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The Breakthrough

The sports fix

Potential customers were slow to grasp Integran's nanotechnology applications — until they got their hands on a new kind of golf club shaft

FRANK ARMSTRONG
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Gino Palumbo stared in awe at the lightweight metal golf shaft in his hands.

After three years in development, the one-of-a-kind shaft, made by fusing a nickel alloy coating to a graphite core using nanotechnology, was ready to undergo production.

"It was definitely a 'wow' moment," Mr. Palumbo, founder, president and CEO of Toronto's Integran Technologies Inc., recalls of the first time he held the finished product.

Historically, a developer of metals for the aerospace and defence industries, Integran felt frustrated by the slow-and-cautious approach of creating metal coatings for those industries and it decided to opt for quicker-to-market solutions.

The company had grown slowly but steadily thanks to R&D financing to help it through the lengthy process of developing nanotechnologies for defence and aerospace. But Integran wanted to see big revenue streams flowing within years, not decades.

In 2004, it branched out into the lucrative $25-billion (U.S.) sports equipment industry, where cutting-edge technology, lightness and strength command a premium price.

Integran decided to start by designing and making golf club shafts because golf is one of the largest athletic product markets, and because golfers are willing to pay big money for gear.

"Some people call golf clubs jewellery for men — they're willing to pay relatively large amounts of money for it," Mr. Palumbo notes.

The gambit worked.

Since the True Temper Epic shaft was introduced in January, 2007, about 75,000 have been sold, bringing in enough money to allow Integran to pursue other sports equipment markets.

HEAD has since released tennis and squash racquets made from Integran's nanotechnology and a line of nano-engineered baseball bats is being produced by a premium bat supplier, Mr. Palumbo says (adding that he can't yet release the company's name). A line of bicycle parts is also coming.

While the leap into the golf shaft market is a success in its own right, it also generated an unanticipated bonus for Integran: It has boosted sales in its defence and aerospace divisions, where Integran designs nanotechnology applications such as more durable helicopter rotor blades and a corrosion- and friction-resistant exterior for a stealth aircraft.

Nanotechnology is the science of manipulating and controlling matter at the atomic level, and selling the idea of nano-engineered metals was never easy for Integran.

The Vitals

Founded in 1999, Integran Technologies Inc. employs 55 people at four locations: its Toronto headquarters; a defence research laboratory in Pittsburgh; its golf shaft company, Powermetal Technologies in Carlsbad, Calif.; and its shaft factory in Tijuana, Mexico. Its original nano-structured materials technology comes from collaborative research out of Queen's University and University of Toronto. With 127 registered patents, Integran develops nanometals for applications as wide ranging as biomedicine, gas pipelines, the military and aerospace industries, and sports equipment.

The intriguing idea

Aerospace and defence can be slow-moving industries. So Integran decided to pursue a whole new market: sports equipment, where new products are quickly adopted. The company started with a golf shaft because of the size of the golf industry, and because golfers are willing to dish out for high-tech gear.

The market

The worldwide golf club market is worth about $3.9-billion (U.S.), according to a recent market study by E-Composites Inc., which notes that the industry mainly uses carbon composites or steel to make shafts. A February, 2006, study by MarketResearch.com pegged the total golf equipment industry at $5.8-billion billion in 2005, with $1.3-billion worth of golf clubs was made in the United States that year.

The key decision

The decision to expand into sports equipment was essential to Integran's recent success. CEO Gino Palumbo was looking for applications for which people were willing to pay a premium for highly specialized metal products. Integran is also concentrating on developing nano-engineered baseball bats and bicycle parts.

The oversight

Integran didn't realize it would take so long to bring the Epic shaft to market. From the initial robotic performance test in January, 2004, it took three years to produce the first shafts. That lag could be costly. With the economic downturn, many golfers may not be as interested in buying high-end equipment.

Potential customers couldn't get their heads around the technology, which involves creating metals with a grain size 1,000 times smaller than regular metals, thereby multiplying their tensile strength and hardness.

The development of the Epic golf shaft erased much of that confusion, Mr. Palumbo says. Suddenly, Integran had a tested, tangible example of how nanotechnology could make something lighter yet stronger.

The result was a boost in contracts across the company, including Integran's aerospace and defence work. Since January, 2007, Integran has more than doubled its total work force, to 55 from 25. It tripled revenue in 2007 and quadrupled it in 2008, Mr. Palumbo says.

And a golf shaft is often taken to sales meetings to showcase the technology.

"People hold it and they feel how light it is and how strong it is and suddenly a light bulb starts going on in their head ... about all the other applications where they could use it," Mr. Palumbo says. "It's a rather convincing way to show that nanotechnology has made its way out of the petri dish."

Special to The Globe and Mail

Original online article

Connect with Gino Palumbo

Mr. Palumbo took your questions on his experience. Click here to read the discussion.

The next steps

Since the successful launch of the Epic shaft, Integran is moving into production of baseball bats and bicycle parts. Callaway Golf currently offers the Epic as an upgrade shaft and Integran is searching for similar arrangements with other big golf companies for the Epic, as well as other designs it is developing. Depending on the economy, Integran also hopes to launch an aerospace spinoff. And it plans to release a new antibacterial nanometal within a year that could be used as a coating on hospital door handles to prevent the spread of disease.

By the numbers

$125: Cost of Epic golf shaft.

70 grams: Weight of Epic shaft.

About 75,000: Number of Epic shafts sold.

20 nanometres: Size of the molecules (one-millionth of one millimetre) in Integran nanometals in the Epic shaft, making it much lighter but four times stronger than typical metallic structures.

80,000 nanometres: Width of a human hair.

Expert insight

"One of the challenges with traditional brainstorming and developing new ideas or solutions to problems is that people are stuck in a box to start with," says Barry Cross, an operations and technology expert who teaches at Queen's School of Business and runs a private consulting firm. He explores some of Integran's business strategies and the marketing boost it received from its new Epic golf shaft in an online Q&A.

Click here to read the interview with Mr. Cross.

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Expert Insight

Barry Cross on marketing strategies

GLOBE AND MAIL UPDATE
JANUARY 20, 2009 AT 8:55 PM EST

Barry Cross is an operations and technology expert who teaches at the Queen's School of Business and also runs a private consulting firm. Here he explores some of the business strategies of Integran Technologies Inc. and the marketing boost it received as a result of its new Epic golf shaft, as well as some of the risks of today's economic climate.

The Epic golf shaft has served as a powerful marketing tool to help people imagine other potential applications for Integran's nanotechnology. Why do you think it has been so successful?

Barry Cross: If you've got a few people in a high-profile area who start to use this stuff and like it and talk about the fact that they like it, then you're going to attract other talent. You're also going to get feedback in what's working and what isn't working, which allows you to tune the process in the technology to the point where it allows you to appeal to a broader audience.

If they're being honest, they're not interested in selling to the top athletes. They want the masses using this stuff. That's really where it starts to get some traction for the organization.

Why is the ability to show potential customers a golf club built with the nanofuse technology that they can touch and hold such a powerful tool?

Cross: When we look at innovation, there are some different tools we use for brainstorming. One of the challenges with traditional brainstorming and developing new ideas or solutions to problems is that people are stuck in a box to start with. When we run these types of [sessions] with our people, we normally run an exercise that gets them thinking a little more macro. That golf shaft was the stimulus that got [Integran] outside of the box.

Integran didn't set out to get golf pros to endorse its golf clubs. Company president Gino Palumbo didn't even know Tiger Woods and Trevor Immelman were using the Epic shaft until their pictures were taken using them. Should Integran more actively seek athlete endorsements of its sports products?

Cross: With a technology like theirs, I am less crazy about the idea of individual sponsorships. If this stuff truly works, it's going to get adopted anyway without [Integran] having to spend $10-million sponsoring a player.

I would be more inclined to look at sponsoring events, like being a PGA sponsor or looking at some type of sponsorship coming up at the Winter Olympics or charity and those types of events. With getting their name out there, people will realize there's a very successful high-tech company in Toronto, and I'm looking for something different. It will help them start attracting more talent to the organization as well, potentially some high-profile players that way.

[Professional athletes] are also so fickle that they're looking for something new every six to 12 months, and in the winter layover they're going to be looking for some other edge the next year. If they didn't have a great season, they could blame it on the technology. If [Integran] let it sit for a little bit, they can say they're the number one golf shaft on the PGA circuit right now.

Is it unusual for a company selling sports equipment to consciously not pursue pro athlete endorsements?

Cross: It's not unusual. There's another organization that doesn't do any top athletic sponsorships and that's a company out of Calgary, called Graf Canada Ltd. They started off with just skates, but they're into all aspects of hockey equipment and they're getting into other industries. They really just focused on building something people wanted to use and play with out there. There are a lot of folks at the pro level who are using their gear and don't get any endorsement dollars for it. If this stuff works, people use it and they shouldn't have to go after any pro athlete endorsement.

Integran's growth strategies involve licensing its intellectual property to other organizations, the creation of business strategies with larger organizations, like DuPont, and developing joint ventures. What do you think of this tactic?

Cross: I like the approach they're taking where they're licensing and forming relationships with other organizations to get the technologies out there. A mixed bag like that, until we get a feel for "who we want to be when we grow up," isn't a bad strategy: "Let's see what works and let's see what area starts to grow for us."

Are there risks?

Cross: Some caveats with that, or some issues with that, are that when you start handing over the keys like that, you have to pay attention to what your partner is doing on the execution side.

If they fail on a launch, or if they fail on an application, or there's some sort of a field failure, then Integran is going to be tarred with the same brush. It's not necessarily the partner. It's going to go back to the technology. They're very susceptible to that right now. They're at that early adoption phase.

The people buying [the Epic shaft] and using it right now are techies and they're excited about new stuff ... They keep up on things that change in the markets right now, whether it's golf clubs, baseball bats, or military technologies. They're looking for a bit of an edge and all it takes is one or two small failures out in the field and that's a real problem for Integran. So they have to have some stake, and some awareness, in what their partners do on the execution side.

The second phase — and I'm sure he has some of the best lawyers in the country — is the IP [intellectual property] and the rights; just protecting [Integran's] interests in some of these relationships is core as well. Those are the crown jewels and they have to make sure that stuff is protected.

Mr. Palumbo says one of the barriers to his company's growth is recruiting people with practical PhD-level science and engineering skill sets mixed with business acumen. How can Integran address this issue?

Cross: That's going to change for him in a big way once the company name gets a little more well known and people start seeing this as something that is sexy.

In Microsoft's early days, they had to go out there and really pound the pavement to get people to take a risk with a startup. Once people realized what they were and what they were into and what their innovation was starting to look at, they had people knocking at their door. At this stage [for Integran], getting their name out there and getting their technology out there with a few different ways with partners is very appropriate.

What other fields of nanotechnology might Integran consider pursuing?

Cross: Are they pursuing the friction side of things — conductivity, wear, resistance? If they have some technologies in their pipeline that can apply to all three of those, we can be looking at tool-and-die coatings, paints and coatings for automotive.

On the friction side of things, I'd love to see a pair of skates with blades that have been coated with some of their coatings. You can get into skis and bobsleds. There may be some conductivity opportunities — how well this stuff conducts current.

When you get into some of the nanotechnologies — very, very thin webs and fibres — you can get to the point where you start to mimic neural and neuron behaviour in the human body and there are potentially some medical applications. This may be the next area for computer processors and that type of thing.

Mr. Palumbo worries about losing market exclusivity because patents can last only 20 years, while it may take as long as 15 years to bring Integran's technologies to market. Is there anything Integran can do to address this?

Cross: I don't think they really need to be concerned with that at this point. I like his pursuit of technology a lot better than, say, biotech where you have phase one, two, and three trials. As long as they keep focusing on discovery, innovation, new technologies, they will be able to come up with additional patents that will protect the latest generation of the technology they're working with.

He's not stuck with the patents he has now. As soon as he tweaks and tunes these processes, the technologies and coatings and that type of thing, he's going to be able to reinvent those patents. Then he's got another 20 years to play with.

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On the Record

Gino Palumbo took your questions

GLOBE AND MAIL UPDATE
JANUARY 22, 2009 AT 2:14 PM EST

Gino Palumbo

Gino Palumbo didn't set out to make super-light, super-strong golf shafts.

His company, Integran Technologies Inc., was formed initially to develop innovative nano-engineered metals for use in industries such as aerospace and defence.

But developing new technologies for those industries is a lengthy process, and Integran wanted to see big revenue streams flowing in years, rather than decades.

So in 2004, Mr. Palumbo took a chance: Integran branched out into the lucrative sports equipment industry, where cutting-edge technology, lightness and strength command a premium price.

Integran started with golf club shafts, made by fusing a nickel alloy coating to a graphite core using nanotechnology. So far, about 75,000 True Temper Epic shafts have been sold, and Integran is expanding to other sporting goods, such as tennis racquets and baseball bats.

But the move into the sports world also had an unexpected bonus for the Toronto company: a boost in contracts across the board, including Integran's aerospace and defence work. Once potential customers got a look at the Epic shaft, Mr. Palumbo says, they understand how nanotechnology can work with their own products.

"People hold it and they feel how light it is and how strong it is and suddenly a light bulb starts going on in their head ... about all the other applications where they could use it," he says.

Mr. Palumbo joined us on Thursday to talk about his experiences in launching a new product, as well as the potential for nanotechnologies.

Dianne Nice: Gino, thank you for joining us today to discuss your company, Integran Technologies. Can you start by telling us a bit about your background and how you got your start in nanotechnology?

Gino Palumbo: It's a pleasure for me to be participating.

I am a materials scientist by training. My start in nanotechnology came while doing my doctoral studies in metallurgical engineering at the University of Toronto in the early '80s. I had the pleasure of working with eminent scientists Professors Uwe Erb and Karl T. Aust. Together we began looking at ways of improving the performance of materials by manipulating their internal structure. Several years after completion of my doctorate, I had the opportunity to apply this fundamental technology to nuclear plant problems at Ontario Hydro. This led to the development of what is likely the first large-scale industrial application for nanotechnology — the Electrosleeve process for nuclear tubing repair. On the basis of this technology and others that had been developed through collaboration between Ontario Hydro, the University of Toronto and Queen's University, Integran was launched as an independent company in 1999.

Dianne Nice: The Epic golf club shaft has been a "breakthrough" for your company. Have you had any other breakthroughs that might be of interest to our readers? The article mentions your activity in aerospace and defence.

Gino Palumbo: For a company of only 55 employees, we have a huge amount of technology development activity that is presently ongoing. These new concepts, which are in varying stages of commercial maturity, range from industrial process piping repair to new materials for microelectronics manufacturing to advanced high-temperature gas turbine engine superalloys. One of the areas that we're most excited about is our environmentally friendly alternatives to chromium and cadmium, which are still widely used, especially in aerospace. Over the past seven years, we've been busy developing environmentally benign alternatives to these processes and we're excited about the fact that they are beginning to receive broad industry acceptance. Removing these harmful metals will be good for the environment and so that certainly represents a breakthrough of sorts for Integran.

Dianne Nice: What about our troubled automotive sector? Could your new materials be used there?

Gino Palumbo: Yes. In fact, we have already launched a joint venture with Algonquin Automotive and Dupont, one of the world's largest chemical suppliers. This new company, called Morph Technologies, is focused upon the development and commercialization of lighter-weight materials, and we are targeting the automotive sector in particular. In a nutshell, what the engineers at Morph are doing is addressing the many shortfalls of plastics by marrying them with Integran's high-strength metal. Take a look under the hood of a car, for instance. It would be great if more of these components could be made from lightweight plastics, but that simply isn't possible because plastics have poor high-temperature stability. Morph's technology equips plastics with metallic properties (such as high-temperature resistance) and this will eventually allow the automotive parts designer to create lighter and lighter weight components, ultimately resulting in drastic improvements in fuel efficiency and less harmful emissions into the environment.

Dianne Nice: Who do you work with to generate new product ideas? Do you generate all technical and product ideas in house or do you collaborate with others?

Gino Palumbo: We work very closely with the Faculty of Engineering at the University of Toronto on basic research, and we also work closely, usually through partnerships, with industrial leaders in different fields in order to gain market expertise and access.

Michael Craine from Calgary writes: Lighter, stronger, origination at the atomic level should result in extraordinary degrees of manufactured precision. How about weapon systems both handheld and larger? Or surgical instruments, ice skates, tools (for example: wrenches, screwdrivers, power tools, automotive parts)? The list could be endless! Do the processes apply to other fabrications, for example: plastics, other metal compounds, clothing fabrics, household fabrics, pipelines, ship-building?

Gino Palumbo: Michael, you are absolutely correct — the list is endless. However, we have focused upon areas where customers are willing to pay a premium for performance.

Our materials are particularly well-suited for many defence applications for which we have established a vertical business in Pittsburgh, Pa., called Integran Defense Systems. Applications currently being looked at include personnel and vehicle armour, lightweight gun barrels, self-lubricating weapons mechanisms, anti-tank weapons, etc.

We have also focused on the automotive parts sector through our vertical business Morph Technologies. Here we are focusing on lightweight automotive parts for improving fuel efficiency and reducing greenhouse gas emissions.

Regarding surgical instruments, we are currently looking at launching another vertical business in the biomedical area. In addition to material strength and hardness, our materials also exhibit anti-bacterial properties which are of high interest in the healthcare and food processing industries.

Our materials can be applied to virtually any substrate (metal, plastic, ceramic, etc.) leading to unique hybrid structures.

W M from Vancouver writes: I understand there has been some research done in the use of carbon nanofibres in the production of power transmission cables. With the current emphasis on infrastructure renewal and the siting issues regarding new transmission, there is interest in making the existing infrastructure more efficient. Have you considered applying the technology to power transmission lines to reduce line loss?

Gino Palumbo: Application of Integran's technology to enable efficiency improvements in power transmission is definitely something that we are considering. In fact, we have already been running an advanced electrical wire development program that is somewhat related. The concept is geared towards drastically increasing the strength-to-weight ratio of aircraft electrical wire without significantly compromising electrical conductivity, the ultimate objective being to remove weight from aircraft. We are presently exploring ways to extend the learnings to power transmission.

Tim Shark from Kent, U.S.A., writes: Mr. Palumbo, congratulations on your success. Wishing you continued success for the future. Your metal coating creates possible interest for our products - decorative laminates for aircraft interiors. Is your coating mixture capable of being processed by outside coating capabilities in the .25 mils or up to 2.25 mils thick? Or how can your coating be provided - in a film near the above 2 thickness ranges? Many thanks! Tim Shark, Schneller, LLC

Gino Palumbo: Hi, Tim. We have traditionally stayed away from decorative applications as the unique performance properties of our materials do not provide us with any competitive advantage. In aerospace, there are a number of both interior and exterior applications where we provide durability and strength enhancements to parts. On the interior, we have looked at enhancing the durability of thermoplastic ducting, while on the outside of the aircraft, we are using the hardness and strength of our material to protect relatively soft carbon composite parts from rain and sand erosion.

Danny Maue from Kitchener-Waterloo, Ont., writes: Good afternoon Mr. Palumbo. Being exposed to the golf business my entire life - my father has been a CPGA professional for almost 50 years, and I personally have been a CPGA professional for over 25 years - my question is, do you have any noticeable PGA Tour players using your product? I have found through the years that if and when someone in the limelight would ever breakthrough and 'win' a significant event using a lesser known product, all hell breaks lose and you as an inventor are off to the races!!! An example of this was in 1986 when Jack Nicklaus won the Masters using that big-headed putter. The next day, MacGregor took orders for more than 5,000 putters!!! Thanks for your time, Danny Maue

NB: I would love to try your product!!!

Gino Palumbo: Thanks for your question, Mr. Maue! One of the first well-known players to use our shaft in competition was Rich Beem. However, the real breakthrough came in last year's Masters when Trevor Immelman used Epic for the big win. His outstanding percentages for fairways hit substantiated what our engineers have been seeing from the very beginning, namely that the unique dynamic flexural and torsional characteristics of the shaft effectively increase shot-making accuracy. We're glad to hear you're excited to try Epic, let us know how it works out!

David Tron from Toronto writes: With a product that seems to sell itself, where do you begin to put a price tag on it?

Gino Palumbo: Thanks for the question, David. First off, we try to target markets that place a high value on performance per unit weight of material. These markets tend to be industries like aerospace, defence and biomedical, to name a few. We then aim to "value price" our products, which is to say, that we charge what the market can bear, given the competition, alternative solutions, volumes and other factors. We are also quite selective from a business development standpoint to choose programs that are a good fit from a value proposition, volume and pricing perspective.

Ariel Castromayor from Toronto writes: Congratulations, Gino, on the success! Has anyone approached Integran with other opportunities in the sports or competition arena? Rotating and friction parts treated at the nano level could potentially reduce drag infinitesimally. Skate blades, bobsleigh/luge /skeleton runners, skis, engine pistons, cylinder walls, ball bearings, etc.

Gino Palumbo: Ariel, good question. We're trying to focus on applications where our ability to manipulate matter on a nanoscale results in performance enhancements, be it in the sports arena or otherwise. One interesting property that is intrinsic to ultrafine-grained materials is the coefficient of friction, which is lower for nanocrystalline materials as compared to conventional engineering metals such as steel. We're exploring applications (e.g. ice skate/bobsleigh blades, replacement coatings for hard chrome, misc. wear surfaces) where low-friction surfaces result in less drag and therefore improve performance. Another neat property that is dependent upon the nano-sized topography of a surface is hydrophobicity i.e. the ability of a surface to resist wetting of a water droplet, for instance. By optimizing the surface structure on a nanoscale, we can create superhydrophobic self-cleaning surfaces that could have a variety of end applications.

Ariel Castromayor: Have there been any discussions on applying the technology for use in the semiconductor/microchip industry? PVD processes have helped the circuit board get smaller (0.5 micron thickness vs. 10 micron for standard electroplating).

Gino Palumbo: Thanks again for your support Ariel! We have found a few good applications for the microelectronics industry which play off of the small grain size of the material, as well as the commensurate increase in hardness and strength. Although I can't go into details, we have a number of solutions that can assist in the circuit board manufacturing process as feature sizes shrink. The creation of small circuit line widths requires high-precision manufacturing and that's one area where we can help. Another exciting application area is electronic device casings, which we all know are getting smaller and lighter. This requires technologies to produce high strength-to-weight materials along with methods to boost the mechanical performance of lightweight plastics, which is Integran's forte.

Pascal Fortier from Toronto writes: Hi Gino. Congratulations on your success. There is a lot of effort in the automotive industry to produce cars that are more efficient, i.e. electric and fuel-cell cars. Would your products be applicable to increase battery life and safely store hydrogen to run cars of the future?
I wish you the best. Cheers.

Gino Palumbo: Pascal, thank you for the kind words. Regarding hydrogen storage, we are looking at safe lightweight impermeable storage containers and we are also exploring the use of our materials as hydrogen permeation membranes for fuel reformers. For electric vehicles, we have an active program for applying our materials for electromagnetic shielding, and also for high-efficiency cores for induction motors.

Dianne Nice: Gino, I want to thank you again for joining us today. The technology your company has been working on is fascinating and I wish we had more time for questions.

Gino Palumbo: Thank you for the opportunity to participate, and I would also like to thank all of the readers for the very high-quality questions that they have provided. I would also like to thank Frank Armstrong for preparing an excellent article and The Globe and Mail for the Breakthrough series, which puts a spotlight on innovative Canadian companies which, through technology innovation, create the high-tech employment opportunities of the future.

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