INNOVATING
THROUGH PARTNERSHIPS

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NSERC
CRSNG

Natural Sciences and Engineering Research Council of Canada
Conseil de recherches en sciences naturelles et en génie du Canada

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A lifeline for 21st century manufacturers

Le texte intégral des articles qui se trouvent à la présente section est disponible en français dans le site Web du CRSNG à www.crsng.gc.ca.

Business investment in higher education R&D is growing at an extraordinary rate, and it's little wonder. With more businesses embracing innovation as an instrument of competitive advantage, many are looking to universities and colleges for help – for skilled people with advanced science and technology training as well as new ideas and research results.

In the past decade, private sector spending on higher education R&D in Canada is up more than 160 per cent. That's roughly four times the increase in overall business R&D spending, and a clear indicator of the growing value universities and colleges provide to industrial innovation.

Despite this trend, many Canadian manufacturers are not capitalizing on higher education research and training. In last year's CME management issues survey, fewer than 20 per cent of manufacturers rated access to university R&D as a key factor affecting business innovation.

"The survey confirms what we're observing in our university-industry research programs," says Janet Walden, Vice-President of Research Partnerships with the Natural Sciences and Engineering Research Council (NSERC).

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A federal research granting council, NSERC invests over $850 million annually in people, discovery and innovation at universities and colleges across Canada. Each year, NSERC supplies over $140 million in matching funds to more than

800 business-higher education R&D partnerships through a suite of skillfully designed programs covering the complete spectrum of industrial R&D, from long-term research to short-term product, process and service development.

"Our programs have become very popular with large manufacturers and research-intensive companies. Yet we don't see the same growth in interest from small- and medium-sized manufacturers, even though many of them have much to gain from collaborative research. For example, a small firm with one or two R&D professionals might easily double or triple its innovative capacity by engaging in a collaborative project with professors and students," explains Walden.

"Higher education is a big asset that we should be exploiting more in this country," contends CME Chief Economist Jayson Myers. "To be competitive, we need to collaborate with college and university researchers because many manufacturers don't have the time to build these resources internally."

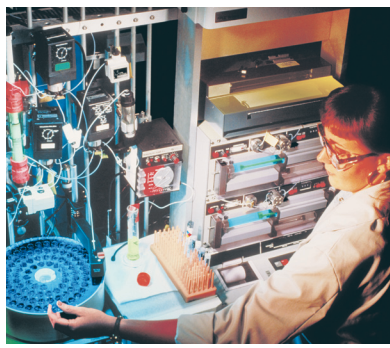
Myers says there's a growing realization that advanced training is integral to the collaboration. "In my view, the main benefit of these projects is not necessarily the research results, but rather the training of highly qualified individuals with the kind of job-ready skills our industry needs."

Students receiving advanced training are the best vehicles for transferring knowledge from higher education institutions to industry, according to Walden. "Their value to business is probably greater today than ever before, as more and more knowledge is infused into processes, products and services. Also manufacturers today require workers with ever-greater skills in order to respond effectively to market demand for more and more product customization."

So why aren't more manufacturers teaming up with universities and colleges? Well, many businesses are simply unacquainted with the research being done in Canada, or are unaware of risk-sharing options with granting agencies like NSERC.

"From our Manufacturing 20/20 exercise, what struck me is the real lack of awareness among businesses about the world-class resources and knowledge available in Canadian universities and colleges," remarks Myers. "As I travelled across Canada, I heard repeated calls from CME members that Canada needs a national database detailing researchers and their experience with industrial collaboration."

NSERC maintains a publicly accessible database of its entire population of grant and scholarship recipients. However, the information is oriented toward projects, rather than people. More recently, NSERC launched a searchable Chairholders database profiling more than 100 of Canada's top scientists and engineers with strong industry ties.



The Chairholders database is part of a larger effort by Walden's group at NSERC and its partners to build better bridges between businesses and higher education researchers, and encourage technology commercialization. "The federal government has sent a clear message that moving ideas from the lab to the marketplace is a national priority," she says. "We're ready to work with any company that wants to explore options with us and our university and college partners."

More information about NSERC's partnership programs can be found at www.nserc.gc.ca/indus_e.htm.

Why R&D collaboration is good for business: Recruiting highly skilled workers

Most CME business leaders believe the supply of highly qualified professionals will be key to advancing the innovative capacity and competitiveness of Canadian manufacturers. For manufacturers, collaborative R&D with universities and colleges provides a unique opportunity to assess potential candidates for future employment. On average, each NSERC collaborative R&D project trains seven students with advanced skills relevant to industry.

Faster machining

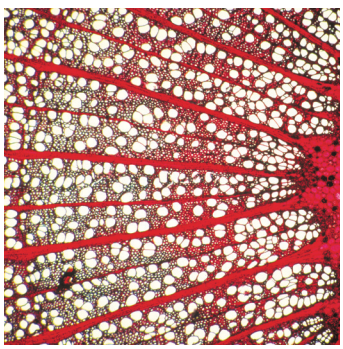
Pratt & Whitney Canada (P&WC) constantly seeks innovative solutions to reduce machine cycle times and improve the productivity of complex aircraft engine components. While sponsoring an NSERC collaborative R&D project at the University of British Columbia, the company hired Dr. Erhan Budak to implement predictive digital models for various machining processes. Within three months, Dr. Budak applied the models to reduce the cycle time for a particularly complex part by 300 per cent. He remained with the company for another six years.

P&WC continues to hire students trained under a follow-on NSERC Industrial Research Chair in Virtual High Performance Machining. "For us," says Don McIntosh, Manager of Manufacturing Technology, "the big-step change was bringing the students in with knowledge from high performance machining projects at UBC." McIntosh says the students provided a unique understanding of the physics of machining parts – knowledge that has helped P&WC improve the manufacturing of sophisticated aircraft engine components.

Thinking outside the box

Winnipeg's Conviron is a world leading manufacturer of controlled environmental systems for a wide range of scientific applications. Like many Canadian manufacturers, Conviron is embracing new management tools, particularly enterprise resource planning (ERP) and lean manufacturing techniques. These reduce the amount of custom engineering required for highly customized products and deliver greater productivity from the company's human and capital resources.

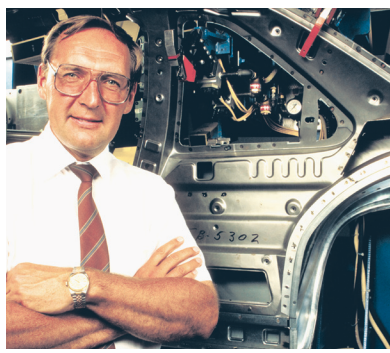
In developing a management plan for ERP implementation, Conviron enlisted the expertise of Olga Kats, then a student in the Technology Management program at Red River College (RRC). Ms. Kats' project was part of RRC's new Leading Advanced Manufacturing Practices (LAMP) initiative, funded under NSERC's recently launched College and Community Innovation Pilot Program.



Conviron's Vice-President of Operations, Ian Mattey, was impressed with Ms. Kats' capabilities. "It was great to have somebody planning ERP implementation who operates outside the bounds of day-to-day operations, and who isn't afraid to challenge our thinking." Mattey adds that while the company's senior management team engaged in a parallel planning exercise, Ms. Kats was able to identify project risks that management hadn't considered. Ms. Kats now has full-time employment with Conviron, overseeing the ERP introduction.

Reducing costs and time to market

After a decade in which the federal investment in university research grew by more than $9 billion, Canada's higher education institutions are now best-in-class in many areas, including advanced manufacturing technologies, materials R&D and characterization, as well as modeling and simulation of new products and processes. These capabilities, which reduce costs and speed time to market, provide a new level of predictability to manufacturers who would otherwise rely on trial-and-error techniques.



A die well cast

Burlington Technologies produces 30 million high-pressure, die-cast aluminum parts for the auto industry annually. In Burlington's business, the useful life of a die – a key measure of productivity – is often limited by an unpredictable and undesirable condition known as die soldering and heat checking (DSHC). Die soldering

occurs when bits of molten aluminum harden and stick to the mold, while heat checking produces unwanted cracks in the die. Both result from extremely rapid temperature changes during the process.

To get around the DSHC problem, Burlington partnered with NSERC-funded researchers at Carleton University in Ottawa. The researchers engineered unique, user-friendly modeling and simulation tools that allow Burlington's designers to develop dies that are less susceptible to DSHC.

"We now do as much as we can with the modeling and simulation tools to predict the flow of material, and the potential for stress and heat checking," explains Burlington President Ken Carpenter. "If we didn't have those tools, it would be totally trial and error, which can be very lengthy and very expensive."

Carpenter says time-to-market considerations drove the collaboration with Carleton. "Previously, our product development was fairly lengthy, but with the simulation software, we've made some significant improvements," he says, noting that the university-developed tools helped reduce Burlington's product and process development cycles from as long as 2 years to 16 weeks or less.

Quieter, safer insulation

MTI Global Inc. (previously known as Magnifoam Technology International Inc.) develops and manufactures insulation products, primarily for aerospace and mass transit markets. MTI works closely with a key customer, Bombardier Aerospace, to create new insulating materials for soundproofing aircraft cabins in the increasingly comfort-conscious business jet market.

One material that shows great promise is polyimide foam, an ideal insulation for aircraft because it's strong (rigid), lightweight, and highly burn-resistant. Despite its desirable properties, Polyimide is a difficult material to test for soundproofing because of its complex open and closed cell structure.

To better understand polyimide, MTI and Bombardier engaged the Université de Sherbrooke's internationally renowned acoustics and vibrations group through a series of NSERC-funded collaborative R&D projects. Lead by Dr. Nourredine Atalla, the Sherbrooke team developed sophisticated acoustic modeling techniques that have appreciably enhanced the noise prediction capabilities of designers at both companies.

"This project with the Université de Sherbrooke has provided us with an important new capability that we could not have gained on our own," says Dr. Tatjana Stecenko, R&D Manager at MTI. Stecenko estimates that MTI and Bombardier now have a two-year lead over the nearest competitor in acoustic characterization of aircraft insulating materials.

Accessing unique facilities and equipment

Thanks to billions of dollars invested in new university research infrastructure by the Canada Foundation for Innovation (CFI) and its partners, Canada's academic researchers are better equipped than ever. In many cases, the facilities and equipment in their labs would be too costly for any single company to purchase and operate.

Energizing a low-grade performer

Spheral Solar Power (SSP), a division of ATS Automation Tooling Systems Inc., designs and manufactures unique spherical photovoltaic (PV) cells for solar energy applications. The company aims to gain a competitive edge by using low-cost, metallurgical-grade silicon instead of the expensive, semiconductor-grade silicon used by most

PV cell manufacturers. Working with the low-grade material is challenging because its many impurities reduce its energy conversion efficiency.

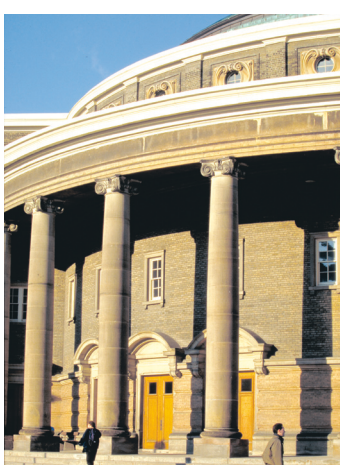
To achieve higher performance, SSP is collaborating on material characterization and process development through an NSERC-funded project with the new Centre for Advanced Photovoltaic Devices and Systems at the University of Waterloo. Silicon nitride thin-film coatings and new hydrogen passivation techniques could potentially eliminate the defects and improve the material's solar energy conversion.

Last year, the Waterloo Centre secured $12 million in infrastructure support to establish and equip a facility with a number of new analytical and process instruments. As a partner in the Centre, SSP is donating an experimental PV cell production line to the university.

"What they're pulling together will be one of the best centres for photovoltaic R&D in North America, says Gary Stevens, SSP's Chief Technology Officer. "We don't have the resources, time and people to operate the research equipment the Centre maintains, so it's extremely beneficial to have that facility nearby."

Smaller is smarter

Industrial Thermo Polymers Limited (ITP) is a leading manufacturer of extruded polyethylene foam products. The company's polymer foaming processes involve gas injection techniques to create tiny cellular structures. Plastics created in this way require much less raw material and enjoy a competitive advantage over conventional non-foam plastics.



"In our business, the smaller you can make the gas cells, the better," explains ITP President Steve Hartman.

Reducing cell sizes improves the foam's physical properties, resulting in superior structural integrity of the foamed plastic products.

To remain at the cutting edge, ITP has teamed up with the Microcellular Plastics Manufacturing Lab at the University of Toronto to develop microcellular hybrid nanocomposites. Led by Dr. Chul Park, and funded by NSERC, the project aims to reduce gas cells to unprecedented nanoscale geometries.

The Toronto lab recently enhanced its capabilities with a $1.5 million infrastructure upgrade. Part of the funds are being used to establish a small-scale plastic foaming processing facility that will bridge experimental-scale processes at the bench level with full-scale production at ITP.

"Dr. Park's group has the facilities, equipment, and capabilities to take foam technologies a lot further than we can," notes Hartman. "We're fortunate to have such a strong technological partner as we move to reinforce our leadership in foam plastics."

Gaining market credibility

Numerous companies, principally small firms, can gain additional marketplace credibility through affiliations with higher education institutions.

A window on the world

Profile Composites Inc. (PCI), a 13-person operation in Sidney, B.C., makes carbon-fibre composite components for a wide range of industries, from aerospace to sporting goods. The company has a successful partnership with the University of Victoria involving characterization of new, lightweight carbon-fibre materials, and development of advanced design methods and tools that can minimize the amount of material required for a given application.

According to PCI President Geoff Wood, the relationship has proven extremely valuable in seeding opportunities with larger partners and customers because the university helps to legitimize the company's capabilities. "Leveraging the relationship for that purpose is very valuable to us," says Wood. "It gets us in the door with larger companies, and is allowing us to develop new strengths in aerospace and alternative energy using optimized materials and processes as well as novel designs."

Wood's principal collaborator at the university, Dr. Afzal Suleman, is also promoting PCI to some of his research partnerships and business contacts in Europe.

Getting the word out

Sputtek Inc., a 15-person company in Toronto, develops and manufactures high-performance, thin-film hard coatings for die casting molds, stamping tools, cutting tools, and mechanical components used in the automotive and aerospace industries. In a bid to develop products for more demanding applications, especially in aerospace, Sputtek has teamed up with researchers at McMaster University to study new metal alloy combinations suitable for physical vapour deposition.

Working primarily with variations on a base of titanium-aluminum, the team has engineered a number of novel hard coatings that can improve the corrosion- and heat-resistant properties of Sputtek's products. "They (the university) are our right arm when it comes to the characterization of coatings," says Sputtek President Dr. Lee Segal.

Moreover, says Segal, the university connection gives the small company a bigger stature in the marketplace. "If you have test results on university letterhead, it represents an accurate and reliable third-party endorsement. The fact that the university is involved is a very useful influence when you are approaching large customers."