SPECIAL REPORT

Research Manitoba

STRATEGIC INVESTMENT

INNOVATION OPENS THE DOOR TO NEW OPPORTUNITIES IN HIGH-END MANUFACTURING

Manufacturing has long played an important role in Winnipeg's diverse economy.

There are a lot of reasons for that, not least of which is the entrepreneurial spirit of the people who live here. But another important reason is innovation. Over the years, numerous local companies have been able to harness the power of innovation to improve their product lines or create new ones for the global market. The importance of innovation in creating a strong economy is not lost on government. Over the years, both federal and provincial governments have made strategic investments in local enterprises with a view to encouraging innovation in manufacturing. While federal funding is usually directed through Western Economic Diversification Canada, much of the provincial funding is provided through Research Manitoba, which is responsible for supporting research in the fields of health, natural sciences, social sciences, engineering and the humanities.

This special report, sponsored by Research Manitoba, highlights some of the innovative work being carried out in our city, thanks in part to those investments.

JOINT VENTURES

WINNIPEG'S ORTHOPAEDIC INNOVATION CENTRE IS GARNERING A WORLD-CLASS REPUTATION AS IT ADVANCES HIP AND KNEE REPLACEMENT SURGERY BY EXPLORING NEW TECHNOLOGIES

By Joel Schlesinger

Martin Petrak points to the little hunk of white polymer in his hand and begins to explain its meaning.

Photo: Marianne Helm

Martin Petrak, President and CEO of the Orthopaedic Innovation Centre, holds a prototype of a drug-emitting bone spacing device.

The item in question, which is roughly the size of a hockey puck, is a prototype for a bone-spacing device used to potentially treat patients with infected total knee replacements.

Every year, specialized two-stage revision surgery devices similar to these are inserted into about 50 Manitobans and more than 1,000 Canadians.

But the one in Petrak's hand is different.

For one thing, it was created using a 3D polymer printer in a lab at the Orthopaedic Innovation Centre (OIC), which is located at the Concordia Hip and Knee Institute, right across from the Concordia Hospital.

That in itself, says Petrak, President and CEO of OIC, is enough to make the device noteworthy.

But the thing that really separates it from other similar devices is that this one is made from a new bioresorbable material designed by Petrak and materials engineers Luke Rogers and Jim Orrock, of Minnesota-based Stratasys, to release infection-killing antibiotics once inserted into the knee.

This is significant because each year between one and two per cent of the more than 70,000 knee replacements performed in Canada become infected following surgery. The device created by Petrak and his partners has the potential to more effectively treat these knee replacement infections, not just here in Manitoba, but around the world.

In that sense, the little hunk of white polymer is more than a novel medical device with the potential to improve care. It is also a symbol of OIC's potential to design and produce hip and knee replacement devices for a global market worth about $50 billion.

"This is the kind of stuff people think of happening at the Mayo Clinic or MIT (Massachusetts Institute of Technology) – much larger organizations than what we have here," says Petrak. "Yet the quality of the work we're doing is equivalent, and that's putting Winnipeg on the map as a leader in orthopaedic research."

OIC's emergence is all the more impressive when one considers its brief history. The centre's roots can be traced back to the early 2000s and the University of Manitoba Joint Replacement Group, a coalition of orthopaedic surgeons with a focus on hip and knee replacement surgery.

At the time, the group, led by Dr. Eric Bohm, was interested in conducting studies into the effectiveness and longevity of hip and knee devices. Petrak – a master's graduate from the Biosystems Engineering

Department at the University of Manitoba at the time – was hired to help out.

"They wanted someone who could evaluate and analyze the mechanical stability of hip and knee implants inside the body," says Petrak. "The surgeons also wanted to know what was happening to implant medical device materials inside the body by studying failed devices."

With Petrak on board, the group launched the radiostereometric analysis program in 2003 . It uses specialized X-ray equipment to monitor the performance of devices inside the body over a period of time. In 2005, it launched Manitoba's first hip and knee implant retrieval analysis program to test and evaluate orthopaedic devices that had failed.

By this time, the group had set up shop at Concordia Hospital and changed its name to the Concordia Joint Replacement Group. It had also started to think about how it might be able to expand its research and development capabilities.

It was at this point that Petrak, Bohm and fellow academic surgeons within the group, including Drs. David Hedden, Collin Burnell, and Thomas Turgeon, started meeting with representatives of Concordia Hospital and the Winnipeg Health Region, including Henry Tessman, Chief Operating Officer for Concordia Hospital, Les Janzen, Chief Operating Officer for Concordia Foundation, and Laurie Walus, Chief Nursing Officer of Concordia and the director of the Region's surgery program at the time. Together, they started developing plans for a state-of-the-art facility that would serve as a centre for hip and knee clinical operations as well as engineering and bioengineering work. Those plans came to fruition in the form of the Concordia Hip and Knee Institute.

Opened in 2009, the 60,000 sq. ft. facility provided the clinical space the Region needed to help meet the growing demand for hip and knee replacements. It also paved the way for the creation in 2010 of OIC – a non-profit corporation that would allow a multi-disciplinary group of surgeons, scientists, engineers, and technologists to work side-by-side conducting research and testing medical devices to uncover potential defects and other problems. Today, all hip and knee devices retrieved from patients in the Region are sent to OIC for evaluation.

All of this was made possible with $10 million in funding – $2.5 million each from


Photo: Marianne Helm

The Orthopaedic Innovation Centre conducts research into the wear and tear of hip replacement parts like those above.

the federal and provincial governments and $5 million from Concordia Foundation, which included donations from industry and the community. The provincial funding includes $500,000 through Research Manitoba.

As Petrak explains, the creation of the hip and knee institute and the funding for OIC opened up a whole new world of opportunity. "With the new equipment, we weren't just looking at evaluating the devices clinically. We were looking at evaluating the medical devices by testing and breaking these implants, looking at fatigue and wear issues before they were placed in the body."

By this time, OIC was fielding requests from a few large corporations who wanted to use its research and testing services for their own devices. But most of the interest was coming from smaller players in the industry working on specially designed devices.

"The major manufacturers do most of their testing themselves," explains Dale Kellington, Vice President of Business Development for OIC. "But we are one of the companies available to small firms and start-ups that do not have access to this expensive equipment to run tests that Health Canada and the Food and Drug Administration in the United States require for a device to be approved."

While large corporations like Johnson & Johnson, Zimmer, Stryker and Smith and Nephew make the bulk of orthopaedic implants, small companies can find niche opportunities developing special devices for specific situations. OIC – with its team of 15 scientists, engineers, technicians and administrative staff – helps these smaller companies by providing access to expertise and technology. It can build the prototype and use its specialized equipment to test it at reasonable cost.

By 2013, OIC was generating significant value from its testing and evaluation business. But, as is the case with many businesses, one opportunity for OIC led to another. "We have all this knowledge, which means we can evaluate products," explains Petrak. "But when you have all of this knowledge, what do you do with it? The natural evolution of learning is to start doing. And that's where we are at right now."

Which brings us back to that little white hunk of polymer. "That would be our largest initial technology that has been pre-commercialized here," Petrak says of the drug-eluting bone spacer.

Petrak came up with the concept to address some of the challenges that result when a hip or knee device has to be removed because of infection. The current practice involves replacing the existing metal implant device with a new one using medical cement infused with antibiotics to bond it to the bone. The new device remains in the patient until the infection has subsided, and is then removed. A second new device is then inserted. This is a costly process because the temporary implant device is actually intended for permanent long-term use and does not provide treatment only function. This device is just discarded after surgery.

That alone had Petrak seeing an opportunity for innovation. He theorized that with 3D printing technology, a temporary implant could be made using polymers with geometries specifically designed to meet a patient's particular physiology. But he also wanted to investigate whether it would be possible to create a polymer that could be infused with antibiotics to treat the infection. Working with Stratasys, he did just that.

"What we learned is that we could actually create material for an implant with an antibiotic built in – similar to what's already used in bone cement – to treat an infection," he explains.

Petrak says the new device potentially solves many challenges in treating infections. For example, 3D printing technology can create custom knee replacement components that fit the patient perfectly for less than the price of a new metal implant, which can cost thousands of dollars. The 3D printed device would remain in the patient for weeks or months, fighting the infection by releasing a cocktail of targeted antibiotics over time, before being replaced with a permanent implant. So, not only is the polymer device more cost-effective, it is also tailored to the patient, giving them the best chance of defeating the infection.

Petrak's new invention will soon undergo further testing to ensure it is safe and effective. If all goes well, it could be licensed by a larger manufacturer and on the market within a few years.

Over the last few years, OIC has been involved in a number of other important research projects. In one case, researchers discovered the cause of an imperfection in a knee replacement component that was undermining its longevity.

As Petrak explains, the problem was first noticed by one of the surgeons at the hip and knee institute. "One of our surgeons noticed there were markings on the back of the femoral component of an implant," Petrak says in reference to the part of a knee implant that attaches to the thigh bone.

"We took a few of these devices to test in the lab to see if there was a pattern, and sure enough after pulling other similar devices from the enhanced retrieval program database, these devices exhibited the same markings. We even reached out to a similar database in London, Ont., which also identified similar markings."

But the problem wasn't a flaw in the device. Research indicated that the surgical technique suggested by the manufacturer was likely causing the small markings on an otherwise smooth surface. While the mark was small, this minute imperfection could in theory accelerate the wear and tear on the polymer liner that served as the cartilage in the artificial joint.

"The marking is easily preventable, so working with our surgeons, we recommended that a slight change in the surgical technique would eliminate the potential for the device to end up being marked or potentially scratched," Petrak says.

OIC has had a major impact on research in other areas, too. For example, it recently helped form the Canadian Radiostereometric Analysis Network, which specializes in measuring the migration of devices inside the human body over time. OIC and the Concordia group surgeons teamed up with other orthopaedic centres in Halifax, Montreal and London to establish a consortium to share research results and work with industry to perform standardized clinical trials. Already the effort has paid off, landing major clients like Johnson & Johnson.

But while much has been achieved, there is still more to be done, says Petrak. "We are very new in terms of what we have been doing, and we hope that we are making a difference in Manitoba. To be able to export services like these out of Winnipeg at this level is really exciting to us."

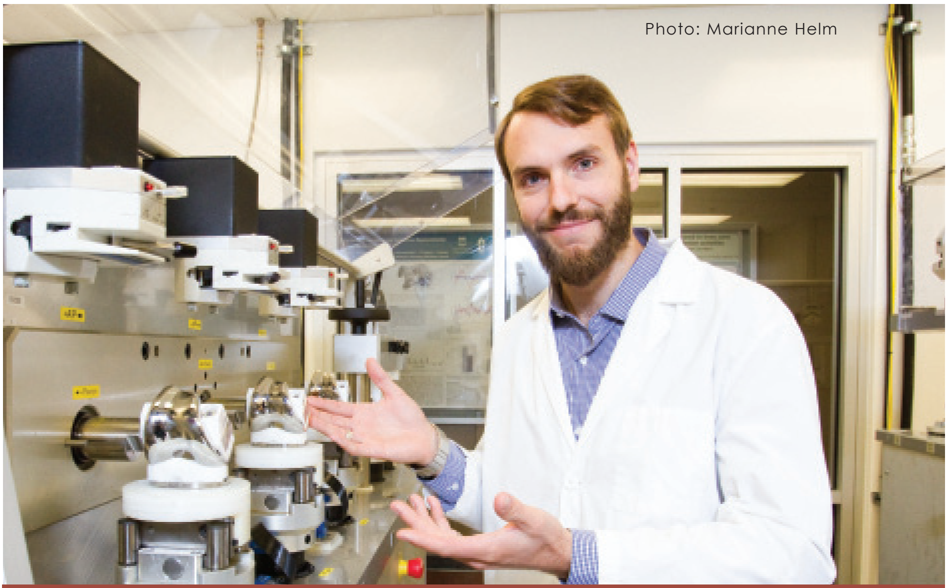


Photo: Marianne Helm

Trevor Gascoyne, Manager of Clinical Engineering and Research at the Orthopaedic Innovation Centre, points to the simulators used to test hip and knee replacement parts.

MANUFACTURING INNOVATION

WINNIPEG FIRM PLANS TO USE 3D METAL PRINTER TECHNOLOGY TO CREATE NEW BUSINESS

By Joel Schlesinger

Photo: Marianne Helm

Mechanical design engineer Jared Kozub (left), and Dale Kellington, Vice President of Business Development for Precision ADM, with the first of two new 3D metal printers.

One day, a patient will undergo surgery to receive a custom-made hip replacement device that will have been designed, tested and manufactured right here in Winnipeg.

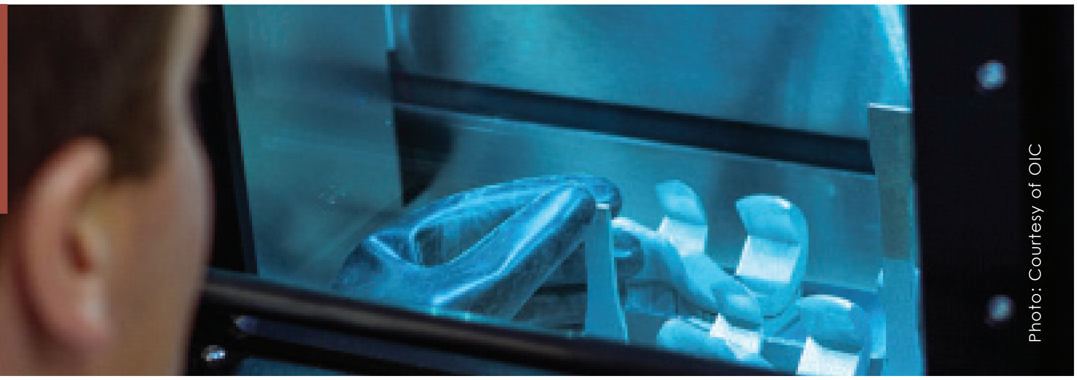
That was the dream when the federal and provincial governments joined Concordia Foundation and the Winnipeg Health Region in creating the Concordia Hip and Knee Institute in 2009.

And since then, a number of steps have been taken to make that dream come true.

One of the most important was the creation of the Orthopaedic Innovation Centre (OIC) in 2010 under the leadership of President and CEO Martin Petrak. It allowed for the hiring of engineers who could work with orthopaedic surgeons at the hip and knee institute to test and evaluate various orthopaedic devices, as well as design new ones. Then, earlier this year, OIC took another step forward.

It created a company called Precision ADM with a mandate to assemble the expertise and equipment needed to manufacture high-end orthopaedic devices, most notably two 3D metal printers that were acquired earlier this year at a cost of about $1 million each.

The move is significant for two reasons: First, it provides OIC with access to a local manufacturing centre that can breathe life into its medical device designs. Second, it means Precision ADM is now the only company in Winnipeg, and one of the few in Canada, that can use a 3D metal printer to produce high-end components for companies working in a variety of industries, including medical device manufacturing, aerospace, and oil and gas exploration, just to name a few.



A Precision ADM staff member cleans residual powder from a completed cobalt chrome metal 3D printing build in the EOS M 290 3D printer.

The implications of these developments are not lost on Dale Kellington, Vice President of Business Development for OIC and Precision ADM. As he explains, the acquisition of 3D metal printing technology opens the door to the potential creation of a whole new industry in Manitoba, no small thing in a province that is striving to maintain a vibrant manufacturing sector.

"We are basically cultivating a new form of manufacturing in Manitoba," says Kellington. "Once we're up and running, it will be the first time in Western Canada that there will be a contract manufacturing 3D metal printer available for both commercial and research and development use," he says.

Although 3D printers have been around for a while, it is important to recognize that different machines do different things. For example, OIC already has a polymer 3D printer that can make prototype medical devices from plastic. But for companies engaged in the production of high-end industrial products, known as "additive manufacturing," only a 3D metal printer will do for many applications requiring material strength and durability.

So just what is additive manufacturing?

Simply put, it is the process of creating a component or part by "adding" material rather than "subtracting" it, a method that is made possible by 3D printing technology.

"The typical manufacturing process starts with a solid slab that gets cut or moulded and then machined into a particular geometry. That's basically a subtractive process," says Kellington. "With additive manufacturing, you're building up a component line by line, similar to printing an image on paper. But instead of ink, we're using metal."

Central to this concept are computer-generated designs. Thanks to 3D printing technology, there is virtually no limit to the precision and complexity of these designs. "It's almost like creating objects out of thin air using a digital blueprint," says Kellington. "If you are aiming at developing low-volume products or specialty products, you're going to choose this technology as your manufacturing technology because there are virtually no tooling costs required."

As Kellington explains, a 3D metal printer works pretty much as you might expect. Metal powder is placed into a reservoir of the machine and is spread in very thin, sequential layers. After each layer of powder is applied, a laser melts select portions of the powder into a liquid which rapidly cools to a solid, bonding it to the layers below. This process is carried out layer-by-layer to create an object based on a digital blueprint.

"In early days, the technology could only create a weak metal structure," says Kellington. "But today, you can create parts with properties that are as strong as those produced through casting and forging processes, if you do everything right."

The decision to get into the additive manufacturing business through Precision ADM is rooted in a series of events that occurred about three years ago, says Petrak.

At the time, OIC's short-term plan was to design metal components for prototypes and then send the digital blueprints to Morris Technologies, a company in the United States that had expertise in 3D printing with cobalt chrome and titanium, the two most common metals used for medical devices.

"But that company was purchased by General Electric in about 2012, so that shut down our partnership, which left a gaping hole in terms of the research and development we wanted to do," says Petrak.

The loss of the partnership opened the door to considering doing the work closer to home, which led to the creation of Precision ADM, says Kellington. "If you want to do this kind of research using this process, there simply are not a lot of places in the world where you can go where people have the knowledge to run the equipment and understand the manufacturing and design processes to make the products," he says. "That set in motion the process to purchase our own machines and learn how to work them so we can figure out the process to make products with our own team."

Still, the idea of creating a company to acquire equipment solely to produce parts for OIC seemed a bit of a stretch financially. Fortunately, Petrak was able find synergies with other companies in Winnipeg and elsewhere that were interested in using the technology for research, development and, ultimately, manufacturing their own products. At the top of the list were companies from the city's large aerospace manufacturing community.

"There is so much logic to it when you follow the whole story because both (aerospace and medical device manufacturing) are highly regulated environments," says Petrak. "Where they're joined at the hip – no pun intended – is the use of the same manufacturing systems, strict quality management systems and materials."

Take titanium for example. It's used in medicine because the human body does not reject devices made with it. "It's also more flexible than other metals, but it's very strong – and it's light, too," says Petrak. That's why it's also used in aerospace manufacturing.

"Why medical and aerospace manufacturing in one shop makes sense is because many of the requirements are largely the same," says Petrak. "The only difference is the geometry of the parts, so the idea for bringing aerospace into the equation was that someone else would develop the design, and we would make the part for them."

In addition to envisioning the formation of Precision ADM, Petrak also saw the opportunity to build an "advanced digital manufacturing hub." This hub, with Precision ADM's expertise and equipment at the centre, would include companies interested in additive manufacturing as well as post-secondary institutions interested in training students for the emerging technology.

With several interest groups dedicated to this technology opportunity, Petrak put together a plan and received $5 million in funding from Western Economic Diversification Canada and $1.5 million from the province through Research Manitoba.

"Without this multi-level government support, it would have been extremely difficult for OIC to enter the arena of metal additive manufacturing on any significant scale," says Petrak. So far, a number of firms both locally and globally have indicated an interest in joining the hub.

In terms of operations, OIC already has one printer up and running for training purposes, with the other expected to be operational in November. Additional metal printers are expected to arrive next spring.

Although Precision ADM is a ways off from having the certifications in place to manufacture orthopaedic devices for implantation, it will soon be ready to take on its first project: the creation of a metal prototype of a patient-specific knee device designed at OIC.

Once created using the 3D metal printer, the prototype will be tested using OIC's specialized equipment, says Kellington. "That's the very start of the process," he says. "We print it. We cut it up. We check to see if the metallurgy will meet the medical requirements. Then we test the mechanics of it – does it move correctly and respond correctly as we thought it would?"

The design could then be tweaked, if necessary, and the device put through another set of tests to make sure it is durable enough to stand up to the kind of use it can expect once inside someone's knee.

Once that is complete, OIC hopes to find a company willing to further commercialize its design. "If that's all good, then the company that licenses the design from us would have to get involved to start pushing it through the regulatory approval process," he says, in reference to meeting the requirements of Health Canada or the Food and Drug Administration in the United States.

Following regulatory approvals, the licensee could look for a company to manufacture the product. Eventually, Precision ADM hopes to capture a fair share of those contracts. Once fully functional, the upside for manufacturing is huge because Precision ADM will be able to build designs that are very expensive or simply impossible using traditional processes.

As an example of its potential, Kellington points to a metal prototype part for a hip implant, normally a solid piece of metal, that has a mesh-like structure making it both light and sturdy.

"With additive manufacturing technology, we can pretty much create any geometry with very few limitations," says Kellington. "We can also make them with varying density through designed or intended porosity – smooth and solid on the surface, and porous on the inside or vice versa, for example, so the piece is lighter and uses less material, but it's still strong enough for its intended purpose."

"This is the case for hip replacement devices where it attaches to the bone, the outer surface of the device is porous to let bone take hold and grow itself into the device causing a long term bond inside the patient," says Petrak

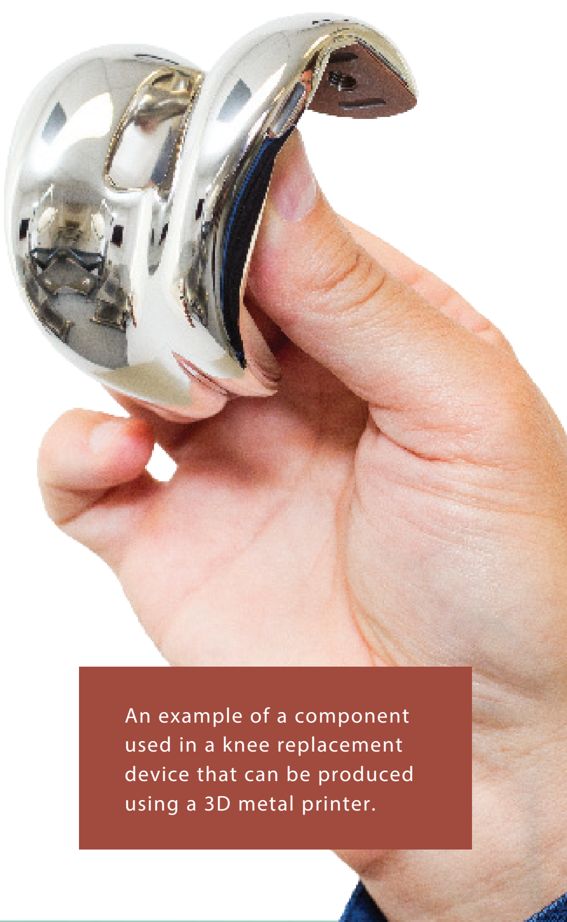
The ability to create custom designs for medical devices is in keeping with the trend towards personalized medicine – the development of treatments and therapies that are designed for the individual patient.

As for other industries, 3D printer technology will eventually lead to manufacturing parts that are stronger, lighter and more complex than ever before, Kellington says. "It's a big advantage for aerospace because for every kilogram of weight added to a plane, there's a cost in terms of fuel every time the plane takes off."

Looking ahead, Petrak and Kellington see a bright future for Precision ADM and additive manufacturing in the province.

"There's a learning curve in terms of expertise, along with significant capital investment, but we're already well on our way in that regard," Kellington says. "Still there's a long way to go to our goal, which is to be a go-to source for advanced digital manufacturing, so if you need a device that requires additive manufacturing like 3D printing, you'll look to get it done here in Winnipeg."

Adds Petrak: "We hope that in the short-run we will be able to take a leadership position in the additive manufacturing industry in Manitoba, and contribute to Winnipeg's economic growth, and in the long run, help supply small manufacturers and exporters and larger companies so they can be more competitive globally."



An example of a component used in a knee replacement device that can be produced using a 3D metal printer.

MOTHER NATURE'S WORKSHOP

LOCAL COMPANY TURNS AGRICULTURAL WASTE INTO MANUFACTURING GOLD

By Joel Schlesinger

Simon Potter can't help but chuckle as a cricket hops across the polished linoleum floor of the laboratory inside the Composites Innovation Centre (CIC), known as FibreCITY.

Simon Potter, Vice President of Product Innovation for the CIC, with a tractor fender (foreground) and hood (background) made from natural fibres.

"We need better pest control here," comments Potter, a microbiologist and Vice President of Product Innovation for the CIC.

Of course, no one should be surprised if they see the occasional cricket roaming around the facility, located in the Tuxedo Business Park. After all, it was built to convert fibre from the stalks of plants such as flax, hemp, canola and agave, among others, into materials that can be used to make everything from tractor hoods to car fenders. A few insects are bound to hitch a ride with the raw material that arrives from nearby farms.

Launched earlier this year, FibreCITY is the crown jewel of the CIC, a government-funded, not-for-profit enterprise that employs about 30 scientists, technologists, engineers and support staff. It was created to help the CIC build on its reputation as one of the leading centres for the development of plant-based composite materials in Canada.

"It's a conglomeration of equipment that is all integrated and dedicated to looking at the quality and consistency of biomaterials for industrial applications," Potter says in reference to the lab.

But the collection of advanced analytic technology is not what makes the lab unique. Rather, it is the intellectual infrastructure that is being built here.

In addition to gaining experience working with these materials, FibreCITY staff members are also building a massive database of information about plant fibres and how they can be used to make composite materials.

"In layperson's terms, we are looking at the molecular and genetic level and determining how we can design better materials made out of plants in the future," says Potter, who received his PhD from the University of Edinburgh and spent seven years doing research developing plant-based composite materials in Australia before being lured to Winnipeg.

The idea of using plant waste to create composite materials that are as durable and useful as those made from plastic, metal or fibreglass has been around for 100 years. But it has only really taken off in the last decade or so with the growing appreciation that these materials are much more environmentally sustainable than their more common counterparts.

The process for making materials out of waste from hemp, flax, or virtually any other type of plant is fairly straightforward. The stalks are reduced to their base fibres and woven into a material, not unlike a very rough cloth. The material is then placed into a mould, say for a car fender. A plant-based resin is then applied through a process that ensures consistency. Once the resin dries, the mould is removed, and you have a car fender that is comparable to its metal counterpart.

The nature of the work being done at the CIC means it can support advances in manufacturing technology across a spectrum of industries operating in Manitoba and elsewhere. As a result, the not-for-profit company has received about $10.8 million in funding from various provincial programs, including those that have been incorporated into Research Manitoba, and $4.2 million from Western Economic Diversification Canada, since it was founded as a consortium of industry partners in 2003. The total funding includes about $6 million from the province and Ottawa for FibreCITY's development: $3 million for the equipment and another $3 million to hire and train staff – five scientists, lab techs and engineers. In addition, Research Manitoba also invested $228,000 for two years to support postdoctoral students in the lab.

The fruits of the CIC's early ventures are on display in its lobby and include a fender for a big-rig truck made from carbon fibre and a gas tank and rear fender of a motorcycle made from plant fibres. There's even a prototype of a car, also mostly made from agricultural waste, built for an Alberta start-up that had planned to make electric automobiles from plant fibres.

Ryan Paradis with a snowboard made from flax fibres.

"It was a little design shop with big plans, but unfortunately, it didn't work out," Potter says in reference to the car company.

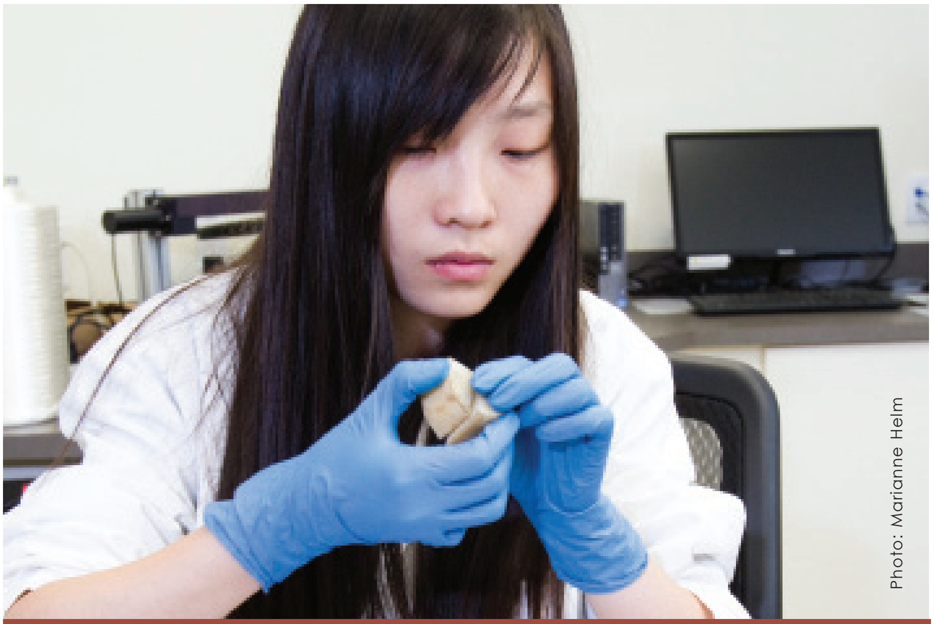
The CIC's biggest success story so far has been a recent partnership with one of Winnipeg's largest manufacturers, Buhler Industries. They joined forces to create a hood for a large farm tractor made from natural fibres that was developed, tested and created at the CIC.

"We built and designed the prototypes for it here in our shop," says Ryan Paradis, Associate Manager of Marketing, adding that Buhler is expected to manufacture about 6,000 tractor hoods.

Despite these impressive displays, Potter says much of the work in plant-based composite materials until now has been more alchemy than science. "It's been empirically trying to see what happens with matching a particular resin with a fibre without any real knowledge of the materials themselves."

FibreCITY will help change the equation.

The new lab will enable the CIC's scientists and technologists to examine the essential nature of individual fibres and how they



Shuhan Liu, Biomaterials Research Assistant at FibreCITY, prepares plant fibres for testing to better understand how they will perform within composite materials.

will react and bond to a particular resin at the molecular level. That means they can examine how a new material might react to heat, cold and moisture.

Potter says the fibre analysis work is sort of like trying to piece together a puzzle.

"For example, if you think pectin (a substance found in plants) is important, then it's helpful to know whether it is inside a plant's cell or on the surface, because if it's on the surface, it's likely to be part of that interface between the fibre and the resin," Potter says. "And if not, how will that affect the fibre's ability to bond with the resin? These are the questions we're trying to answer here."

In many instances, the questions being answered are driven by the CIC's industry partners. As Potter explains, a number of companies have approached the CIC to test and evaluate the potential of a particular fibre from a plant for use in a composite material that could be used in their manufacturing process.

"We developed the tractor hood with hemp and agave using agave samples sent to us from New Mexico, but we've had people send us medical marijuana fibres, and a whole bunch of different materials," Potter says.

FibreCITY is happy to experiment with the various plant fibres it receives because it helps feed the database with more information about plants and how they perform in composite materials.

Potter says one of the challenges in creating a composite material from plant waste is ensuring it will perform consistently. As he explains, a material made from flax from one field may not have the same consistency as material made from flax from another field because of variations in moisture, sun or soil conditions. That in turn, could result in a certain amount of variability in materials made from flax sourced from various locations, which is a problem for manufacturers who want all their products to perform to the same standard.

"To understand the performance of these natural materials, you have to break it down to the molecular structure and then build it back up again, and it's only through using this new equipment at FibreCITY that we can do that here in Manitoba. This lets us look at nano-scale interactions and then translate how that might play out in an entire field of flax," he says.

In other words, the knowledge being generated at FibreCITY will better position the CIC to create composite materials that consistently meet specific standards of quality, even if mass produced. That will eliminate the trial and error process – which can be costly and often discourages industry from seeking more green solutions to manufacturing.

Potter likens the work going on at FibreCITY to that of an oil refinery. "But instead of a refinery that will ultimately produce plastic, we're what you might call a bio-refinery," he says. "We're looking at the total utilization of crops like flax, grown for seed and oil, where we can take the leftover waste – the stem and other fibres – and make something like a car door out of it."

Over the years, the CIC has launched 429 projects with 135 industry partners and 40 government agencies. It has also created a program – called CIC Connect – to foster relationships with industry and government partners. This helps it fund projects, which may or may not turn out to be profitable ventures. "It's an industry liaison program to co-fund projects for industry where our services and expertise are partially funded by industry players to research and develop new composite materials," Potter says.

And major manufacturers are interested in working with FibreCITY.

In addition to Buhler Industries, the CIC has also worked with Hyundai and has had interest from General Motors and Ford.

"The automotive industry, particularly, is being forced down the road of highly-renewable content for vehicles," Potter says. That's because plant-based composite materials are potentially just as strong and durable as a synthetic material, but won't end up in the landfill.

Without FibreCITY, however, the CIC likely wouldn't be able to get its foot in the door with these industry giants. That's because manufacturers making millions of parts need to be assured of the consistency of materials made from natural plant materials.

"We built this lab so Ford might come to us and say, 'OK, you can make one nice door for us, but we're not certain that you could make 500,000 the same way because of the variability of the fibres," Potter says. "So we want to be able to put a stamp of quality to provide that level of assurance so automakers and other large potential clients believe a reliable supply chain can be established for these materials, both in terms of quantity and quality – and only at that point we will see this concept of plant-based manufacturing really take off."