriginal Affairs and Northern Development, announced the appointments of Richard Boudreault as part-time Chair and Dr. David Scott as President of Polar Knowledge Canada and head of agency.

Polar Knowledge Canada, established as a new Canadian Federal independent Agency on June 1 2015, is responsible for advancing Canada's knowledge of the Arctic and strengthening Canadian leadership in polar science and technology. As a key component of Canada's Northern Strategy, it comprises a pan-northern science and technology program, the Canadian High Arctic Research Station in Cambridge Bay, Nunavut, which will be operational in October 2017, and has a knowledge management and mobilization function. Moreover, it includes the activities of the previous Canadian Polar Commission.

Polar Knowledge Canada (POLAR) as Canada's Polar Agency is on the cutting edge of Arctic issues and strengthens Canada's position internationally as a leader in polar science and technology. POLAR also promotes the development and distribution of knowledge of other circumpolar regions, including Antarctica. It will provide a world-class hub for science and technology research in Cambridge Bay, Nunavut called the Canadian High Arctic Research Station (250M\$+). As part of Canada's Northern Strategy, POLAR improves economic opportunities, environmental stewardship and quality of life for Northerners including First and Inuit Nations and all Canadians.

## **President of the R&D oversight committee, BoD member (1999-2004) at INO**

1999 - Present

A great Canadian success, INO is a 200 specialists strong research, technological, design and development firm for optics' and photonics' solutions for SMEs and large corporations. It is Canada's foremost national center of excellence in photonics, home to the largest concentration of skill in the field and serves clients of all sizes from all parts of Canada and around the world. With a client oriented approach, INO has one of the highest rate of self-funding in Canada. INO offers a complete range of integrated services in the fields of optics/photonics to clients of all descriptions in every field of industrial activity. It also possesses a variety of technologies and innovative processes based on a strong IP portfolio. It has a portfolio of 209 patents and 60% of the clients are SMEs. Over the last 26 years, INO has performed 5000 service contracts for the industry and 54 technology transfers. INO has also generated 29 spin-off corporations employing more than 1000 people. Similar to best applied R&D center in the World, INO is raising 50% of its operating budget directly from the industry. INO is second to none in terms of raising industrial money per employees. Widely recognized by most players as being highly instrumental in the diversification and revival of Quebec City's economy to full employment, creating a high-tech/optics-photonics hub. The R&D advisory reviews the internal research projects, product development and advise on potential applications. [www.ino.ca/en](http://www.ino.ca/en)

## **Executive Chairman and CTO at Sigma Energy Storage Inc.**

February 2014 - Present

Sigma Energy Storage has developed, designed, prototyped and proven a new generation of award-winning transportable, Cleantech, CO2 capturing Hybrid Compressed Air and Thermal Energy Storage (CAES) system meant primarily for remote northern communities where power is produced by hydrocarbon-fuelled generators. It operates at higher pressures and efficiency and swiftly captures the heat generated through a proprietary thermal management system using molten salts phase change materials and nanotechnologies. The patent pending system can store and restore energy rapidly and be scaled up or down and modularized from a multi-residential size to multiple MWh storage capacity. With a high combined round-trip efficiency, it enables 25,000 of cycles of energy storage at levelized capital cost of energy of a few cents per kWh / cycle. It is transportable and an all-weather system uninhibited by extreme temperatures.

To achieve such results, the system uses a combination of air compression with an advanced thermal recovery system stores energy for short or long periods, requires less space, with a lower capital cost and offers better operating cost and performance. This technology should have a meaningful impact on GHG emissions, by enabling the utilities to generate less energy from nonrenewable sources to meet their demand peaks. Storing generator power can save some 30% of diesel, such savings can go up, in the 70-80%, if intermittents sources are used jointly. It also enables utilities in taking onto their grids significantly more non-GHG releasing, albeit intermittent, renewable energies such as solar / wind.

Sigma has completed, tested its first scaled system and is working with Hydro-Québec, Hydro-Sherbrooke, BC Hydro and NRCan towards a commercial unit. The Honourable Bains, Minister of Innovation, Science and Economic announced a \$2.5M financing towards the commercial unit development. Technoclimat funding from the Quebec Government completes the 15M\$ round.

### **Member Board of Directors, Executive Committee and the Awards Committee. at Sigma Xi, The Scientific Research Society**

December 2014 - Present

Sigma Xi, The Scientific Research Society is the international honor society of science and engineering. One of the oldest and largest scientific organizations in the world, Sigma Xi has a distinguished history of service to science and society for more than one hundred and twenty five years. Scientists and engineers, whose research spans the disciplines of science and technology, comprise the membership of the Society. Sigma Xi chapters can be found at colleges and universities, government laboratories, and industry research centers around the world.

More than 200 Nobel Prize winners are or have been members. Sigma Xi was established first at Cornell University nearly a century ago.

<https://www.sigmaxi.org/about#sthash.apAcyXFN.dpuf>

### **CREATE Internal Selection Committee Member at Natural Sciences and Engineering Research Council of Canada (NSERC)**

## **December 2014 - Present**

The Collaborative Research and Training Experience (CREATE) Program supports the training of teams of highly qualified students and postdoctoral fellows from Canada and abroad through the development of innovative training programs that encourage collaborative and integrative approaches, and address significant scientific challenges associated with Canada's research priorities; and facilitate the transition of new researchers from trainees to productive employees in the Canadian workforce. The program is one of the largest at NSERC and generally funds around 17 new centers annually, the funding has a 6-year duration.

CREATE is harnessing the country's deep research and development tradition and helps in translating the graduating scientists to a productive and innovative workforce, enhancing national productivity.

I serve as a physics and photonics, materials, natural resources and energy, environment, ecology, and ocean expert. Representing industry.

## **Consultant**

### **February 1991 - Present**

Business, entrepreneurship, strategy, governance, profitable sustainability, product development and innovation specialist. Technology-Market-Financing coupling services including venture and Intellectual Properties (IP) valuation. With a special interest in space technologies and exploration natural resources, clean tech, energy, climate change, environment, aerospace, quantum computing, quantum cryptography and entanglement, quantum and physical optics, biophotonics, power and energy issues. Proven expertise in merger and acquisitions (M&A), strategy, financing of ventures, restructuring-change management and public corporation management. Serves as Advisor and Entrepreneur-in-residence to a privately funded industrial technology incubator.

## **Space Systems: Mechanical, Orbital, Optical, RF**

### **June 1979 - Present**

1. Radarsat - mission definition study and SAR antenna design (CSA)
2. Skynet IV - EHF satcom (UK)
3. Space Based Radar System (DND)
4. Space Based IR (DND)
5. WISP - STS based Wave in Space plasma(CSA)
6. Windii instrument - Freja Satellite with SSC
7. Eureka - Free flying microgravity platform ESA
8. Remote Manipulator System (CSA)
9. Space Station Remote Manipulator and Dextrous Manipulator and Stereoscopic vision
10. Space Station Float Zone Furnace (CSA)
11. On-Orbit Servicing (ESA)
12. Cospas-Sarsat (DND)
13. SPOT - remote sensing (CNES)

14. Lunar and mars mission Planning (CSA)
15. Asteroidal impact deflection (NASA)
16. Multiple Black Bandt suborbital missions (DND, ESA, SSC, Nor)

## **Judge at John Molson MBA International Case Competition**

December 2014 - Present

The John Molson MBA International Case Competition is a not-for-profit event organized by a team of four MBA students from the John Molson School of Business, Concordia University, Montreal, Canada. The competition is open to top business schools worldwide, and is recognized as the largest competition of its kind. Its main purpose is to bridge the gap between corporate and academic worlds, which ultimately enriches both students and executives alike.

The competition format is a round-robin tournament consisting of five business cases. The cases are selected from among the top entries from the annual Case Writing Competition. One of these cases is a live case presentation by a major company about a real-life business challenge that they are currently facing.

## **Governance Experience at Board of Directors**

1993 - Present

- 2015-now Chair, Polar Knowledge Canada, Federal Agency
- 2014-2016 Canada's Space Advisory Board
- 2014-now Sigma Energy Storage, Chair
- 2015-now Anyon Systems, Chair
- 2013-2014 Canadian Rare Earth Network - Founding Member
- 2005-2014 Orbite Aluminae (Alumina & Cleantech mining) TSX
- 2008-2013 Atomic Energy of Canada Ltd(Nuclear energy and technology) Crown Corporation
- 2007-2009 Broadsign (Chairman, Digital signage software) Private
- 2006-2011 JAG Mines (Natural Gas exploration) TSX-V
- 2005-now ITSMAX (Intelligent highway technology for public transport) Private
- 2004-2012 Raymor (Carbon nanowires, plasma surfacing) Public became Private
- 2001-2013 Mechtronix (Flight simulators) Private and M&A to Textron
- 2002-2004 Institut National d'Optique (Photonics, R&D and tech transfer) Parapublic
- 1999-2003 Autovu (Autonomous optical reading of license plates) Private & M&A
- 1999-2002 Codagen (Autonomous software writing software) Private
- 1999-2002 Nikrom (Nanotechnologies, Metallic resurfacing) Private
- 1995-2002 Poetic Tech (Ergonomic and Memory farms cooling technology) Private
- 1999-2002 Smartsight (IP surveillance camera technologies) sold to Verint
- 1998-2001 Extensotech (Tourism guide technology) Private

1997-2001 SMT Hydrasil (Nanotechnologies and surfacing) Private  
 1997-2001 PyroGenesis (Nanotechnologies, Cleantech) Private became public TSX-V  
 1996-2001 Tetra Tech (Fleet managing technology) Private  
 1998-2000 AT2/Biogen (Surgical glue and instruments) Private  
 1999-now Géomax (Geomatics) Private  
 1996-1998 ART Advanced Research Technologies (Biophotonics and aero technologies) TSX  
 1992-2008 Visuaide (Technology for the visually challenged) Private became Humaware  
 1994-1996 Aeroports de Montreal (Management of the Montreal and Mirabel Airports) Parapublic  
 1993-1996 CLD de la Montérégie (Regional Development Agency) Parapublic  
 1993-1996 Centre de Technologies Aérospatiales (Aerospace technology research center)  
 1985-1990 Advisory Committee of L5 Society (NGO)

### **Member of the Board at Anyon Systems Inc.**

January 2015 - Present

Anyon Systems Inc. is a funded and profitable Canadian technology startup with the mission of building and commercializing modeling and design software tools enabling the accelerated development of a universal quantum communication devices and processors. Quantum computing is a new and promising paradigm in high performance computing in which laws of quantum physics are used to obtain significant computational speed up for efficient solution of some of the most challenging problems in cyber security, big data analysis, molecular simulation, climatology and weather forecasting, petroleum modelling etc. Successful applications of quantum computing to any of these problems will open doors to massive and growing markets. Anyon's QC software tools has entered the Alpha test phase and is expected to be in the Beta test phase with leading market clients by the fall. The software can be used by superconductor, quantum optics and nanotechnology technologies manufacturers and save months to years in developmental schedules.

According to Market Research Media Inc., Quantum Computing market is expected to grow at USD ~2,464 million by 2022, at ~24% of CAGR between 2016 and 2022

The early adopters of quantum computing solutions are government agencies as well as major IT/Defense contractors who are eager to use the power of quantum computing for encryption and decryption and large scale simulation applications. The Canadian Government announced July 30th, 2015 a grant 33.5M\$ for a new research industry-university partnership and clients, headed by U. of Sherbrooke, including Microsoft, Google, and Anyons Systems.

Given such opportunities, Anyon Systems Inc. has positioned itself to produce tools to develop and manufacture universal scalable quantum computer to address the computational need in cyber security, big-data analysis as in weather and climate forecasting, and simulation technologies.

### **Canada's Space Advisory Board Member at Innovation, Science and Economic Development / Innovation, Sciences et Développement économique**

**December 2014 - October 2016 (1 year 11 months)**

Reporting to the Minister of Innovation, Science and Economic Canada, the Board provides advice on the Canadian Space Agency (CSA) space program and land based Astronomy. Including strategic advice on a vision for the L/T commitment to space of the Canadian Government, space-based solutions and their commercial success.

As outcome, the Minister has recently announced Canada's participation extension to the space Station until 2024, a new ESA Comsat technology program participation, a participation in the new world-class Thirty Meter Telescope to be built on Mauna Kea besides the actual Canada-France-Hawaii large aperture telescope. Canada is also continuing its participation in the James Webb Space Telescope. The budget of CSA is about 350M\$ per annum.

**President, CEO and director at Orbite Aluminae Inc.**

**August 2005 - February 2014 (8 years 7 months)**

Grown a start-up into a technology leader in circular economy with a mining and cleantech expertise. invented, conceived, developed and patented an innovative metallurgical/chemical process enabling the environmentally clean production of alumina from various aluminous ores, the sustainable transformation of industrial and mining wastes (Red Mud, Fly Ash...) into a series of metallurgical (Al, Fe, Si, Ti, ...) products and of the co-located rare metals products including rare earths (REE) and rare metals (Ga, Sc, ...).

Raised over \$140M of innovative financing from institutional and government sources and directed a knowledge-based publicly traded start-up to reach a valuation of more than \$1/2B and, that generated 13 patents as well as more than 67 pending. Listed amongst the 50 Top public corporation in Quebec by Les Affaires and in the 300 top Canadian listed firms by the Globe and Mail. Principal author of the IP portfolio. Because of which, Orbite was recently selected to be amongst the 20 most innovating firm by the Canadian Innovation Index.

Negotiated deals with MicMac first nation for the operations of a natural resources operation in the Gaspé peninsula successfully traded for the pipeline delivery of natural gas from a local source.

Resulting in roughly 567% market share gain over tenure, representing a CAGR of roughly 35% per annum. Developed relationship agreements and partnerships with aluminium producers such as RUSAL (smelter-grade alumina), an off-take contract with Glencore (smelter grade alumina), as well as with the environmental services world leader Veolia (for sustainable treatment of Red Muds and coal combustion residual Fly-Ashes). Development of a Pilot facility and of a circa \$100M High Purity Alumina commercial production facility. On-boarded a highly effective quality team. [http://en.wikipedia.org/wiki/Orbite\\_Aluminae](http://en.wikipedia.org/wiki/Orbite_Aluminae). [http://en.wikipedia.org/wiki/Red\\_mud](http://en.wikipedia.org/wiki/Red_mud)

**BOD Member at AECL**

**January 2007 - April 2013 (6 years 4 months)**

Atomic Energy of Canada Limited, a crown-corporation, is Canada's premier nuclear science and technology organization. For over 60 years, since the Manhattan project, AECL has been a world leader in developing peaceful and innovative applications from nuclear technology through its expertise in physics, metallurgy, chemistry, biology and engineering. It developed the CANDU 6-800 MW class heavywater and the smaller Slowpoke reactors, the sole nuclear energy technology capable of burning naturally occurring Uranium (and Thorium) without reverting to enrichment and without producing climate changing CO2 and Greenhouse Gasses (GHGs). 22 reactors were built in Canada providing some 15% of the country's power requirement at a 5-8 cents per kW/hr cost. There are CANDU-type units operating in India, Pakistan, Argentina, South Korea, Romania and China. The technology can burn the cheaper and more prevalent element Thorium as tested in China and soon in India. While in tenure, the BoD successfully divested the CANDU business unit to SNC-Lavalin and supervised the repair and bringing back the world-leading Chalk River medical isotope reactor, developed the EC6 reactor concept and set AECL with a new structure as a GOCO. Served on the Audit, Chalk River oversight and Technology committees. [www.aecl.ca](http://www.aecl.ca) and [en.wikipedia.org/wiki/CANDU\\_reactor](http://en.wikipedia.org/wiki/CANDU_reactor).

AECL installed in many Canadian cities centers, within universities, SLOWPOKE Small Nuclear Reactors. utterly stable and handled by universities. This is an older technology that may come back.

Developed a concept for the green processing of heavy oil sands in Alberta using a thermal Candu.

### **BoD director and Head of Audit Committee at Mechtronix Systems Inc.**

2000 - 2012 (13 years)

Mechtronix is a private world leader in civilian flight simulation; offering a complete range of products from 2D training tools and FTDs to Full Flight Simulators (FFS) Level D, has extensive experience in the flight simulation business and a well implemented worldwide support network. During tenure, the firm went from a start-up providing training tool to the second largest full-flight simulator corporation in the single aisle aircraft category (B737, A320 families) generating circa 10x in shareholder value growth over tenure. It was recently sold to the US based Textron conglomerate (operating now under TruSimulation) with 350 employees. <http://www.mechtronix.com/home/>

### **CEO**

February 1991 - January 2010 (19 years)

Within Aerospace sector: Performed contracts for ESA in automation and robotics, optics, microgravity and international Technology Transfer mechanisms; CNES and France's DGA on remote sensing technology; CSA on moon and mars exploration missions; Intellectual property (IP) technology transfer; NASA committees and workshops on asteroidal-earth impacts and avoidance strategy; Microgravity Processing and planetary In-Situ Resources Utilisation (ISRU); and process development for lunar illmenite; at the Canadian Royal Military College, introduced space specialty program involving the novel milspace operations curricula.



In the management sector: Consulted on the M&A of large European and American aeronautics and aerospace conglomerates.

In the energy sector: Studied and modeled Space Power Systems (SPS) and created Space Relay Transmission of power (SPR) clean technologies, Lagrange Point Solar Flares vulnerability, detection and associated warning technology for Hydro-Québec and Hydro-Ontario; but also with power grids stability and oil and gas prospection.

In the advanced materials sector was involved advising 5N+ (semiconductors) and Canadian Electronic Powder (CEPC) Tantalum electronics and on the development and applications of Single and Multiple Walls Carbon Nanotubes resulting in a high throughput production line.

Client list included large Japanese and European firms such as IHI, Nippon Steel, Matra-Marconi and Société européenne de propulsion (SEP), and Canadian DMR. Worked as Advisor to the Québec's Ministry of Industry on aerospace and robotics affairs.

Developed strategic and business plans for the CSA, DMR, ATS Aerospace, Lockheed, Lockheed-Martin, Matra, Instrumar, C-CORE and provincial governments. Served as expert on technology transfers and intellectual properties for the European and Canadian Space Agencies. Throughout his career, he has participated directly as a principal to more than 13 space missions/satellites and aircraft programs.

### **Director, Board of Director at Humanware**

1981 - 2005 (25 years)

For over 25 years, HumanWare's inspirational vision has resulted in a range of highly intuitive and intelligent solutions that empower people with visual impairment and learning disabilities by giving them the independence to participate effectively within a sighted world. Served on the Board and the audit committee as well as a Strategic advisor. The corporation began as a not-for-profit start-up distributing technologies to the blind and low-vision communities, it then became a private firm financed by venture capital, to become the most innovative and the largest low-vision technology manufacturer and distributor. It is of recent part of the Essilor group.

### **CTO and VP Strategy**

November 2000 - April 2004 (3 years 6 months)

Public firm using a proprietary infrared optical technology to create and market biomedical and pre-clinical pharmaceutical bio-optical imaging devices. The firm at the onset was a start-up, then graduated to be traded on TSX stock exchange and had a market cap of approximately \$100M at the end of tenure. Hired to effect a technology turnaround and divest a business unit.

Developed high speed time-domain fluorescence bio-optical platform used in breast cancers and new drugs investigations small animal imagery system; Quantum dots applications to molecular imagery; Ti-saphir lasers.

Established the corporate strategy, R&D, engineering and business development functions. Conceived and developed new products in Optical Molecular Imaging in 14 months (3 patents). Product accounted for all of the firm's revenue. Negotiated commercial licensing deal with GE Medical for two products. Raised two rounds of more than 17MUSD in financing.

Divested the ISIS division at 5x sales to Photon Dynamics (based in California). Was pivotal in firm's IPO (24M\$ in strategic and institutional investors, \$35M in TSX IPO and prepared for a NASDAQ listing) increasing market capitalization from \$20M to \$200M in 36 months.

Optix small-animal imager has become a technology quality standard in the market picking up more than 10-15% market share with more than 50 units fielded. Developed inverse-solution image reconstruction technique. Research dealt also with the mechanics and biophysics of cancerous cells.

### **CEO, CRO at PyroGenesis Canada**

2003 - 2004 (2 years)

A cleantech and advanced material firm dedicated to the application of thermal plasma technology for aerospace depositions and the oil and natural resources industries to solve important environmental/energy problems. It also produced nanomaterial such as Bucky balls and carbon nanofibers and nanowires. Involved also in Clean technology to treat municipal and ship wastes using high temperature plasmas, sold systems to US Navy and Caribbean Cruises. The firm is presently publically traded TSX-V.  
[www.pyrogenesis.com](http://www.pyrogenesis.com)

### **Venture Advisor, SOFINOV at Caisse de dépôt et placement du Québec**

February 1995 - November 2000 (5 years 10 months)

#### **INSTITUTIONAL FINANCE**

Executive level Venture Advisor for Caisse de dépôt et placement du Québec's (CDP – \$132B in assets then) primarily for Sofinov (\$1B in assets) and in support to Capital Communications (\$2B in assets). Responsible for managing venture capital equity investment in high technology industrial companies, specifically materials, aerospace, cleantech and energy ventures including energy storage systems such as fuel cells.

Developed and managed more than 22 international investment projects commitments worth in excess of \$110M, with an orientation towards new economy. Generated more than 200 investment leads. Enabled CDP's investment in an aerospace-oriented US Venture Capital (USVC) fund (Spacevest) for \$40M. Served on seven Boards of Directors for CDP. Developed a tech valuation model for CDP venture funds. <http://www.lacaisse.com/en>

## **Co-Chairman, resources and manufacturing department at International Space University**

1988 - 1997 (10 years)

The ISU is an international non-governmental organisation providing a post-graduate education on space issues. Every summer, the selective program attracts 130 young space professionals from 30 countries. ISU is now also located in Strasbourg as a research and education university with a full year graduate program as well.

Member - Board of Governors and Founders

Member - Board of the Canadian Foundation for ISU

Faculty member, robotics, microgravity processing and space resources

## **Founder and CEO at Centre technologique en aérospatiale - CTA**

1993 - 1996 (4 years)

Established a federally-provincially financed research and technology-transfer center of excellence in aerospace with aim of transferring aerospace and materials technologies to SMEs to increase their growth and profitability. Projects in light aircraft design, aerospace metallic and composite structures, flight and aircraft maintenance simulators were carried out. A successful start-up incubator was established. Located near the Canadian Space Agency (CSA) and École Nationale d'Aéronautique on the St-Hubert airport near Montreal.

Responsible for implementation and management of Centre de technologies aérospatiales (CTA) a para-governmental R&D centre of excellence.

- Centre with one of highest levels of self-financing in the province and country.
- CTA was self-financed in initial year with low initial capitalisation.
- Five year business plan accomplished in less than three years.
- Built-up client loyalty and satisfaction to high levels with a high contractual repeat rate (>3.3).
- Developed and established a successful technological enterprise incubator, with two (2) firms receiving VC funding

## **Executive Advisor at C-CORE, Memorial University**

1990 - 1992 (3 years)

As consultant to C-CORE, founded and set up an original research center under the auspices and financing of the European Space Agency in St-John's NF with Prof. Jack Clark. The primary goal of the center was the use of Arctic, Ocean and Extreme Environment conditions to drive the design of advanced engineering technologies. The center is called CIRUS and was created within the C-CORE center located at Memorial University. The center's objectives were to study surface and interface physics using low-gravity and enable the comparative study of extreme environments of oceans and space. The projects were centered on enhanced oil recovery (with a Calgary research group), the thermodynamic modelling of oil reservoirs and studied foam stability with ELF-Aquitaine. The Canadian Space Agency came also in funding the center and

provided two Get-Away Special canisters (GAS cans) on the space shuttle to carry out the experiments. It was involved also in Ice and Climate Physics research.

### **Director, Aerospace Systems at Oerlikon**

August 1989 - 1992 (3 years 5 months)

An international high-technology company specialised in the development and integration of air defence systems based in Switzerland. Responsible for the development of a diversification unit involved in space technology at Oerlikon Aerospace. Awarded contracts from the Canadian Space Agency on dextrous robotic devices (DEXTER or SPDM) and other on the exploration of a Canadian contribution to a future international Moon-Mars mission. Sat on external NASA committees for the in-situ uses of local resources (ISRU) and processing ores on the Moon, asteroids or Mars to produce oxygen, fuel and water.

### **Sr. Staff Scientist**

1984 - 1989 (6 years)

Join the early phase start-up in space engineering, developed 8 different satellites and space station programs ranging from Radarsat, SPOT, to military telecom and remote-sensing platforms to a variety of scientific payloads and satellites. Grew to 200 persons before being sold to EMS technologies.

Developed software to position distressed individuals/pilots using Doppler shift of emergency beacon on the radio emission on the Cospar-Sarsat satellites. This system has saved more than 500 lives as of last, through the space detection and location of emergency beacons (121.5 and 243 Hz). Developed and flown energy storage devices such as NiMH batteries.

Established new ventures for CAL in space technology and space utilisation (microgravity) growing to finally 25% of the revenues of the firm. Was leader in developing microgravity material processing float-zone furnace technologies for high-purity germanium, gallium-arsenide (III-V) semiconductors now flown on the space station. Developed on protein crystallisation, encapsulation of Beta-cells (diabetes) and electrophoresis separation of long chain pharmaceuticals in low-gravity. Trained on NASA's KC-135 parabolic flight aircraft simulating low-gravity. Developed Moon-Mars mission scenarios for the interdepartmental committee on space (prior to CSA's emergence).

Provided design for equipment mounting and operational aircrafts and helicopters involving obtaining the required Transport Canada authorisations.

### **Faculty at Ottawa University**

September 1985 - May 1986 (9 months)

Lecturer Mechanical Engineering. Part-time.

### **Professor of aerospace and mechanical engineering at Université de Sherbrooke**

1982 - 1984 (3 years)

Professor of aeronautics and mechanical. Developed an undergraduate specialty program within the Mechanical engineering department in partnership with Pratt&Whitney Canada and Bombardier Aerospace. A first in Québec, the project also included an international faculty exchange program with Ecole Polytechnique in Paris, ENSICA and Sup'Aéro in Toulouse. Developed a complete aircraft design curricula involving DeHaviland Aircraft (now Bombardier). Produced refereed research and publications in fluid dynamics including the aerodynamics of Darrius type windmills (used by NRCC & Hydro-Québec), racing sailboats (North Sails), racing cars and transonic wingform (Bombardier). Acted as an aeronautics expert for the media and expert witness for administrative courts.

Organized the Sherbrooke International Airshow with a mixed pageant of civilian and military aircrafts from Canada and the US in 1983 and 84

### **Defence Scientist at Canadian Forces**

1981 - 1982 (2 years)

Computation Fluid Dynamics (CFD), Internal and Store Aerodynamics and Ballistics, Simulation of missiles in warfare scenarios, Vulnerability assessments.

### **Graduate Teaching Assistant at Cornell University**

1980 - 1981 (2 years)

TA on undergraduate Mechanical engineering courses. Replaced leaving faculty on teaching graduate Fluid Dynamics class. Was TA on graduate Quantum Mechanics Course in Physics using the then novel Cohen-Tanoudji text.

### **Aerospace Simulation Engineer at CAE**

1979 - 1980 (2 years)

World leading manufacturer of flight and marine systems simulators. Involved in modelling engines and aerodynamics for military and commercial aircraft simulators. Coding in machine language and Fortran. Simulation of space robotics systems. Left to attend graduate school at Cornell University.

### **Research and teaching staff - Physics at University of Waterloo**

June 1978 - August 1978 (3 months)

Under a National Grant from NSERC. Working with Prof. Pim Fitzgerald. Involved in Globular Cluster astrophysics, supporting undergraduate astronomy classes. Participating to an International Solar Energy Workshop and a Princeton Astrophysics conference.

### **Optical and Astronomy Research Associate at Université de Montréal**

May 1977 - August 1977 (4 months)

Design, planning and performing optical engineering acceptance tests and civil engineering on the OMM 1.6 m. Ritchey-Chretien telescope located at Mt-Megantic. Site location studies for the OMM. Optical modelling. Astronomical instruments design and testing. Under Prof. René Racine, father of the Canada-France-Hawaii Telescope located near the summit of Mauna Kea mountain on Hawaii's Big Island at

an altitude of 4,204 meters (13,793 feet), and is one of the observatories that comprise the Mauna Kea Observatory. Operational since 1979, the telescope is a Prime Focus/Cassegrain configuration with a usable aperture diameter of 3.58 meters.

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## Education

### **Cornell University**

Professional M. Eng., M&AE, Space Physics, 1980 - 1981

**Activities and Societies:** Sigma Xi honour society member. Teaching assistant at Sibley's School of Mechanical and Aerospace Engineering.

### **Massachusetts Institute of Technology**

Short Course, Technology and Sustainability, 2017 - 2017

### **Université de Sherbrooke**

MBA, Innovation management, international economics and finance, 1995 - 1998

**Activities and Societies:** Participated to the International MBA Case Competition, Organized by the Molson School of Business of Concordia U., lead a MBA student team representing the university into the finals.

### **Université de Sherbrooke**

Graduate Degree, Environmental Science and Sustainable development, 2015 - 2017

### **Université de Montréal**

B. Sc (Honours), Physics, 1976 - 1979

**Activities and Societies:** Elected class president 1976-1979

### **McGill University**

Ph.D. (incomplete), Mechatronics, Robotics, and Automation Engineering, 1995 - 1997

### **Massachusetts Institute of Technology**

EDX program, 2014 - 2014

### **Harvard Business School**

Executive Education Short Course, Leading Product Innovation, 2011 - 2011

### **Canadian School of Public Service**

Governance in Public Service, 2008 - 2008

### **École des hautes études commerciales (HEC)**

Executive Education Short Courses, Management, 2006 - 2010

### **McGill University - Desautels Faculty of Management**

Short Course, High Tech Marketing

### **Concordia University**

Short Course, Conceptual and advanced design of Aircraft

### **Ecole de Technologie Supérieure (ETS)**

Operational Research Short Courses, Operational Research

### **Kansas State University**

Short Course, Aircraft reliability

### **McGill University**

Graduate seminar lecture series by Richard Feynman Ph.D. Nobel Laureate, Quantum Electro-Dynamics (QED) and optical physics., 1979 - 1980

### **University of Waterloo**

Solar Energy Conversion, Dept. of Physics, University of Waterloo, Canada, Aug. 1978, 1978 - 1978

**Activities and Societies:** Short Course on Solar Energy

**Palisade**

Short Course, Risk management

**NATO Summer School**

Concordia University, Short Course in Nanotechnologies, 2005 - 2005

**Institute for Electrical Power (IGEE) Summer School**

IGEE at Ecole Polytechnique, 2016

**Université de Sherbrooke**

Doctor of Philosophy (Ph.D.), Biology/Theoretical Ecology/Exoecology/Earth Systems Sciences, 2017 - June 2021

**Institute of Corporate Directors**

Crown Director Effectiveness, 2017 - 2017

**Université de Sherbrooke**

Ph.D. Ecosystemic Biology, Mathematical Ecosystemics, 2017 - 2022

**Université de Sherbrooke**

Summer School in Mesoscopic Physics, Quantum mechanics and materials, 2015 - 2015

**Université de Sherbrooke**

The Canadian Summer School on Quantum Information, Quantum computing and information, 2017 - 2017

**Massachusetts Institute of Technology**

Certificate Technology and Sustainability, Mechanical Engineering, 2017 - 2017

**Université de Sherbrooke**

Summer School, Big Data Analysis with Bayesian Statistics, 2017 - 2017

**Activities and Societies:** Application to Mathematical Ecology

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## Honors and Awards

Fellow Royal Canadian Geographic Society, Beacon in Photonics Research and Leadership, Energy Globe Award Canada, 2016 CAP-INO Medal for Outstanding Achievement in Applied Photonics, The Aluminium Rising Star 2013, Medal of Queen Elizabeth II's diamond jubilee, Canada's most Innovative New Technology (regional & national awards IRAP), Fellow CAE, Fellow WASS, Fellow CASI, Art & Sciences Faculty Medal, Fellow IAA, Associate Fellow AIAA, Member and Board member, Finalist, Best faculty (two years running), Best Published Paper Award, Sr. Member IEEE, PerformAS Award, Alpha Prize, Innovation & Creativity Award, The 2016 CAP-INO Medal for Outstanding Achievement in Applied Photonics

# Richard Boudreault

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