Thierry Harris: Hi folks, Thierry Harris here. On this episode of Market Hunt, we understand the impact of trade wars. Learn how business and universities work together and reveal the differences in accounting practices for marketing budgets in North America and Europe. First, let's set the scene. An entrepreneurial engineer is running a small optical manufacturing company in Ottawa, one of the coldest capital cities in the world. He had been making optics for bottling canned factories and fiber optic switches for use in Canada's harsh winter environments. His optics had to withstand the cold, wind and snow that are typical of Canadian winters. He figured why not use it to measure what's going on in space?

Brian Creber: We had been making reflective optics and looked at this and said, "Well, okay. That's not a whole lot different than what we're used to. Ignore the fact that it's going to space."

Thierry: What happens when an entrepreneur decides to hunt for a market with one client producing one product that's only going to be made one time? What happens when the conditions to test out this unique product don't exist on earth because the product was meant for outer space? Well, what wouldn't you do to discover whether or not there was water on Mars? Find out more on this episode of Market Hunt.

Brian: What we don't understand about the universe far outweighs what we understand.

Nick Quain: Entrepreneurship is hard. You need to have support there.

Brian: The thing about the space industry, once you start adding space successes to your corporate resume, then you get more requests.

Thierry: We're coming up with some pretty interesting ideas.

Andrew Casey: We've solved it. Solved everything.

Thierry: We solved it all.

[music]

Thierry: Why would a business pursue something that isn't scalable, repeatable and which will put a serious strain on their capacity? Meet Brian Creber of B-Con Engineering. B-Con Engineering designs and manufacturers non-traditional optics. Their optical instruments are made with computer numerically controlled optical equipment. This expertise gives B-Con the opportunity to work in many different markets including space, automotive, projection displays and defense. The company is international in both its supply chain and its sales territories. Brian explains how he determines which markets he works with internationally.

Brian: One of the first things that I consider mostly because I'm the marketing guy, I like to work in countries that do business similar to the way we do business in Canada. That's not to say that there aren't huge markets in areas where I would have to learn a

new way of doing business. For the purposes of B-Con and how we're growing our company, we typically will go into a market where the methods of doing business are similar because doing business means setting up a relationship.

If you can set up a relationship in a way that you understand, then you're more likely to be successful. We have very good long-term clients in countries like the Netherlands, Norway, the US, Australia, a lot of countries and other Western, European, Germany, France. Countries that typically when you think of doing business, you're doing business in a very similar method. It's all about developing that relationship with the client, growing it from there.

Thierry: The company uses universities to help develop its products. Brian explains what type of research projects he is looking for.

Brian: A lot of it is the science that they're doing. We don't typically do projects where the focus of the academic is say, high volume production. Let's take for example, projectors that are all going to be built in Asia. We don't get into that kind of area very much. Where we do get involved is areas where there could be, there doesn't always have to be, but there could be a fairly high component of Canadian input into it.

Certainly, Canada is known for a fair number of areas of science. As long as it has that kind of component to it, and we are seeing it. Certainly the work at Lethbridge, we've done work with physics department at University of Toronto, areas like that that Canada is, if we're not leading, we're certainly in the top five in those areas of science. That ticks at big box on our list.

Thierry: B-Con works with various universities in Canada and the United States, including the MMRI Institute at McMaster University in Hamilton, Ontario led by Dr. Stephen Veldhuis.Let's listen in on how Brian put that project together.

Brian: Most of our equipment is CNC or computer numerical controlled. I was looking for a facility that specialized in the understanding of CNC equipment. In our industry, there is typically a little bit of history on tool design. Tools are all made out of natural diamonds or synthetic diamonds, but what is understood about making optical surfaces with diamonds and CNC equipment is really what was in the heads of a handful of people 20 years ago.

When we were looking at what we needed to do in the space industry, what we needed to do for larger volume products, we needed to understand more about how a diamond cuts material, what we needed to do to the material to enhance that effect, what coolants we might need. I was looking around for a university that had a great deal of CNC experience and McMaster had one of the best labs in Canada. It was set up to support the automotive industry. At the time we approached McMaster University, the automotive industry wasn't very busy in Canada so Stephen Veldhuis was looking for projects to work on.

We defined a few projects for them to work on, and the students were using the same techniques that they would be using to develop cutting feeds and speeds and what have you for the automotive industry. They really didn't think much about the fact that we're using a precision that is a thousand times greater than the automotive industry. They were still just looking at how tools interact with the materials that we're using. In fact, a number of them were quite surprised when they actually saw what we were doing with what they were learning.

That's initially how we approach and why we had to approach that particular university. Different universities are doing different things. We do a lot of work now with the University of Lethbridge. The University of Lethbridge is doing a great deal of work in ground-based astronomy instruments. We're doing a fair bit of work with them. They have some equipment that we don't have and couldn't justify putting it into our facility. David Naylor at University of Lethbridge has a need for the kinds of things that we do. There's always one off projects to do for him, and then we get the benefit of what they learn and then we can put it into our processes.

Thierry: What exactly does Brian mean by benefits?

Brian: Take for example, the work that you did at McMaster University. We were looking at how the tool cuts the material. The students started looking at how the grain structure of the material affected the surface that was cut. When we looked at that we said, well, if we could find a material that had grain sizes that were a 10th of a micron, typical material is aluminum alloy. Typical grain structures are two to 10 microns. If we could get something that was a hundredth of the grain structure, we could make a better product. We started looking around and there was a material, the national research council had shown the existence of this rapid solidification material. We tried doing some work with that at the university and sure enough, it followed what the students were predicting. Then we had to look for a commercial supplier of that material and there is a commercial supplier, it's in the Netherlands. We now have been working with that Netherlands company for the last 15 years using this material to mostly make space optics although if we get an optic where the client is looking for extreme specifications, we will offer that material as a possible solution. The material is, I typically think of it is 100 times more expensive, but in the end it actually makes a less costly optic because you can reach the spec that the customer is looking for a lot easier.

Thierry: What the students are essentially doing and correct me if I'm wrong, is that they are working on materials and processes and they're testing hypothesis to see if what they thought would work will actually work, and then you can then port that onto a business case or onto a space project. Then you have your commercial supplier and then you're able to replicate those processes in B-Con Engineering in order to produce the optics that will then go into the optical system that will then go into space. Is that more or less?

Brian: That's correct. That's what we're doing. With the group out in Lethbridge, they typically have an instrument design and we'll put into the design what we think can be

manufactured. By proofing out their instrument, they are actually confirming the hypothesis. The thing about the work at the University of Lethbridge, it's usually in an area where most of us can't work.

Most of the work at University of Lethbridge is working near absolute zero. It's in the two to four degree Kelvin range. Most of us can't work in that area. At B-Con we typically have processes that we will run at 77 Kelvin, but we don't typically go much colder than that. Lethbridge has the capability to confirm a lot of things that we only design theoretically and manufacture and hope that this design works.

Thierry: Then it goes back to what your initial point was about penetrating the space industry, is a need to be proving what you're doing every step of the way so that by the time the engines are running, it's going to be okay and the work is done.

Brian: Yes, you can't really send a service man up there if the thing is orbiting Mars to fix it.

Thierry: The use of universities to test B-Con instruments stems out of the need to demonstrate with certainty that B-Con's instruments will work. Brian's team acts as an integrator to put these processes into a greater optical system. He elaborates.

Brian: Our focus is typically, what do we need to do to the machines to make them better? It's very useful if someone else is doing some of the science for us so that we can do the engineering. We have some of the only CNC optical lays in the world that are totally temperature controlled for making space optics. We continue to evolve that over the years. The last few years we've done R&D projects that have been funded by the Canadian Space Agency. We have a reputation at the Canadian Space Agency of coming up with interesting ideas that they like to fund.

Thierry: Let's go back in time and explore why B-Con decided to go into the space industry in the first place.

Brian: I think the first one that we did we were approached by Ball Aerospace out of Colorado. They were working on a Mars mission. It was an orbital mission and they had a camera that used reflective optics. We had been making reflective optics and looked at this and said, well, okay, that's not a whole lot different than what we're used to. Ignore the fact that it's going to space.

It's not a whole lot different than what we're used to doing. We think we can do that. The biggest challenge was being able to prove to the industry that you actually did what they asked you to do. Some of these optical systems for space are a little bit out of the ordinary. We had to be fairly innovative in the methods and tools that we set up to prove to the client that we did what they asked us to do.

Some of the work was well outside of the range of what our equipment was designed to do but by a little bit of thought and innovation, we were able to make that first

instrument. Then the thing about the space industry, once you start adding space successes to your corporate resume, then you get more requests.

Thierry: Brian had taken a bet on dedicating the little resources he had to develop an optic which would eventually go into space. His bet paid off and he continued to pursue space missions following the initial foray into this new market. Was this all by design and some master plan?

Brian: Not really. We were looking at positioning ourselves in the area of optical systems for harsh environments. I'd had some experience with harsh environments, plants that used a lot of water and chemicals and things like that. I'd done a fair bit of work in that area.

Really it was just focusing on making optical systems for harsh environments. Those harsh environments could be-- some of my background has been in things like bottling shops for breweries. We did a lot of work in the telecom business in the fiber optic days. Making switches that survive the outdoor environment, that kind of thing.

Thierry: Brian was able to transfer his knowledge of optical manufacturing and translate this towards integrating his optics into larger systems destined for space missions. He was also able to optimize the processes for working with the industry, which would serve him well during B-Con's early years of making optics. Looking back, what would Brian today have told Brian back then during this early stage of his company?

Brian: Probably what Brian then knew, it took a lot of patience. Things for space don't happen quickly. As long as you are patient and like to be challenged by something new, then it is a niche market that you can be successful in. The single major thing that you have to have in the space industry is you have to be able to show the sequence of events.

You have to be able to describe your processes in advance, get those approved and then prove to the client that you followed those processes to achieve the final result. There are many optic suppliers out there that have difficulty in the space industry because they can't show that every process is documented, then every process was followed.

Thierry: As Brian points out, the process of documenting the innovations and designs they were executing were critically important to be able to pursue the space market. He did have one small advantage.

Brian: In those years, that was fairly easy because there was only two of us in the company. It was a matter of documenting what the plan was going to be and then following and documenting the plan. There were iterations very definitely, particularly in the metrology. We had to be a bit innovative because our building wasn't quite big enough to get the path length that we needed to do the measurement so we had to be a little bit innovative there.

Thierry: Another important aspect is the customer experience of working with B-Con.

Brian: We want the client to understand that we can be a resource in the design of their optical system. The client doesn't have to have all the answers, they can involve our engineering team in solving the problems of building a particular instrument. Certainly, that has evolved over the years to where we are today. We are part of the design team on a number of the projects, we get invited by our clients to things like-- The most recent one was, we were invited by the Canadian Space Agency to the monthly meeting of ESA over in the Netherlands, to tell the European clients, the European partners, about the Canadian capability which is fairly unique in making all reflective instrument telescopes.

These are not the James Webb, these are not large diameter telescopes. These are typically instrument telescopes that are anywhere from 100 millimeter diameter to 3, 400 millimeter diameter. These are the kinds of things that would orbit a planet. There are a number of missions going on. Some looking at the sun, some looking at the outer planets, but every one of those missions that has some sort of view of the science is using a telescope of some sort.

We typically make all-reflective telescopes. The important thing about an all-reflective telescope is you can use all similar materials so that the thermal changes don't really change the performance of the telescope. That's important when you're in space, because-- I'll use James Webb as a good example. One side of James Webb sees the sunshine, so it gets hot. Where our instruments are on James Webb is the cold side of the telescope. It's 4º Kelvin all the time so it's super cold. You have to be able to handle those kinds of temperature extremes.

Thierry: After completing the Ball Aerospace project, B-Con went on to work on a NASA project with the Jet Propulsion Lab for the Phoenix Mars Lander mission in 2008.

Brian: Well, the Mars, the Phoenix Lander, the Canadian contribution to the lander was the weather station. The weather station was a LiDAR, a laser-driven device. They needed a telescope as part of the light collection part of the device. We were extremely restricted in the mass that we could put on the satellite. We had to come up with a telescope that was about 100 millimeters in diameter, but it could only weigh 130 grams. 130 grams is about half the weight of a can of pop. It wasn't allowed to weigh much.

I had to be strong enough to survive the rigors of launch and the landing and then do what it needed to do for a period of-- Our mission was about 12 weeks, although the mission itself, the lander returned information well past its 12-week mission. We were in the north part of Mars, Northern polar region. In their summertime, our daytime temperature was -40ºC and at nighttime it got to be -80ºC. It was a balmy summer day. We basically monitored things like particulate in the air, in the atmosphere, wind speeds, that kind of thing.

The whole focus of the Phoenix Lander was to determine whether there was water on Mars. In fact, we did find water. There was water in the soil samples, we were seeing

snowflakes in the air. Yes, it was a successful mission because it was focused on, “Is there water on Mars?”

Thierry: In space projects, a small manufacturer like B-Con will work with a larger integrator in order to deliver a product for them to integrate into their systems. At the time, B-Con was interfacing with MDA, a large space aeronautics company. Back then, B-Con had under 12 employees. Let's hear Brian describe this process in greater detail.

Brian: Typically, we are making optical assemblies that go into a larger integrated instrument. The instrument would have electronics and things like that that we don't typically supply, but we would make optical assemblies. Sometimes we actually integrate the optical assemblies into what might be a housing for the whole instrument. In the case of the first one with Ball Aerospace, we did some work on the instrument housing, integrated the optics. With the Phoenix, we basically made the telescope assembly.

Thierry: Prestige aside, why make one product, one time for one client, on a particular mission? Let's hear Brian elaborate on this.

Brian: Until recently, the space industry really has been focused on single missions. A single mission would be an instrument package going somewhere to do something. The very useful part of being a part of that industry is the ability to develop processors, which you can then use for other things that are higher volume on earth. In fact, that's been a common goal of the space industry since the early '60s.

[music]

Thierry: Technologies stemming from space exploration include phone cameras, wireless headsets and athletic shoes. You can check out some more space innovations on the ie-knowledgehub.ca website. For a small company with limited resources, partnership with a larger high profile institution was a good move.

Brain: It's the prestige, it's on the corporate resume. That's quite valuable from a marketing perspective. We can go almost anywhere if you have that on your corporate resume. Clients can look up that mission, there is all sorts of published data on all of these missions. Just to be able to say, “Yes, we were part of it.” We have a few certificates from various missions when they're successful.

Thierry: A few certificates. [chuckles]

Brian: Yes, that’s all we get.

Thierry: Data?

Brian: We get the data too. In fact, even the work we're doing now, I consider that there's a great deal of use in the science that is being developed. What we don't understand about the universe far outweighs what we understand. The educational part

of doing this is extremely useful to all of us. Some of us may not think of it much on a day-to-day basis, but it's useful to have an understanding of what's around us. A lot of people look up in the sky and think they see everything that's there, but you got to remember that what we don't understand is more than 90% of what's out there. What we understand is only 10% or less.

Thierry: The data on the performance of B-Con's instruments allows them to innovate their own product lines. This creates a virtuous cycle of innovation. Brian explains why SMEs like his are ideal places for innovation to occur.

Brian: One of the things that the SME has to be aware of is that you don't design inside a black box, you have to know what's going on outside the box. Be prepared to offer your client assistance to integrate your product into his system, because you're probably the best capability to be able to do that. Offer that to them. Essentially try to help mode as much as you can.

An SME is always faster at being able to supply a solution than a larger company. Many of our clients are bigger companies. We can turn things around a lot faster than they can. We're always at the door saying, "Please make a decision on the following because we're ready to go. We're ready to provide that solution." Give them the list of things that they have to make a decision on, don't leave it to them to have to come up with the list. If you do it all for them then it's a lot easier for them, makes their job easier, gives you more leverage to be their solution provider.

Thierry: B-Cons' expertise allows them to operate in many markets, including designing optics for optical manufacturers who are mass producing optics on their own.

Brian: We can support companies that are mass producing them. It's a growing market. Even the space industry is a growing market. There is a US company that's saying that they're going to put up 42,000 optical communication satellites in the next five years. Those are all requiring optical telescopes. Those are not radio devices. It's a growing market.

Over the years, we've done work with automotive companies in Germany, doing next-generation heads up display. That stuff goes out of vogue, back in again. Just the last couple of months we've been doing a heads up display for automotive, this time for a US client. Those things come and go, but the basic science behind them is the thing that we continue to evolve, and we continue to evolve it mostly for our space clients. We have it in our arsenal of things that we can do when the automotive guys show up and they have some money to spend and want to come up with some new products.

Then you have to teach your-- In my case, the other engineers in the company have to introduce them to those relationships because you have to pass that relationship onto the other members of the team.

Thierry: We had a chance to see that because you got to sell this to your own team saying, "Hey, this is going to be a fruitful relationship for us, and here's why it's a

win-win." The company we are referring to is Pufferfish based in Edinburgh, Scotland. Pufferfish makes spherical displays. Some the size of small cars that go into rock concerts, museums and other venues. Brian is leading the North American Division of Pufferfish.

Brian: Pufferfish North America is a major investor in the UK parent company. We've looked at how you market the spherical display in North America, how you market it in Europe. The markets are different actually. In North America, there is some competition. There are American suppliers of the same similar products.

It's more difficult for us to actually sell the hardware in North America. We rent it. A big part of our business is renting it because we've looked at the market and said, "Well, who is going to need it and do they have a budget to buy it?" We determined in North America, the guys that need it are the marketing departments of companies. Marketing departments typically don't have capital budgets, they have discretionary budgets. They can't buy it, but they can rent it.

Our model in North America has been, "Well, we have the equipment, we'll rent it to you, you use it at your trade show, we take it back and put it back in our stockroom and the next trade show that you need it at, just give us a call and we'll be there for it." That's a little bit different. The European model is gradually picking that up. The European model had typically been, "We sell the hardware to a company, so you need to convince the company that they need to invest in this capital equipment because their marketing department might need it." You would typically put it into a company's head office as a centerpiece piece of equipment to market their capability to visitors to their facility. Whereas what we're doing is renting the equipment to their marketing department for use at trade shows and things like that.

Thierry: Yes, and maybe legal firms or investment banks with very deep pockets want to remodel their front office every six months, and then you can offer them another one. The sky's the limit with that.

Brian: Sky's the limit. One of the systems that I did sell was totally based on that. Sold one to Madison Square Garden in New York and they had no use for it, but they said that "We need one in our stock just in case some group comes in and they need it, and we have it."

Thierry: Well, you might see it at the Westminster Dog Show. Who knows?

Brian: Yes. Who knows?

Thierry: That's amazing, Brian. This is a good example. You gave a very poignant point here which I don't want to overlook, which is that you said that marketing-- but first of all, you have to know who can buy it and if they have the budget to buy it. Marketing departments often don't have capital expenditure budgets, they have discretionary budgets. Seeing this as something that they have to put depreciation on and they're going to hang on to it for a while and it's probably not a cheap thing to buy, it's more to

their advantage to rent it out. When you're looking at that as a solution you're actually solving their job, which is, "I don't want to be stuck with this thing that's gathering mothballs 10 months out of 12," kind of thing.

Brian: That's right, and then we can become very good at making sure that that piece of hardware is at the show at the right time. We set up relationships with the trade show support companies. There's a number of major ones. We set up relationships with them. That just takes a lot of the work from the person that's actually trying to set up their marketing at a trade show. If you've ever done a trade show, they are incredibly difficult to coordinate and you have to be there. This is not a situation where you can be four hours late. You have to be there when the show starts, ready to go.

Thierry: Yes. Lights, camera, action. That's it. Just to finish up with Pufferfish. The software is still being developed in Edinburgh or are you doing any software development over here as well?

Brian: We do application development over here. The basic software in the equipment is developed in Edinburgh, but to brand the equipment for our clients, so to make it look like it is his equipment, we do that over here. That we call application development.

Thierry: Going into international markets isn't without its challenges.

Brian: You have to keep on top of what's going on in the world. You have to know what the politics are doing because that can really affect you. Take B-Con for example. With the last government change in the US, the US has focused much more on the Buy America. We had been manufacturing a lot of product that they used in their military and then exports in that area went to zero, so we had to look for other markets for our capability. Over the last few years we had other markets come to us. You have to be aware of the geopolitics and then you have to make some decisions on what you're going to focus on based on those geopolitics.

We still have extremely good relationships with our clients in the US, both the clients that we buy from and the clients that we sell to. That really didn't change a whole lot. It's just that the markets that had been integrated, there are some protections that they've put in place. Some of the other markets are actually expanding. Certainly, the environmental protection type markets, doesn't matter where they are, those markets seem to be growing. We have clients in the US that make instruments for that market and those clients are continuing to grow what they're purchasing from us. We buy product in the US so that that continues.

[music]

Thierry: Geopolitics aside, let's explore the SMEs role in innovation creation in a modern economy. The SME truly does have a purpose in a modern industrial or post-industrial, whatever you want to call it, in a modern economy?

Brian: Oh, absolutely, absolutely. I have to think that the biggest part of innovation happens in SMEs. The bigger company has the resources to make the big project happen but a lot of the innovation is happening in the small enterprise. That's why a lot of the big companies are looking at smaller groups within their organizations like greenhouse innovation projects within their own organization, because they realize that you can't innovate with 4,000 employees. You have to innovate with a few.

Thierry: Market Hunt is produced by Cartouche Media in collaboration with Seratone Studios in Montreal and PopUp Podcasting in Ottawa.

Market Hunt is part of the ie-Knowledge Hub network. Funding for this program comes from the Social Sciences and Humanities Resource Council of Canada.

Executive Producers: Hamid Etemad, McGill University Desautels Faculty of Management and Hamed Motaghi, Université du Québec en Outaouais.

Associate Producer, Jose Orlando Montes, Université du Québec à Montréal.

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Artwork by Melissa Gendron. You can check out the ie-Knowledge Hub case study on B-Con Engineering as well as other cases at ie-knowledgehub.ca

For Market Hunt, I'm Thierry Harris. Thanks for listening.