Award Winning Castings

Here are two examples of NADCA Chapter 10 area companies producing award winning die castings at the 2018 Die Casting Congress in Indianapolis.

**Aluminum Die Casting - Structural/High Integrity**
Award Winner: AMT Die Casting Inc., St-Cyprien, Quebec
Part: Right Member for Snowmobile Chasis
Material: Aural 2, heat-treated
Weight: 3.4 lbs
Advantages Gained: AMT’s high vacuum process allowed the designer to create a series of light castings, resulting in a very stiff and light snowmobile platform.

**Magnesium Die Casting - Over .5 Lbs**
Award Winner: Awanfeng Meridian, Strathro, Ontario
Part: Magnesium Subframe Casting
Material: AE44 Magnesium Alloy
Weight: 23 lbs
Advantages Gained: 31% weight savings and reduction from 15 major stampings and reinforcements to one casting.

Next Meeting

**NADCA Chapter 10, Ontario Canada**
Date: **Wednesday, March 4, 2020**
Speaker: Beau Glim, NADCA (see page 16)
Topic: **2020 AGM and State of the Industry**
Meeting Place: Grand Chalet, Milton
324 Steeles Ave, Milton, ON
Networking Cash Bar: 6:00 – 7:00 p.m.
Dinner: 7:00 – 8:00 p.m.
Cost: Guests – $30.00 (GST included, cash or cheque)

**Members, staff of corporate members and our Bulletin advertisers: No charge/Free this meeting**

Annual General Meeting: 8:00 – 8:15 p.m.
Presentation: 8:15 – 9:15 p.m.
To assist Dinner Reservations, Members and Guests are asked to place their reservation no later than Monday, March 2, 2020.
Contact: Ralph Timm (905) 830-1730 or Fax (905) 830-1339
Email: raftech@gmail.com

www.diecasting.org
When your Company is considering new equipment options, materials, supplies or services we encourage you to give consideration to our Bulletin Advertisers.

<table>
<thead>
<tr>
<th>Wednesday Dates &amp; Topics</th>
<th>Description &amp; Company</th>
<th>Speaker</th>
<th>Location</th>
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<tbody>
<tr>
<td>October 9, 2019</td>
<td>Overview of Industrial CT Scanning</td>
<td>Dylan Yazbeck</td>
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<td>Additive Manufacturing 3D Printing</td>
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<td>NADCA</td>
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<tr>
<td>April 1, 2020</td>
<td>Eliminating Die Solder with Pinpoint Accuracy Using Simulations</td>
<td>Rabi Bhola</td>
<td>Grand Chalet Milton, Ontario</td>
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<td>Bolster Technologies</td>
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<tr>
<td>May 14, 2020</td>
<td>TBD</td>
<td>TBD</td>
<td>Elio Restaurant, Montreal</td>
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Attention Chapter Members!

Has your address or company affiliation changed?

Has your phone number or fax number changed?

Do you have an Email address?

If so, be sure to let the Chapter Membership Chairman, Mr. Rabi Bhola, know to ensure that you will continue to receive the monthly meeting notices. In addition, NADCA headquarters will be notified.

Mr. Rabi Bhola  
Email: rabi@bholstertech.ca

For NADCA on line courses & webinars click [here](#)

NADCA Chapter 10: Technical Program • October 2019 – May 2020

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Bholster simulations solve actual problems in the foundry:
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Here are some examples of what we can predict:

**Die Temperature**

Precisely identified features that will solder if run faster. And found the correct die cooling that allowed us to meet our target cycle time.

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This is a flow simulation, but Bholster takes this to a new level with actually showing how gas porosity is formed in the part.

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Simalex Manufacturing Company Ltd
Langley, British Columbia.
Winners of this award 5 years in a row.

Congratulations from Chapter 10!

Next Meeting

REMINDER:
For members, staff of corporate members and our Bulletin advertisers, the March 2020 dinner meeting is FREE!
December Meeting Review

Our Speaker Wes Byleveld did a very detailed Presentation about Exco Engineering Additive Manufacturing 3D Printing. He talked about Design and Process for additively produced tooling for the Die Casting industry. Exco Engineering has successfully used additively manufactured (AM) maraging steel components to triple the service life of conventional H13 components. In addition to conformal cooling, the material properties of the powder were a large factor in delivering long-lasting components. Our Members and Guests could inspect some samples Wes brought with him. A lot of comments and questions were asked. Wes supplied me an interview he had done with the Additive Magazine which you can read on pages 22 - 29.

Wes Byleveld
Director of Additive Manufacturing, EXCO
Email: wesselb@excoeng.com
Website: www.excoeng.com/additive.php
Tel: 289-716-5702

NADCA Chapter 10 Invited Speaker for March 4, 2020

We are pleased to announce that Beau Glim from NADCA Headoffice will be speaking at the upcoming NADCA chapter meeting in Milton on March 4th.

Professional Background

Beau Glim is the Project Manager at the North American Die Casting Association where he has held this position for the past five years. His responsibilities include: coordinating research & development efforts between member companies, government agencies, government laboratories and universities; providing technical information and resources to die casters, suppliers, designers and original equipment manufacturers; and teaching NADCA courses and webinars, such as PQ2, Gating, and Operator Training.

Beau joined NADCA after 7 years as a mechanical seal design engineer for Rexnord Aerospace in Downers Grove, IL. This company is a producer of mechanical seals for aircraft applications. Beau holds a B.S. degree in Aeronautical Engineering from Purdue University in West Lafayette, IN.
Ignacio’s report on Ryerson Awards Ceremony

It was good to have our chapter represented at the Ryerson awards ceremony for the Department of Mechanical and Industrial Engineering. They were very appreciative of the award and of our presence there.

NADCA Chapter 10 has a long-established scholarship award for students in the department of mechanical and industrial engineering at Ryerson University in Toronto, that recognizes high academic achievement and a demonstrated interest in metal casting.

This year’s awards ceremony took place on November 13th, 2019 at the Mattamy Centre in Toronto and the winner this year was Timmy Ngo, a 3rd year student of mechanical engineering who showed excellence in both categories.

NADCA Chapter 10 was invited to present the award and take part in the celebrations. We are pleased to support young promising engineers who show interest in our industry and look forward to continuing this initiative.

From left to right – Dr. Ravi Ravindran (Professor), Dr. Liping Fang (Acting Dean, Faculty of Engineering and Architectural Science), Timmy Ngo (Ryerson Mechanical Engineering Student Year 3 - 2019 NADCA Chapter 10 Award Recipient), Ignacio Musalem (President & General Manager Cana-Datum Moulds Ltd (Chapter 10 BOD and NADCA Board Of Governors).
North American Die Casting Association Chapter 10 Ontario Award (1 award) $2000

Award for a full time Mechanical Engineering student in 3rd or 4th year with high academic achievement in Materials related courses and a demonstrated interest in metal casting.

Faculty of Engineering and Architectural Science

North American Die Casting Association Chapter 10 Ontario Award

To provide financial assistance and to recognize the academic achievement in Materials related courses.

Eligibility and Application Process

Applications must be submitted to the Mechanical and Industrial Engineering Department office in EPH 300 by the date and time stated on the Mechanical and Industrial Engineering Department website.

Applicants must meet the following criteria:

- Be a Canadian Citizen, a Permanent Resident or a Protected Person;
- Be an Ontario resident;
- Demonstrate financial need as determined by Ryerson University through completion of a detailed budget submission in accordance with OTSS guidelines;
- Demonstrate interest in metal casting;
- Demonstrate good academic performance in their studies, particularly in Materials related courses, with a cumulative GPA of 3.0 or higher;
- Write a one page letter of application explaining how they meet the criteria
- Provide letters of support demonstrating interest in metal casting.

Criteria for Selection

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weighting</th>
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<tbody>
<tr>
<td>Budget/Financial Need</td>
<td>50%</td>
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<tr>
<td>CGPA, Academic Standing</td>
<td>20%</td>
</tr>
<tr>
<td>Letters of support (up to three) demonstrating interest in metal casting</td>
<td>30%</td>
</tr>
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<td>100%</td>
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Adjudication

The Department of Mechanical and Industrial Engineering Awards Committee will recommend the name of a candidate to the Chair for final selection. All prospective recipients of the award must complete a detailed budget that demonstrates financial need.

Please submit an APPLICATION LETTER outlining how you meet the criteria and include the completed Student Budget and letters of support in a sealed envelope addressed to the Chair, Department of Mechanical and Industrial Engineering, EPH 300.

Here are the winners of the NADCA Chapter 10 Award for the last 6 years:

<table>
<thead>
<tr>
<th>Year</th>
<th>Winner</th>
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<tbody>
<tr>
<td>2014</td>
<td>Jasjeet Sing</td>
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<tr>
<td>2015</td>
<td>Nikola Kuzmic</td>
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<tr>
<td>2016</td>
<td>Shekinah Shilesh</td>
</tr>
<tr>
<td>2017</td>
<td>Michael Rinaldi</td>
</tr>
<tr>
<td>2018</td>
<td>Nicholas Prabaharan</td>
</tr>
<tr>
<td>2019</td>
<td>Timmy Ngo</td>
</tr>
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</table>
On behalf of NADCA Chapter 10, it was a pleasure to attend the unveiling of the Donors Wall at Mohawk College. Our Chapter 10 scholarship provides annual funding to a student of the college to complete or upgrade their studies. I’d like to share the appreciation and gratitude for our support that was expressed by the Mohawk leadership.

*Ignacio Musalem, Delegate/Board Member*

Ron McKerlie (President of Mohawk College) emphasized that without the help of the many donors, it would be impossible for grad students to complete their academic program.
Mr. Mike Jurcic  
North American Die Casting  
Association  
c/o Craft Casting Engineering Inc  
21 Metcalfe Crt  
Georgetown, ON L7G 4N7

Dear Mr. Jurcic,

Your commitment to our Awards Program has made a profound difference to our students by helping them complete their academic journey. On behalf of all those students who have benefited, and those who will benefit in the future, please accept our sincere appreciation for your support of the North American Die Casting Chapter 10 Bursary.

We are pleased to let you know that students have been selected as the 2018/19 recipients of the North American Die Casting Chapter 10 Bursary. In recognition of your generosity, you will find enclosed, a special thank you letter.

There is nothing more gratifying than watching students grow, taking new knowledge and translating it into the essential skills for their chosen career path. The financial assistance you provide to our students makes education accessible and sets an incredible example of community support.

Once again, thank you for your ongoing dedication to Mohawk College and our students. Because of donors like you, our graduates emerge future-ready!

Regards,

Gena Cureault  
Senior Development Officer

---

Mr. Mike Jurcic  
Chapter Elective Director  
North American Die Casting Association  
c/o Craft Casting Engineering Inc  
21 Metcalfe Crt  
Georgetown ON L7G 4N7

Dear Mr. Jurcic,

Thank you for making an impact on Mohawk students each year. Your support of students like me, helps makes the difference in our lives.

Right now, my plate is overflowing. I’m working two part-time jobs while I’m a full-time student at Mohawk College in the Computer Systems Technology - Software Development program. I often find myself struggling to afford it. Expenses like tuition, books, rent, food, supplies, really add up. I’m always wondering how I’m going to keep up with all the costs.

The gift catalogue in your hands is one way to help support students. It contains carefully selected items that will help make a difference in a student’s life. When you make a gift through the gift catalogue you are helping students to focus on their studies by reducing their stress and giving them hope.

I ask you to consider making a gift to support more students like me. Your gift will help Mohawk students stay in school and graduate.

Every gift can make the difference.

With thanks,

Estefani Saban-Chacon ’16  
Software Development Program

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Email: igm@cana-datums.com

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Technical/Education Program
Mr. Wilfried Schwark
Art Braun Inc.
Membership
Mr. Rabi Bhola
Bolster Technologies
In Automotive, Is Additive Manufacturing an Answer for Die Cast Tooling?

The largest high-pressure die cast tool builder in North America is 3D printing die inserts and water jackets for major automakers. It’s a tough sell, but one company is succeeding — and it’s just getting started.

This demo version of a 3D-printed water jacket is opened up to allow visibility of cooling channels inside. The superior cooling of this type of water jacket prevents the build up of solder, which can increase cycle time for polishing as well as cause fatigue, cracking and failure of the part.

Wes Byleveld has gotten used to working backward in his sales pitches. The bottom line, he tells Exco Engineering’s automotive customers, is that additively manufactured die cast components can provide a distinct competitive edge. He shows how 3D-printing conformal cooling channels close to the surface of these tools creates a thermally balanced die, and how the benefits cascade into decreased cycle time, lower scrap rates and lower labor costs. And yes, he goes on to say, the mechanical performance of inserts and water jackets printed with maraging steel, which is suitable for sintering via the powder-bed fusion (PBF) process, equals or exceeds the performance of H13 tool steel. Using thermal stress simulations and real-world testing, he presents years’ worth of research that backs up his claims.
It's a pitch that Byleveld has made with a good deal of success for Exco, where he serves as director of additive manufacturing (AM) for the largest high-pressure die cast tool builder in North America. Exco's top customers are the Detroit Three automakers, but the list extends to just about every major automotive brand known to the United States.

Through their success, Byleveld and his team of additive champions at Exco seem to be quietly altering the definition of what “production” means when it comes to 3D-printed components for the auto industry.

The result of Byleveld and Exco Additive’s work is that several powertrain, body and structural components on the road today or in the near future will likely be produced with 3D-printed die cast tools. Considering that roughly 70 million cars are produced each year, this is no small feat. But more impressive — and more important to the way we think about additive manufacturing’s role in the industrial landscape — is how Exco has incorporated metal 3D printing into one of the harshest manufacturing environments imaginable. As Byleveld explains, it started with simple curiosity.

Wes Byleveld has been with Exco Engineering for 15 years, beginning in the company’s die cast department doing robotic programming work for die casting process- and workflow-related issues. But for the last four years he’s been fully dedicated to additive manufacturing, an initiative that he says began after learning that one of Exco’s competitors had begun experimenting with the technology. “It was curiosity more than necessity,” as he puts it. But after an initial round of positive benchmarking tests — fueled by the potential to drastically decrease temperatures via 3D-printed conformal cooling channels — Byleveld says he was given broad latitude to bring additive manufacturing into Exco’s production tools.

Industrial-scale die casting — the process of forcing molten metal at extremely high pressure into a mold cavity — is an extremely inhospitable environment for metal powder-based 3D printing. Exco’s facility in Toronto comprises 130,000 square feet of heavy-duty machine tools, including a 4000-ton high pressure die cast machine and three massive furnaces — an inhospitable environment for metal powder-based 3D printing.

Through their success, Byleveld and his team of additive champions at Exco seem to be quietly altering the definition of what “production” means when it comes to 3D-printed components for the auto industry.
A typical die produced by Exco consists of several components, some of which require complex machining operations for intricate features such as threading and cooling channels. The die cavity insert is a prime example of this. As the name implies, die inserts — which are machined separately due to their geometric complexity — are inserted into a pocket of the die when finished. While machining inserts as standalone components allows the cutting tool to access external faces of the part, internal cooling channel geometries are still limited to basic linear shapes. Because of this, inefficient cooling of the die during and after the casting process creates thermal imbalance, which causes several problems further down the production chain. As Byleveld and his team learned, the transition to 3D printing die casting inserts wasn’t as simple as purchasing the right printer. In fact, the act of finding a 3D printer capable of producing automotive die casting parts — and surviving in a die casting environment — was itself a challenge. As a benchmark part, Byleveld selected an engine block water jacket, a part that features a thick base and extremely thin walls. Byleveld then sent water jackets to several 3D printer OEMs with a challenge attached: “If you can build this part for us, we’ll buy your machine.”

In 2015, Exco purchased its first 3D printer, an EOS M 400. The next obstacle to overcome was a materials-related issue: H13 tool steel — the standard material used for Exco’s dies — doesn’t play well with the powder bed fusion process.

Test strips can be used to determine the bend rate across a certain distance, the results of which can be input into a modeling method for pre-stressing 3D printed inserts.
The Trouble With H13

"Materials are the name of the game," Byleveld says. The problem with laser sintering H13 alloys, he says, is that the high degree of carbon in the steel leads to the formation of microcracks throughout the material just like traditional welding. Even with a properly preheated system done just the right way, defects will persist and lead to a highly unreliable part that may get a lot of shots one time and as low as 75 the next. "It’s extremely hard to produce additively," Byleveld says. "When you look at some of the parts printed with H13, they're cracked and full of porosity. When you’re injecting metal at 13,000 PSI in 20 milliseconds, and you have a waterline 1 mm from the surface, if that water line burst during metal injection it blows open the machine. It’s a big safety concern for me."

The material solution that Byleveld and his team landed upon is one that dates back to a previous generation of die casting: maraging steel.

Maraging steels were developed in the 1960s for high strength pressure vessel applications, specifically rocket motors casings, and were for a time used widely throughout the automotive die casting industry. With its low carbon content, maraging steel is extremely weldable and thus ideal for the powder bed fusion process. Combined with the proper heat treatment and aging processes, Byleveld says that the overall mechanical properties of maraging steel meet and exceed traditional tool steels for die casting while maintaining a high level of dimensional stability and low distortion.

Through trial and error and several commissioned studies with a local university, Exco has created a proprietary heat-treating process for 3D printed maraging steel that Byleveld says results in a hardness similar to H13, but with much lower porosity and a higher resistance to cracking. "The material lasts," he says. "We’ve printed die inserts from maraging steel that have lasted more than 150,000 cycles."

Exco’s heat-treatment process, shown here, has allowed the company to use maraging steel in place of H13 for its 3D printed inserts.

This stat is all the more impressive when you take a close look inside the looping geometries of a 3D-printed die insert.
In these 3D-printed test parts, a slight teardrop shape can be seen in the tube on the left. Stress can concentrate within this shape, leading to failure of the part. Exco has experimented with other channel shapes to offset this problem.

Cooling Channels

The rule of thumb for cooling channels within a typical insert is that they must reside no less than 0.75 inches from the die casting surface. Anything closer to that risks failure. But thermal and mechanical simulation testing has allowed Byleveld and his team to push the limits with 3D printed conformal cooling channels, placing them within a fraction of the conventional minimum of 0.75 inches.

A heat map shows the drastic temperature differences achieved with conventional (linear) cooling channels versus conformal, 3D-printed channels.
Exco is also closing in on the ability to pre-stress CAD models in a way that offsets bending and warping that takes place during the printing process. Byleveld showed me printed test strips that he measured on CMM in order to determine the bend rate across a certain distance — the results of which can be input into a modeling method for prestressing inserts. The smaller the insert, the easier this is to accomplish, Byleveld says. This work was part of the motivation for Exco to invest in its second metal 3D printer, an EOS M 400-4, in which four, 400-watt fiber lasers operate in separate quadrants with 100 mm of overlap area in the center. Because a single, large part can now be made with multiple lasers at the same time, the part stays warmer for longer. Because the delta change in temperature is what leads to warpage, keeping the entire part at a steady temperature limits the overall distortion.

Conformal cooling channels have long been touted as a key benefit for utilizing 3D printing in the mold-and-die industry. And Exco’s investment in bringing additive manufacturing to automotive die casting bears this out. Thermal balance within a large automotive die, which contains a dynamic range of thick and thin sections shot through with liquid aluminum, is extremely difficult to control. The ability to do so impacts not only performance, but also cycle time, scrap rates and labor costs — all critical factors in an increasingly competitive global market, especially from Eastern Europe.

While powder costs for additive manufacturing — as well as the time and capital expenses on refining the printing processes — elevate the costs for 3D-printed parts like die inserts and water jackets by two-to-five times, Exco says that its parts not only out-perform traditionally manufactured dies, but save substantial time during the solidification process. This, in turn, results in substantial cost savings during the die lifecycle.

Contrast that with intricate setups on a five-axis machine to drill difficult angles, which wastes not only valuable time but also substantial amounts of material. Not to mention that complex machining also requires skilled labor to perform the task. “You can imagine on a 200,000-pound die, as delivered, we’re probably removing 40 to 50 percent of material conventionally,” Byleveld says. You buy a hundred-pound block of H-13 at $5 a pound and whittle it down to 30 or 40 pounds and get 10 cents on the dollar for your waste. Same with a large die insert; you remove 40 percent. With additive, you’re only producing what you need plus a little bit of machine stock. Yes, the material is much more expensive, but it actually starts coming closer and closer to conventional manufacturing.”

Because this might not be intuitive to his customers’ purchasing departments, Byleveld says that the most important role can be that of a sales engineer. What is the hourly cost on a machine? What is the ROI for a part that lasts several times as long as a traditional part? The savings, he says, can be thousands of dollars compared to a traditionally produced insert.
10,000 Cycles

Ultimately for Exco, delivering dies that out-perform those that are traditionally manufactured allow customers like GM and Chrysler to produce parts faster and remain profitable. One critical component that Byleveld believes can be drastically improved via additive manufacturing is the water jacket — the benchmark part that won EOS the company’s business.

Wes Byleveld, director of additive manufacturing for Exco Engineering, the largest high-pressure die cast tool builder in North America.

Water jackets inserts essentially create the coolant channel within an engine block. They are difficult to machine, let alone print, due to the variance in thickness of the curved walls from top to bottom. Because temperatures can vary across the face of a water jacket die by as much as 220°F, solder buildup often occurs during the metal injection phase of the casting. Machine-related downtime associated with polishing solder is itself costly. Eventually, fatigue in these areas will crack through the water jacket and result in leaks between the coolant and oil passages on the engine block itself. The typical cost to an auto manufacturer can be upwards of $10,000 per insert, and these inserts often last fewer than 15,000 cycles before having to be discarded.

Byleveld says that one of his Big Three automaker customers is testing 3D printed water jackets that contain a water line near the surface to substantially decrease the temperature variance and limit solder formation. While the central geometry of the 3D-printed water jacket is no different than a conventionally produced part, Byleveld is betting that, even at five times the cost, the expense of an additively produced jacket is more than justified when you calculate increased performance, longevity, and machine-related downtime associated with polishing solder.

Conformal cooling channel on a 3D-printed water jacket.
Full adoption of 3D-printed water jackets by automakers has the potential to be a game changer for Exco in many ways. The company produces roughly 500 of these parts per year conventionally. Byleveld says that even producing 200 a year additively — assuming that the performance enhancements doubled the shot life result — it could justify Exco purchasing another two or three additive machines.

Before that happens, the benefits will need to be made clear, Byleveld says. The durability of 3D-printed parts like the water jacket will have to bear out during testing. And a mindset change may need to occur among customers who may consider bottom-line costs before calculating savings for material, labor and performance. “You know, it’s a tough sell sometimes, because the cost of one of our additively produced inserts is two- to five-times the cost of a conventional one,” he says. “But when the conventional is a thousand dollars and you’re only charging you know three or four thousand for it but you’re getting all the benefits, that’s where the real savings are for people.” Until that’s widely understood, he says, he’ll keep doing what he’s been doing: Starting his sales presentations at the end, and working his way back.

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