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BOXX MAGAZINE

You Cannot Kill a BOXX

With over 26 years within the AEC industry, Duane Addy has put his trust in BOXX— a decision he can back with benchmarks. ***Page 5***

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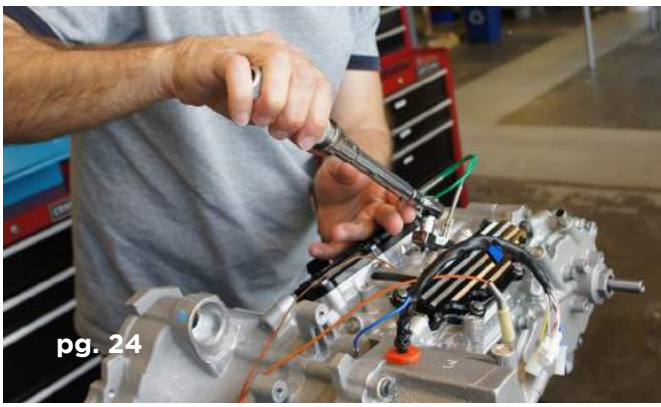

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BOXX architecture, engineering, and construction workstations, custom-configured for Revit®, AutoCAD®, 3ds Max®, Adobe® CC®, Sketch-Up®, and other applications, maximize application performance, deliver rock-solid reliability and ROI, and enable you to work faster and more efficiently than ever before.

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YOU CANNOT KILL A BOXX

BOXX CUSTOMER STORY

BY: JOHN VONDRAK

With roughly $750 million in construction projects under his belt and over 26 years within the AEC industry, Duane Addy has built a career on quality design and rendering production—a career that is only as successful as the performance of his software and hardware. As many organizations look to send project renderings to the cloud, Duane Addy has stood firm and put his trust in BOXX— a decision he can back with benchmarks.

THE DUANE ADDY BENCHMARKS

Sent to BOXX on April 25, 2018

I just wanted to provide an update on where things are and share some of the facts on how things are working out so far. First, where we came from:

2015 We utilized SketchUp with V-Ray for rendering and saw the following times to render (not including modeling, etc.) 5000 pixel images:

Exterior Renders took 45 minutes on Microsoft Azure Cloud

Interior Renders took 2 hours to render for the project

Once these renderings were completed, they still had another 30 minutes of post production process.

This was implemented as a band aid solution to help us get the renderings to a newer, fresher look, but was not the full direction I wanted to go. We could do better.

2017 We utilized a combination of SketchUp and Lumion. Lumion was always intended to be implemented since it would allow us to work in full virtual environments. (No more Photoshop building post production).

This saw render times become the following:

Exterior Renders took 12 min to render on Microsoft Azure

Interior Renderingstook 20 min on Microsoft Azure to render

No post production was needed. This is better, but I want perfect. I want the team pushing the limits of what can be done.

2018 **Dell workstations**

We installed new desktops and the thought was to take us away from the cloud (only on rendering). Think of it this way: George Lucas would not have built an entire campus for rendering at Industrial Light and Magic if the cloud was the perfect solution to render.

The desktops helped us get better:

Exterior renderings took 6 min to render

Interior Rendering took 16 min to render

Better than Microsoft Azure in the cloud, however, the problem was the team sat waiting for a rendering to finish before starting another one.

SO WHERE ARE WE NOW?

BOXX APEXX S3 workstations with 32GB RAM and an NVIDIA 1080

This is the exciting part. Implementing two BOXX APEXX S3 systems has allowed us to achieve the following:

Using a single APEXX S3:

Exterior renderings at 7600 pixels renders at 2 min 39 secs. Now we're talking.

Interior renderings at 7600 pixels renders at 5 min 46 secs.

So it looks like this:

2015 | 5000 pixel images

Exterior: 45 min
Interior: 2 Hours

2018 | 7600 pixel images

Exterior: 2 min 39 secs
Interior: 5 min 46 secs

Higher quality image, more realistic and full virtual environment (we can show you any blade of grass from any angle with no extra work). These APEXX systems are also a fraction of the cost of rendering on Azure.

As for the revised renderings process, we are looking at having close to 180 done by the end of this week and this is while having other priorities to finish. The team has done an amazing job of readying files. Before I left on holidays, I was able to get the premade environments made from the research I have been working on the past few months. Implementing the premade environments has allowed them to get their times around the 5-7 minute mark per house before rendering. With rendering, that puts us around 10 minutes. We have budgeted 60 minutes.

That's right: 1/6 the time.

So while I know you have maybe wondered about the research and development and the amount of time it has taken to get to here, now we can see the results. So thank you for your patience while this developed and for letting me implement the mad science.

Rendering starts tomorrow on the first 120, so doing the math, we can now render 180 renderings in 7.95 hours with the new APEXX machines.

Exterior Renders: 2 min 39 secs
Interior Renders: 5 min 46 secs

with BOXX

NOW I'M HAPPY. BETTER QUALITY. BETTER RESULTS.

Thanks, Duane Addy

First off, the benchmarks. In the process of interviewing BOXX customers, we don't always get this level of benchmarking. This is incredible, Duane.

That was one thing that I was always wanting throughout the years. Many companies are going the route of online cloud-based systems and while I understand and agree for the most part in doing this, when it comes to cloud based rendering I haven't totally bought into it yet. Many times, in business we must make calculated decisions quickly and in order to do that effectively, we need to have all the facts. Most often, these facts are derived from the continual testing of benchmarks and proving which rendering process is better. Again, I completely understand the reasons as to why cloud-based IT systems are great (enhancing storage, redundancy, and accessibility from anywhere), but I just am not there yet with rendering. Based on my experience, unless you've really done rendering, it's hard to understand it and why a physical machine just works better. Most people would think it's just computing power, but there's a whole science to it. For the last couple of years, there's been a challenge between designers, modelers, and IT departments on pushing rendering to the cloud and I think that many of them, especially those that I work with, understand now. That's probably because I can be a bit of a pitbull with a bone (laughs)!

Based on the times I have now versus a cloud test, we have helped everyone to understand. Joking around one day I said to an IT Director, "I'll tell you what, when George Lucas decides to switch Industrial Light & Magic over to a cloud-based system or when Digital Domain does it, I will agree and submit to adding mine to the cloud, but considering they just built new campuses and have run hundreds of thousands of miles of network cable to all the processors and the render farm, I don't think that will happen for quite some time." So, George if you're reading this please, please take your time.

You sound like BOXX founder Tim Lawrence.

Well through many years of trial and error I've done rendering and animation with some machines bought, others built, and tons of software, and it was from those years of "error" I knew what I needed to do and what I didn't, so it was more a point of proving why people needed to simply trust my decisions.

Tell us about yourself.

I graduated from Fanshawe College in London Ontario. They have a four-year architectural technology program where we learned the architecture and design side of things, but also the building science and technological side. I've known since I was 12 years old that I wanted to be in this business, so I wanted to learn anything and everything that I possibly could. I started as a framer when I was 17 or 18 years old and then tried taking every job I could all the way through college working for pre-engineered construction, steel detailing and design, and working my way up to project management. I'm coming up on 1700 projects that I've worked on myself and close to $750 million total in construction and design. It's been a 26-year career with everything from 100 square foot additions and 18,000 square foot custom homes, to high rises.

Tell me about your career path.

When I got out of school I wanted to get a new car. I was driving an old beater, so I test drove a new model which immediately made me think if I'm paying $25-30,000 for a new car and I can first test drive this vehicle, why would I ask clients to trust me on the single biggest investment of their lives but, yet they can't test drive it. That was in 1997. That's when I really got into the rendering side of things. I wanted to make it a point of every job, I wanted to know anything and everything about 3D. I wanted to be able to showcase it to customers first, then the builders and trades, so that's where it started. Over the years, it's been numerous software products, trying to get rendering times down. Today, with all of my projects, I try to build-in full interactive virtual construction models that I can not only pull quantifiable data and drawings from, but models that showcase realistic renderings as well. With regard to renderings, I focus on realism as much as possible. It's really fun as I work on projects from small $50,000 construction budgets to $320 million projects, as well as everything in between.

I have eleven designers with whom I work hand in hand on a variety of projects. In a very short amount of time, over 200 renderings for a $320 million project were completed, along with several other facets of the project: one batch of 155 single family renderings, a second batch of 650 single family renderings, a 174 unit townhome project, all on top of developing a new, innovative way of designing and modeling that I am

just now implementing into my overall process. It's something I have been working on the last eight years and it's finally at the point where I am using it daily.

What are the typical steps involved in a project?

Typically, I'll come up with the concept, a 2D floor plan first, then an initial 3D concept model. From there, depending on what task is required (rendering, interactive virtual construction model, quantity take off, etc.) I will begin modelling a more detailed model. From that model, I can spin off the initial set of drawings and/or renderings, fulfill quantity takeoffs, and more. The project then goes to the next step in media delivery and fulfillment. This is where it either becomes an interactive experience or static media such as wall renderings for sales centers, brochures, and the like. I always do exterior renders, but not every job gets interiors done.

Are interior renderings dictated by the project?

Yes. On the larger multifamily projects, I'll do multiple renderings for the interiors. Up until now, only about 40% of the single family projects go with the interior, unless it is a large-scale builder and they want to showcase new models. Occasionally, we rely on an associate of mine, John Brock, who has trained and worked within my main software SketchUp as long as I have.

Who is John Brock?

John and I have always said we're brothers from different mothers. We just share the same philosophy that it didn't make sense to not know what you were building. John is a builder, and over the last eight years, he and I have been developing a system by which he, as a builder, and I, as a designer, look at the construction process from two different vantage points. With this system, we can actually know anything and everything about a project. Once we implement it, it will allow us to actually produce interior renderings for every project. Up until this point, most clients and companies I have worked with or worked for have been primarily using AutoCAD with some Autodesk Revit. John and I made the switch over to SketchUp about eight years ago which allows us to do full construction drawings, the interactive virtual construction model (IVCM), the renderings, everything tied to that one house. Right now, based on our system, we've been able to substantially lower development times while decreasing cost overages on site by as much as 40%. Where it would typically take two weeks to do an entire project where you're just getting your AutoCAD drawings and an exterior rendering, we can do a full IVCM model, including all framing, quantity estimates, renderings inside and out, a full set of construction drawings, interactive pieces, all in just over three days. We're cutting down from two weeks to three days! With everything I'm trying to implement, I'm always looking at the time side of things. Rendering times have to come down and development times have to come down, so that's what I'm always pushing for.

You mentioned SketchUp. What other software applications do you use?

I just made the switch to Lumion about a year ago am really loving it. Back when I first started working with SketchUp, I learned from them that the beauty of it is that it can be as little or as much as you want it to be. If you want more, you can build custom plug-ins, but it's intuitive and scaled back on purpose. I think Lumion has done a similar job where you're so used to everything almost being over complicated that they've scaled things back and made it very simple. Once you determine how you want your lighting rig to be for doing interiors, it becomes something you can save as an effects stack and then you can apply it to each interior you're doing. I look at how our rooms are laid out, for example. If I've come up with a lighting rig for one of the

houses that has two large windows across the back, French doors, or some other feature, that's in there. I can then apply that same lighting stack on very similar designs and cut down the workflow time. I look at things like that, the shape of the building based on how I've done that lighting and that's something Lumion has become very good at—the ability to save those FX stacks. The same with material stacks. You can set up all your materials whether it be stainless steel, granite, cabinets, flooring, and you can have all that and simply export it out as a material stack and then you bring it into another scene. It's essentially doing a lot of the work for you. I love working with Lumion, the interactivity, and my team loves being able to fly around inside of it.

What's your biggest workflow challenge?

The switch over is the biggest challenge right now because you're asking people to change and sometimes people are open to change while other times they've been with a company for 20 years and satisfied with the way they've always done it. I'm a firm believer that good design always evolves as much as history repeats itself. You're never going to do something 100% fully creative that's never been done. If you put columns in the front, the Romans already did it. If you crumpled the side of the elevation wall — Frank Geary already did it. Good design evolves and better execution evolves quicker. That's where we always want to be pushing the limits of what we do and how we do that and always looking at new products and new ways. When you produce 650+ single family renderings in 2.5 months, you don't have a whole lot of time. You need to get in, get it done right, and move on to the next one. That's what we have to be cognizant of. That's why we always have to be evolving. The hardest part is getting people into that mindset that we are going to be changing and implementing more VR strategies. There are a lot of really cool things out there that I'd really like to see adopted, but we have to do it one step at a time and make sure we do it right.

Pushing the limits with new products and new ways. Sounds like a perfect segue into BOXX. How did you discover them?

In 2010, I was with a company and we were frustrated with our rendering performance. We would build our own rendering machines because we thought, "We can build these for a thousand bucks apiece and have twenty of them." We didn't know anything about rendering, so at that point, it was a lot of trial and error

as I said earlier, money spent, and not getting the numbers we wanted. We went looking on the internet and came across BOXX, the renderBOXX product, and kept reading up on it—specs, customer stories, anything that we could find, because we were a very small company where every dollar counted. It was a serious investment. We purchased five renderBOXX modules and it dramatically changed our lives—like night and day. The best part was they were robust. They could take a beating and just smile back at you.

Fast forward to today - Just prior to implementing Lumion, we tested the online cloud system using Microsoft Azure Cloud Service as well as on local machines. Even though we were working in the cloud, I kept thinking about my previous success with the renderBOXX systems and how it could be the basis for more major success.

So you're switching to Lumion, a GPU-based renderer, which necessitated a hardware switch. You've tested online cloud systems and from that you concluded that new BOXX APEXX S3 workstations for rendering would be the better way to go. Tell me about that and the creation of the benchmarks.

It's probably not the way I would suggest anyone else do it, but there was a lot of frustration leading up to the benchmarks because I'm responsible and overseeing hundreds of renderings at any given time. I can't be spending seven months of the year on those. I need them to be out quickly. IT consultants and managers want to move toward where there are not a lot of physical machines on site because that means replacing machines every few years, i.e., the product life cycle and I totally get it.

One of the things I tried to explain was you cannot kill a BOXX. That's the thing. An eight year-old BOXX will still run. It's a different kind of system. There is a secret sauce one that no other machine possesses. I acknowledged that there are a lot of different ways of doing things, I just needed a resolve to move forward with the tasks. As I said earlier, if someone has never done a rendering, they cannot understand completely what it takes and sometimes it can lead to several voices offering opinions. In the end, the one who has the most experience in running the systems and is responsible for their performance has to be left to do what is best. It was on one of those days I just said "Everyone, you just have to trust me." It was at that point I was able to get the first two BOXX workstations internally and the render times speak for themselves. They dramatically reduced render times, but there was still that nagging question from IT consultants where they felt building a system with the same specs would be cheaper. Having the history of both building my own systems and using BOXX, I always caution when someone says something like that because I do know how it will end. You can use the same specs, but you're never going to get the render times that you do with the BOXX machines because BOXX, as I said, has the secret sauce. It's something developed in the pipeline that uses every facet of the machine and produces better results. Build your own all day, but you'll never get the times that you do out of a BOXX. It's like going to Hardees and asking for a Big Mac. It will be a burger with lettuce and cheese, but it won't be a Big Mac.

Now we have these machines, so how much more do we implement in terms of team members doing renders? How much work do we see per year and how many BOXX systems do I need to order for the next year or two? That's where I am now. The trust is there. Everyone involved sees the numbers, sees the results. Put everyone else on the cloud, but leave rendering alone (laughs).

Describe the specific project where BOXX made an immediate impact.

We had 180 renderings due in just over two weeks. I had gone away on holidays and while I was away, my team had taken all the models and brought them into Lumion. Overall, it took them about a week. These were ready to render, so about the time I got back, we had just received the APEXX S3 systems so we put them all together. We were rendering at 7600 pixels and did all 180 in less than eight hours, finishing in just over a week in total prep and total rendering time. We cut it down by half in terms of the deadline. It's almost like a security blanket. You now have that trust in the machine. Now it's okay if a client wants to see the interior of a scene I've been working on. If they come into my office and say they need it this afternoon for design meeting I know I can work right up until the meeting because it will take an interior rendering 5 minutes and 46 seconds at 7600 pixels or an exterior at 7600 pixels in two minutes, 39 seconds. I know I can render that out and throw it into Adobe Lightroom to do a few adjustments.

I essentially need ten minutes to render and tweak it, so I can work right up to close deadlines.

BOXX has had my back for the last eight years, so the trust is there. That's why it was easy for me to stand up against IT consultants and managers and say with confidence "We need to look at BOXX," because there is that experience and BOXX has never let me down. The quality is second to none. I also know BOXX has awesome technical support, but happily, I've never had to use them.

Tell me about the future for you and BOXX.

I'm starting to get into much bigger projects with a lot more interactive and media work in addition to the architectural design. The team I'm involved with — project managers, construction managers, and estimators are always the best at what they do and exceptional in every aspect. They've met every challenge, even if it's something we've never done before. From the design side, I'm always looking to push those limits. How can we make things more interactive? How can we have more realistic renderings? How can we deliver something faster without substituting quality? So BOXX is going to be a big part of that because if I had my way, I'd have all of my workstations be BOXX workstations. When you get into the larger panoramas, the one thing I don't want is anyone to think there is a quality issue, so I always render to the higher resolution so we can see crispness and detail, especially when adjusting and tweaking inside of Lightroom and Photoshop. You have to have that strong base image and you have to have that powerhouse hardware behind you in order to produce those images.

With the number of houses that I have rendered, and with being on track to do more than last year, along with larger scale projects, plus new townhomes and street towns, there is always going to be a large number I must juggle. So much will come down to efficiencies and speed, timing, and scheduling, but we need to make sure that the best equipment is always there to produce those times. The one thing we don't have to worry about is BOXX. These workstations have been phenomenal and (BOXX performance specialists) Rich Petit and Matt Gubitz have been exceptional guys to work with. I'm look forward to 10 or 20 more years of working with BOXX. They have the vehicle to take me where I want to go. ■

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BOXX CARES

Our hometown of Austin, Texas is internationally recognized as an epicenter of hi-tech innovation, education, and creativity. As proud members of this community, BOXX focuses its charitable giving on our city's most valuable resource—the next generation of artists, innovators, and leaders.

TeamFX | Through our sponsorship of TeamFX, a team of marathon runners led by VFX artist and BOXXer Gary Walker, BOXX supports the Austin Children's Shelter (a Program of SAFE) which provides services for children, young adults, and families affected by abuse, exploitation, and neglect. To date, TeamFX has raised over $375,000 for the shelter. To support TeamFX and the SAFE/Austin Children's Shelter, visit TeamFXAustin.org.

The Austin Cup | Each year, the BOXX bowling team participates in the Austin Cup Invitational Bowling Tournament benefitting the Center for Child Protection, a nationally accredited children's advocacy center. The center serves children in Travis County who are suspected victims of sexual abuse and serious physical abuse. It also offers refuge and services for children who have witnessed a violent crime. It is the only nonprofit in Travis County involved in the investigation of crimes against children. Learn more at CenterforChildProtection.org.

Build-a-Bike | In addition to our annual support of TeamFX and the Austin Cup, BOXX has also participated in other charitable causes including Build-a-Bike, where BOXX employees assembled bicycles for youngsters from The Boys & Girls Clubs of Austin. Learn more at BGCAustin.org.

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Certified for Autodesk® and Dassault Systèmes SOLIDWORKS®, CATIA®, and other professional applications, BOXX product design & manufacturing solutions deliver unparalleled power and reliability for the most demanding workflows. For over 22 years, we've earned a reputation as the leading innovator of high performance solutions that enhance creativity and increase productivity—resulting in increased profits and accelerated workflows for engineers and product designers like you.

The MPD workstation marketplace consists mostly of computer hardware manufacturers that rely on a "one-size-fits-all" approach, but BOXX is just the opposite. We specialize in 3D CAD, providing cool, quiet, record-setting solutions tailored to meet your specific workflow needs. We're the workstation equivalent of a custom shop, building hot rods that will take your applications and workflow faster and farther than ever before. How fast do you want to go?

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KISTLER

THE BALANCE BETWEEN SPEED AND QUALITY

BOXX CUSTOMER STORY

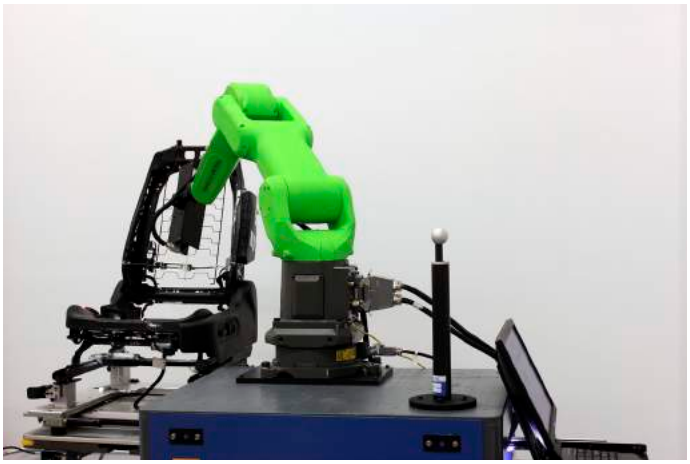
BY: JOHN VONDRAK

The brilliant minds at Bluewrist deliver . . . with a little help from BOXX

Bluewrist Robot & Vison Solutions may sound like a futuristic corporation from Blade Runner or some other sci-fi epic, but in fact, it's a Canadian-based company every bit as cool as its moniker. Within the realm of robotics and machine vision, Bluewrist produces innovative, software-based, industrial automation solutions, vision inspection systems, robot guidance, and industrial communication products that increase their customer efficiency, improve production quality, and reduce operating costs. Speaking of customers, Bluewrist's include the likes of Chrysler, Magna, GE, and many more. With multiple projects underway throughout North America and China, the number of Bluewrist employees has doubled over last year.

The company's computer vison R&D team provides all the algorithms and methodology, the library Bluewrist relies on (they build their own custom library for inspection processes), while their application engineering team consists of PLC experts, mechanical experts, and automation experts to help design or retrofit projects for customers. When customers arrive with their projects, this team will see the requirements and work with R&D to determine feasibility. Bluewrist takes a rigorous scientific approach for all projects so that what

the customer wants is feasible with today's technology and software capabilities. Another key component of their job is customer education. The typical Bluewrist customer (if there is such) has never implemented an automated 3D vision project from start to end, so setting the right expectations is crucial. For Bluewrist, the job is ultimately a balance between speed and quality.



The Hi-Tech Marketing Guy

The Bluewrist marketing and communication manager is Jason Niu, a University of Toronto grad who majored in marketing and economics but parlayed his deep technical background and passion for technology products into gigs at AMD, ATI, and Canon prior to joining Bluewrist. "I began my tech career focusing on ink jet printers which led to photography, and video," Niu recalls. "To process images with more pixels or higher resolution, you need better computers. It all snowballed for me and became the driving force behind my interest in tech because I'm always interested in what's on the horizon, the next greatest thing. I've spent almost a decade in the semi-conductor, hi tech space and now I've moved on to another booming industry, industrial automation."

At Bluewrist, the next greatest thing is often driven by customer demand and according to Niu, those customers, on average, come in two types. The first is starting a manufacturing facility from the ground up, setting up a new plant, and in need of various robotic solutions like robot guidance which instructs the robots to perform specific repetitive tasks. "We help with the guidance," he says, "and we also marry vision sensors to the robot, enabling it to perform even more complicated tasks such as assembly, loading, or product inspection. In addition, we provide the software infrastructure to enable various industrial devices to communicate with one another." Because building a modern, automated factory means dealing with a lot of industrial peripherals like PLC, controllers, and sensors, those must be centrally managed. Bluewrist produces the software which enables the programming and ultimately allows the customer to set up a new factory.

Niu says that the second type of customer is well established within an existing facility, but running older equipment in dire need of an upgrade. "We go in and take a look at what they do," says Niu, "and because our software is hardware independent, we can use it to raise capabilities with minimal disruption to their existing operations." He also admits that there are definite overlaps between the two types of customers. "Every customer is unique. Everybody makes different products," says Niu. "On the other hand, sometimes we have a customer that is creating ten production lines to make the same thing, so every line is pretty much identical. When you talk about different customers, they are usually in different industries with different products, so there are different challenges. But overall, the challenges are often the same."

All the software applications used by Bluewrist are their own—created in-house and custom. In citing an example, Niu points to a welding video in which the challenge is to maintain the adequate cycle time speed in order to accomplish real-time weld inspections. "A lot of the welding is automated by

high speed robots," he says. "They have a 3D laser profile scanner that will track the weld pattern and our software actually generates a third point cloud off of that pattern and compares that to the weld specs. We do real-time comparison to ensure that there are no gaps, cracks, or other weld defects. So when we deal with a customer like this, we really have to see what the weld speed is. Our software is highly scalable based on the hardware you use to support it. You can scale anywhere from 2 to 22 CPU cores, or as many CUDA cores as you can throw at it."

Niu admits that sometimes Bluewrist is limited by the customer's budget, as well as power constraints. For example, a customer cannot install as powerful a system on their shop floor because the environment is simply too harsh. In this instance, Bluewrist conducts a lot of internal benchmarking and simulations to determine the optimum sweet spot between the number of CUDA cores and CPU cores, as well as meeting the customer's speed requirement. "In addition to that, we do our own in-house testing and simulation and run it with various system configurations or with different hardware capabilities to at least match the customer requirements," says Niu. "So this is our workflow: we take it apart, we do our simulation, feasibility study, and determine the ultimate hardware specifications needed for this project."

Cradle Scan

Niu admits that determining the specifications is a challenge, but also one of the easier ones. With the availability of multi-core CPUs and powerful GPUs, Bluewrist's options are extremely broad. Other key challenges include the accuracy needed, but Niu says that is a whole different discussion. "We always have to balance accuracy and speed," he says. "You can achieve really accurate scans but you're dealing with a huge amount of data that will overload even the most powerful system. We have to find a sweet spot in terms of accuracy. With weld inspection, we're accurate up to 0.1 mm and that's good enough because welding is typically not that intricate. We're looking for brazen defects like burn throughs or missing welds which are easy to locate. It's just a balance of many factors, but ultimately, it boils down to this: Can this be put into a production system? Can we meet the customer's requirement 24/7? Many factory operations run 24/7."

A Clear Cut Decision

For years, Bluewrist relied on industrial grade PCs, but as inspection processes became more complex (incredibly dense point clouds and higher resolution cameras), the need for processing within a small form factor increased dramatically. Traditional industrial PCs could no longer offer the required level of performance, so Bluewrist began researching alternatives, focusing on form factor, support, and reliability. All roads led to BOXX. Niu even had a ringing endorsement from Adam Glick, a onetime AMD coworker and former BOXX-labs engineer. "Because BOXX is designed, manufactured, and supported in the U.S., we really needed that level of North American support and good service just in case things went wrong—because things always go wrong in manufacturing," he laughs. "It's a given factor that things will go wrong, so it's what you do afterwards that's the deciding factor of a good or bad service provider. We came to BOXX because their incredibly

flexible hardware configurations allow us to scale any number of cores up to the socket limitations."

This push to move to BOXX was spurred by a specific project. It seems Bluewrist had an extremely challenging project involving one of the top three Japanese OEMs, a company which had an existing type of cell that after two years of trying, they still could not get to work. So they brought it to Bluewrist.

"A lot of our hardware had to be compatible with the existing hardware," Niu recalls, "and there's really not much of a physical space for us to work with inside of a control cabinet. There was a lot of stuff—relay switches, power supplies, PLCs, you name it, so we could not use a full-size, industrial strength PC because there was not enough airflow. Secondly, it would not be powerful enough. Only the BOXX APEXX 1* had the small physical size and processing power combination to make this project work." Bluewrist software developers and engineers conducted performance analysis to determine the best possible hardware configuration and the optimum number of CUDA cores necessary. "It involves the inspection of over sixty different screws and fasteners on a door panel, so we were dealing with a lot of data under ten seconds," he says. "The APEXX 1 form factor does not exist outside of BOXX, so it was a clear cut decision."

Internal analysis clearly demonstrated that the BOXX system would deliver the necessary performance, so Bluewrist contacted BOXX MPD Performance Specialist Scott Campbell. They asked some straightforward questions regarding scalability and hardware configurations and came away impressed with Campbell's knowledge and customer service. "We could spec out the system, but it was Scott who made sure the system was built as soon as possible. Because they were so custom, we really need-

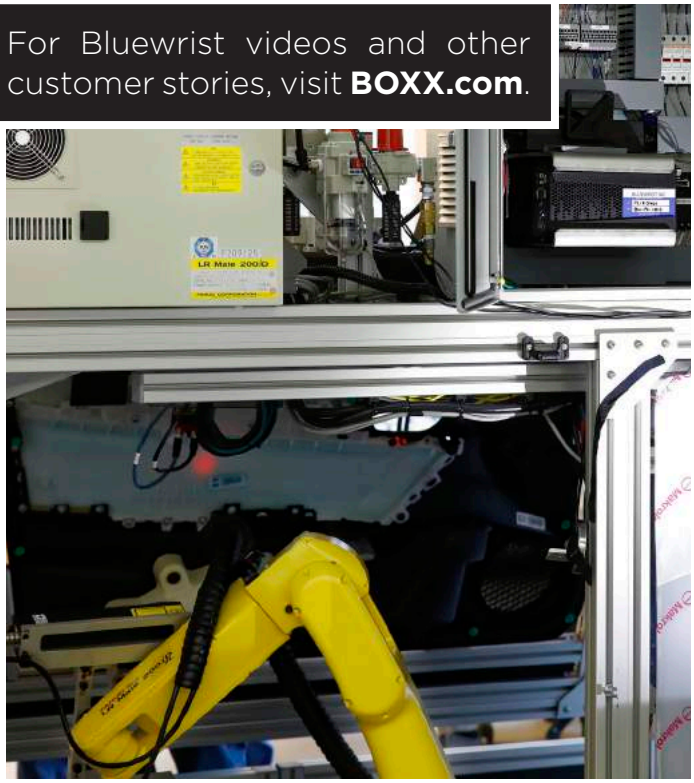
BOXX APEXX 1

ed to test the performance." Niu says.
The portable powerhouse quickly passed all performance tests and was soon put to work on the project. "Our customer was very impressed when he saw that tiny workstation running that whole cell," Niu recalls. "The cell basically has a robot arm with two cameras mounted on it and the APEXX 1 is the brains behind it all."

Critical Situation

Thus far, Bluewrist has only deployed the APEXX 1 for this specific (and very challenging) project, but Niu says they are looking for more projects where Bluewrist can deploy additional systems. For these professionals, regardless of project, the biggest workflow challenge is speed. "Manufacturing is all about cycle times," says Niu. "I know on the design side you talk about rendering times, but at the end of the day, if it takes one minute or two minutes, it won't really break the bank. In manufacturing, if we're over by one second, we don't get the project. Sometimes it's even less than a second. The time factor is really, really critical and that is the

For Bluewrist videos and other customer stories, visit **BOXX.com**.



single biggest workflow challenge BOXX solves because without the combination of hardware, we would just not be able to do it. We can still inspect it, but if we don't meet the cycle time requirements, then what we deploy becomes the bottleneck in the plan and they obviously don't want that. We're helping reduce bottlenecks, but not from a traditional software perspective like in the CAD or 3D animation world where you have to wait for your render to complete. Here, we are solving a real physical problem. This is why I think our story is so unique. We can talk about benchmarks all the time, but everything is software. How fast does this take to compile, to render, etc., but that's not the case here. We are in a much more critical situation."

Sensible Hardware Configurations

Niu insists that as inspections get more complex with Bluewrist software, the limitation is the camera sensor. Because their software is hardware agnostic, they can use various scanners and sensors available on the market (of which there are many) and their resolution and accuracy increase year by year. It's the same with the evolution of many electronic components. But to Bluewrist, that also means there is a substantially more data to process. "We are constantly optimizing our software to take advantage of more CPU cores or CUDA cores in order to minimize the cycle requirements," says Niu, "because with any inspection system, you're adding another step in the process and also adding overall time to the manufacturing cycle. If we can keep that low, our system becomes extremely competitive. We see more opportunities with BOXX in this scenario because they have the most sensible hardware configurations on the market."

*The Intel-based APEXX 1 1802 model workstation has since been replaced by the APEXX S1 workstation featuring an Intel® Core i7™ Processor.

Niu says that with the best software on the market, it takes a few seconds to actually recognize the parts, orientate the robot, and ensure that the robot doesn't hit the bin or tap the component on the side of the bin. With a tremendous amount of mathematics behind it all, Bluewrist and their competitors are looking for ways to overcome the challenge. In a relatively fragmented industry, companies large and small have their particular strengths. Niu believes Bluewrist's strength is the fact that they are hardware agnostic. "We can use any sensors, any controllers, any robots," he says. "Our competitors are more closed ecosystems, so you have to use their sensor, their devices, etc. Our other advantage is our data logging capabilities that enable intelligent, real-time quality data capture and analytics. We provide real-time insight into the manufacturing process through our software (called SPCWorks), so plant managers and quality control techs can have a high level overview of how their manufacturing process is functioning. With SPCWorks, quality information from the shop floor and QA

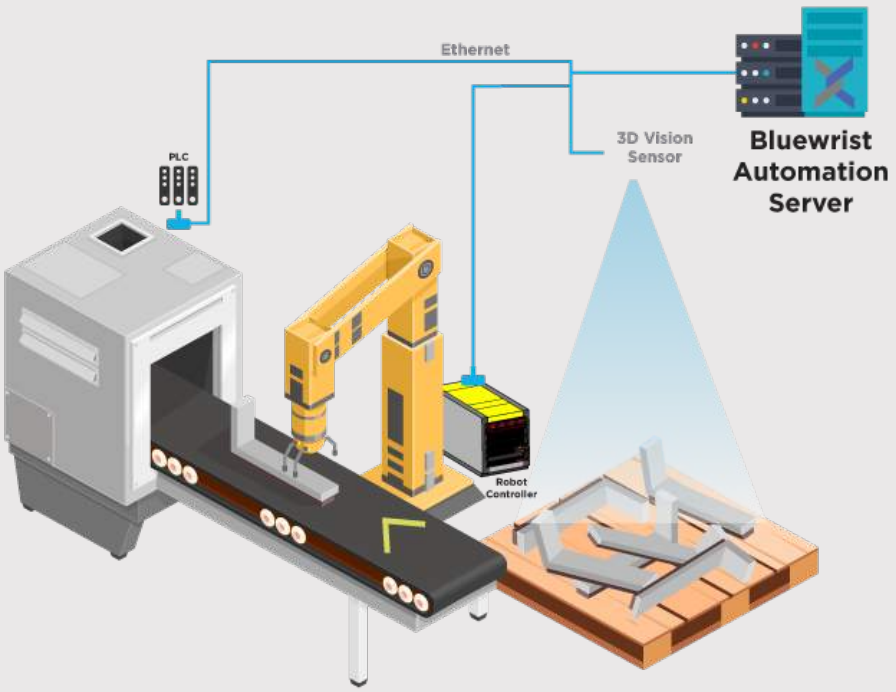
department can result in actionable insights that drive productivity improvement and cost savings across the entire organization. That's more on the reporting side, not the vision side, but our vision system captures the raw data needed for analysis."

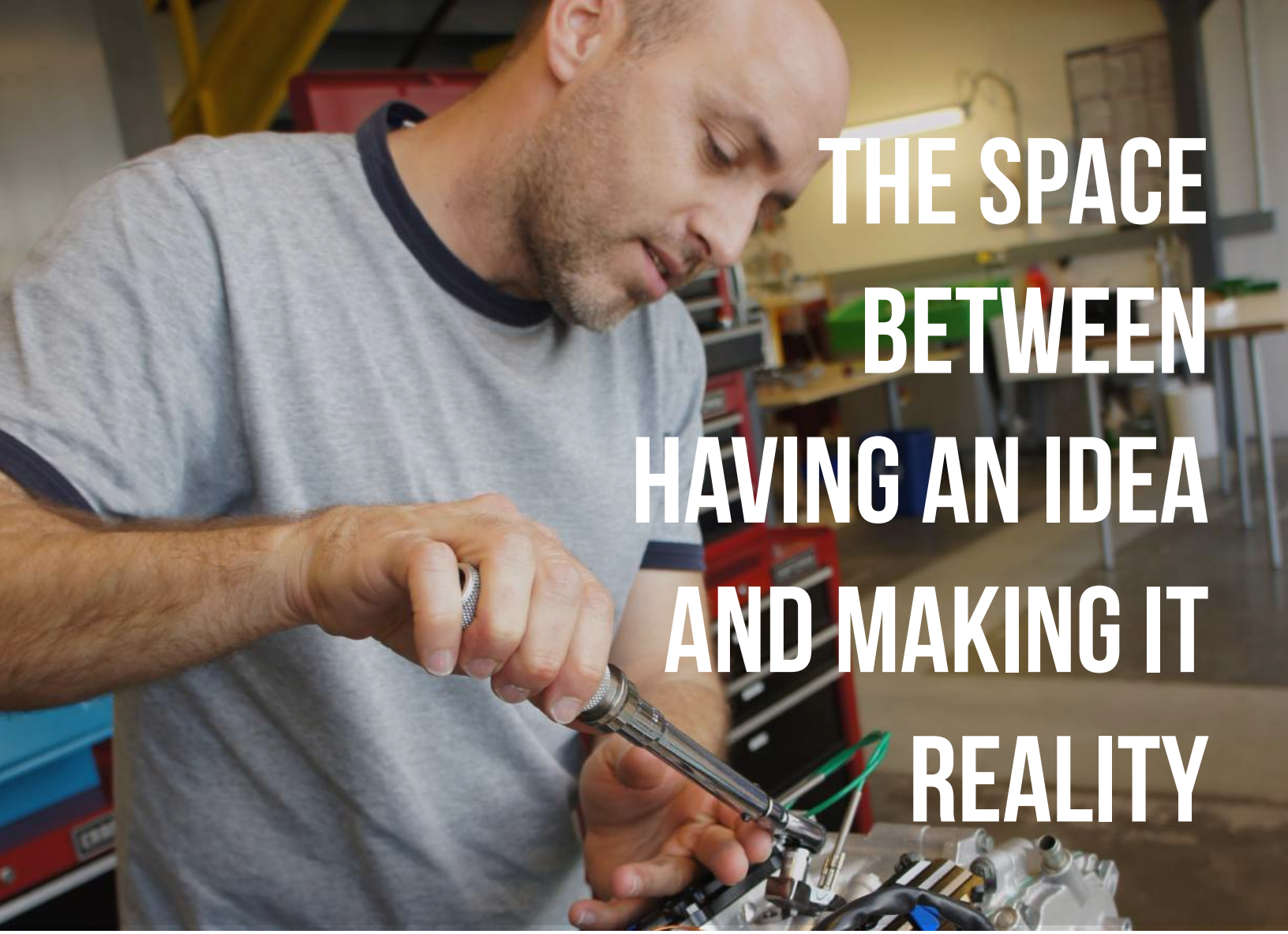
With all of Bluewrist's 3D scanning and the inspection, they try to help the manufacturer achieve 100% inspection capability because traditional quality control is done by sampling, where parts are taken off the line at random intervals which can result in bad parts being sent downstream. This can lead to minor problems or in worst cases, very expensive recalls. Through 100% 3D vision inspection, Bluewrist helps eliminate that because all parts are inspected. "Without 3D vision and fast compute time, it's not possible," says Niu. "If your inspection becomes a bottleneck, it's unacceptable. Of course, every manufacturer want 100 percent perfection, but there are limitations you have to overcome. The door inspection project where we relied on the BOXX APEXX 1 was one case where, through education, we became aligned on the same page and we're still able to deliver a project despite a tight deadline." ■

UNDERSTANDING RANDOM BIN PICKING AND 100% PERFECTION

Random bin picking is essentially a robot picking up randomly stacked parts in a bin and placing them elsewhere—either packaging them or as an additional step in the manufacturing process. As one might guess, this requires a significant amount of compute power. "The 3D camera takes a picture of the parts in a bin, a 3D representation of the model," says Niu. "This is then compared against CAD and in the comparison, we have to do various angle rotations, adjustments, and a lot of mathematics, to determine which angle is best for the robot to go in and pick. Every pick is a randomized approach and it takes a lot of processing power to meet this type of requirement. Bluewrist is working hard to actually improve both accuracy and stability to do optimizations on the mathematical side and also on a software performance side. Bin picking is the holy grail of machine vision. It's giving the robot the human ability to detect randomly placed parts."

Bluewrist bin picking





THE SPACE BETWEEN HAVING AN IDEA AND MAKING IT REALITY

BOXX CUSTOMER STORY

BY: JOHN VONDRAK

Josh Raimond of Pinnacle Engines

When Joshua Raimond was 13 years old, his friend's father gave him a ride home in his Porsche. Joshua had never ridden in a car like that before and in the moment, a passion was ignited. Oddly enough though, not as much for the style of the car, but for the sound of that engine. "I'm more of an engine guy than a car guy," Raimond says.

Fast forward a number of years, and when he left the United States Marine Corps after four years of service, Joshua decided to pursue his passion and make a career out of working on Porsche racing engines. He went to work for the renowned SoCal shop, ANDIAL. Formed in 1975, ANDIAL's name is an anagram made from the names of the founding members; the late Arnold Wagner AN; Dieter Inzenhofer DI; and former PMNA president and current consultant Alwin Springer AL. Porsche Motorsports North America purchased the brand in 2013.

"That's how I got into motorsports," Joshua recalls. "ANDIAL has a fantastic history racing Porsches and when Porsche Motorsports bought the racing side, it was literally me walking across the parking lot. I worked at Porsche Motorsports North America for six years. That's where I cut my teeth."

While there, a manager told Joshua if an engine needed to be built quickly, it did not necessarily go to him (Joshua), but if it needed to be built unquestionably perfect (like for a 12 or 24 hour endurance race) he was indeed the guy. Despite the high praise, Joshua moved on, deciding to attend college where he majored in physics at Cal. Unsurprisingly, upon graduation, he found his way back into the motorsports industry,

At the controls of the Hasselgren AVL

this time building racing engines at Hasselgren Engineering. While there, he created and managed Hasselgren's first Porsche race engine program running three teams, brought into commission and ran the AVL test cell, programmed Bosch Motorsport and Pectel ECU's, traveled to support Daytona Prototype data acquisition and engine support. Truth is, he did a little of everything.

"I'd go to the track and do track support," he says. "I would run the test cell, calibrate the ECUs on the dyno, build the engines, etc. I've just really been entrenched in motorsports most of my life."

Things changed, however, in 2008, when the economy went into the wall. "Folks weren't spending as much on motorsports," he laments. "I ended up moving over to what used to be called Cleeves Engines, founded by Monty Cleeves, which he later changed to Pinnacle Engines. It was here where I started the design phase of my automotive career."

Joshua relied on his engineering and physics background, as well as his previous motorsports experience, and began contributing to the design side. After seven years, he has contributed to three clean sheet engine projects: the first two were for a scooter project, while the current one is a 235 cc engine for the three-wheel market.

I ask him how his reputation for slow, meticulous work (dating back to his Porsche days), adapts to the Pinnacle Engines environment and Joshua laughs. "I've always been a little slow," he says. "At ANDIAL, the ethic I was taught was that perfection was what it was really all about. I was just so obsessed with getting it right and took to heart all the detailed lessons I was taught, so I ended up being a slow moving engine builder who guaranteed that everything was right—clip orientations, ring gaps, all clearances proper and all measurements were methodical and well documented. It just became my reputation to be the slow guy that didn't mess up. The work really was an art. Emphasis wasn't on turning out work quickly and bringing in a lot of money. I never felt that ANDIAL was ever about that. It was about executing the rigorous work ethic, attention to detail, more artistry than some job that was shopped—turning around cars for cash."

From Builder to Designer

By the time Joshua arrived at Pinnacle, where the company's primary focus is automotive (specifically the three-wheel and two-wheel markets), he wanted to transition to design, but forty percent of his work was still focused on building. However, in his design hours, one of his first projects was a flow bench rig for Pinnacle's novel sleeve valve engine technology.

"It took a little cleverness," says Joshua. "I designed a rapid prototype printed system, a nice encapsulated little unit that took the

Working in the Hasselgren dyno - 3.2 L short stroke 911 engine

sleeve in reality and was able to move it with a measurable and consistent amount of lift."

It was trial by fire, but his work garnered notice throughout the small company which was always on the lookout for design talent. "Valvetrains are my jam," he laughs. "With my physics background, they're a good fit because you're doing a lot of physics—active mass, inertias, forces, springs, contact stress, integrals and derivatives, complicated moving geometry— when you're designing valve lift profiles. You're creating acceleration profiles and there is so many ways to do it. I just started getting in there and doing it."

Joshua credits mentor Simon Jackson, PhD, an experienced motorsports expert who earned his stripes at Cosworth. Jackson also specialized in valvetrains (among other things) and from him, Joshua learned the finer details of a functioning valvetrain. With an engine under his belt, there was no time to rest on his laurels. Another project (with a slightly different architecture) quickly followed and Joshua just kept on going to where he is today. "I've done a lot of valvetrain design and development," he says matter-of-factly. "I designed my own spin rigs with the whole sensor suite and data acquisition. I did a piston design as well. I know what it's like to develop a skirt profile, the barreling and ovality, get into the details of ring packed dynamics, or the volume game you play to try to get the rings to stay stable for a certain period of time before the pressure causes the rings to shuffle. It's a small company, so I take on any design task that's required."

While at Cal, did Joshua dream of one day designing engines? "I didn't even know it was possible," he admits. "Frankly, if I did, I probably would have got a degree in mechanical engineering. I thought I had exhausted my career in engine building. I really just focused on physics and transitioning my career. I went skydiving for a couple of years and thought about what I really wanted to do. It was awesome, but base jumping was crazy. I only did nine of those and they were scary as hell."

After this "living on the edge" foray, Joshua re-discovered his passion for motorsports. While trying to determine how to transition to a new career, he started building engines again for money and while doing so, discovered a non-functioning AVL test

cell. He managed to get it working again and with the guidance of an experienced mentor, began teaching himself how to calibrate ECUs, how to do launch control and rev-limiter PID, and how to properly map an engine. Joshua was satisfied for a while, but still wanted to move on when good fortune smiled. "Frankly it was just luck that Pinnacle Engines wanted to hire me," he admits. "I saw an available design opportunity and wanted to see if I could fill it." He joined a company of 30 employees with a testing facility in San Carlos, including a main building for design and simulation. There is also an office located in India.

Joshua also considers himself lucky for the guidance of his career mentors, chief among them Tony Wilcox and the aforementioned Simon Jackson. "They really gave me an opportunity to thrive," he says. "The Pinnacle work environment promotes self-learning. It's a bit autodidactic–about becoming an expert as quickly as possible in the many different tasks at hand."

Joshua relates his Pinnacle experience to the AMC series Halt and Catch Fire. "There's a really quirky programmer and someone from a major computer corporation offers her a job where she will have all the resources she needs but she says, 'Why, so I can sit in a cubicle and be a drone and work on some long, boring project that doesn't do anything?' She'd rather work at this little company that is doing something innovative where she has autonomy. There's a great Car and Driver magazine article where the writer basically destroys our company for launching a product. He said something along the lines of us pulling this off were as likely as a Sasquatch playing a Stradivarius while riding a unicorn over a double rainbow. So there are people who think that what we're doing is nuts and not very likely. There are a lot of the big folks who have seen us and say well, maybe . . . but they're not interested in the technology. However, in India, I find it interesting that they have shown themselves to be capable of absorbing a real amount of risk for a real amount of reward. We've demonstrated the fuel efficiency that we proposed to offer and we've demonstrated the emissions we purport to offer. We're not kidding ourselves. Our technology is different. We look at our technology warts and all and then we share that warts and all with our potential customers and everyone has a realistic view of what's possible. It's an exciting time now.
I think if you had asked me this question a couple of years ago I would tell you it's really hard and it's difficult to find someone to take on the risk and who wants to do it. But now, we have a great customer, great fuel economy, increasing emission standards, and the fact that we run so lean which enables us to have incredibly low NOx. Pinnacle Engines has carved out a little niche. It's real good now."

The Design Process

For Pinnacle, the design process begins when a customer has a torque and power requirement, and/or a fuel efficiency requirement that must fit into some package representing a vehicle with a specified displacement. From there, Jackson, the VP of Engineering, creates what he calls "an 80 percent solution."
"By himself, Simon damn near creates the whole entire engine architecture," says Joshua. He'll create a camshaft, a crank, and a rod, etc. He whips this stuff up and creates a general architecture for the engine. Is the cam going to be above or below? Where will the ports be located?"

With rough CAD, some masses, and some early valvetrain design, Joshua begins producing forces using Gamma Technologies GT Suite to create a one-dimensional simulation—a mechanical simulation of the entire valve train. "I'll build it, simulate it, and pull out those forces" he says, "run FEA on

SOLIDWORKS Simulation, then refine CAD on the components that need it, and converge on a design that gives the desired dynamic lift profile"

Joshua also relies on a MATLAB script to narrow down what can be tens of thousands of possible valve spring designs. He specifies wire properties and geometry, spring frequency, the necessary load at installed and full lift, even the cost of materials. Ultimately, he arrives at a solution that works with all the other components, crankcases, and all the other things that define the space: including a Converge CFD combustion simulation, port design, and injector spray pattern—anything that is captured.

"It's really up to the engineers to start working out the details and that's where we get into the feasibility and the engineering issues of space claim and making things work," he says. "It has to be designed for manufacture. The cost has to be low so you have to be careful about your features, materials, etc."

Going over the crankcase assembly of a Porsche 911

And the manufacturing location depends upon the customer. The general intent is that the customer specifies the engine, Pinnacle designs the engine, creates the 3D and 2D documentation to take it into manufacture, and deals with tier one feedback, but the customer ultimately takes that data and mass produces the parts. So essentially, Pinnacle licenses the technology created and becomes the steward of it.

Beginning in SOLIDWORKS

Joshua begins in SOLIDWORKS, creating designs which are close approximations of what he thinks the part will be when it's finished. Because he focuses on valvetrains, Joshua pays close attention to geometry, the locations of things, cam axes, pivot axes, roller follower axes, etc. He then moves into Gamma Technologies GT ISE mechanical simulation. "On my BOXX, I have the software and I'll run this mechanical 1D simulation after spending a lot of time populating the model with material properties and 1D contacts, oil properties, clearances, masses, inertia values, stiffness, etc., I'll then go back into SOLIDWORKS, open up my rocker arm, apply a force to it, pull out a stiffness value, and then put that stiffness into my 1D simulation which helps the 1D simulation predict the dynamic motion of the valve train. We'll use MATLAB to narrow down the field of possible springs, model the springs in the GT software in a number of ways including inputting the actual helix of the springs into the model to help predict dynamics. Then it becomes an iterative process where I'll get a dynamic valve lift profile. I'm looking for valve motion, valve float, and control in the ramps. I'll go back into CAD and say I could lower the forces if I changed the rocker ratio—is that feasible? It's sort of interesting how when you get into engine design it seems like you can do anything, but once you start putting things in position, it about designs itself and you are fighting for millimeters. It gets tight real fast. It's an iterative process where I'll try to change some geometry, go back, look at the forces, make sure it clears all the other components

and again, more FEA with the different components. The good idea in valvetrain design is to get it as light as possible, so I'm always chasing that. Just a lot of optimization circles. My workflow involves a lot of FEA , a lot of CAD, and a lot of 1D simulation."

Accelerating SOLIDWORKS

Since his arrival at Pinnacle Engines in 2010, all Joshua had ever heard (and all he had ever experienced) was terribly slow SOLIDWORKS. "It was such a pain to watch it rebuild," he recalls. "We had these Dell T1600s and we would start developing a pretty complicated engine assembly with each component well-modeled in CAD for manufacture. When we would start rotating it around, it would get clunky. We would always spend a lot of down time as the design phase went on, and you have to interact with the assembly. You can pretend, just do it in lightweight mode so it looks all graphical, but that just isn't good enough. You need to section things and you want to measure things in sections. You want to measure proximity of components. You just have to have it at full weight. We spent a lot of time waiting for the computer to work. We were also setting up some reasonably complex FEAs, press fits, and applying different loads at different cases because we have to work out the fatigue life. FEA takes a while and you're wasting a lot of time waiting for it to chug away."

Raimond's custom designed piston, connecting rod, and wrist pin (DLC coated)

According to Joshua, the real casualty of slow computing was that the design department was unable to focus on nuance. "You don't get the time to do nuanced design if you're just sitting there," he says. "It may not sound like a big deal, but it becomes one when it takes six minutes or more to rebuild and you have to wait six minutes over and over again, day after day. That's just talking about pure rebuild time. There are so many other things happening that are slow and really adding up to wasted time. It kills creativity. You walk away, you go to the kitchen, the computer is working, but you're not. You don't have your head in the game."

To make matters worse, Joshua is the SOLIDWORKS admin, so any time there was a problem, his colleagues would seek him out. "We would spend all this time looking for little ways to speed up SOLIDWORKS," he recalls. "I'd get more RAM, turn off Windows Aero, until I finally thought, 'This is ridiculous. I'm going to figure it out. So I started searching around and finally I came to the conclusion that the rate determining step in SOLIDWORKS is processor speed. There are other things like having a nice fast HD, which is also great, but the number one rate determining step is proc speed. So where was the fastest processor I could get? I knew about overclocking, but thought, that seemed sort of absurd, so I dismissed it at first. I began looking around at computers with fast processors. I saw a lot of gaming computers,

which didn't feel like a good fit. Then I found BOXX. I was sold just based on clock frequency and the fact that you guys were overclocking the APEXX S3 and the build quality seemed really good, very professional. Not that SOLIDWORKS is the sun of your solar system, but I felt like it was one of the big planets. It seemed like you guys were doing a great job of it and could verify your systems for SOLIDWORKS."

Joshua's next step was to go to the boss. "Yeah, it was a hard sell," he admits, "but I'm a hard salesman. I really just had to put my foot down and say all I hear all the time as the admin are SOLIDWORKS issues." He discussed his findings regarding clock speed and after "a lot of kicking and screaming" received approval for BOXX workstations. He also managed to finagle better graphics cards and 4k monitors that provided ample real estate when looking at large assemblies.

Prior to the new BOXX APEXX workstations, Joshua says that substantial investment in the design department had never been a serious consideration. "We were crippled with the processing time," he says, "but also graphics cards and everybody had two different monitors, etc. The design department is the space between having an idea and making it reality so it was frustrating that we were under-investing in it." Having successfully pleaded his case, Joshua tried to "get the best of everything." He called BOXX and spoke to BOXX MPD Performance Specialist Rich Petit who he says was "fantastic." "Rich was great to talk to," he recalls. "I told him what we were thinking, that we wanted quotes, and he sent them right away. He was flexible regarding whether we wanted this, that, or the other. It felt like I was talking to someone who was genuinely interested in our problems and wanted to help us solve them any way he could. It was reassuring knowing that I was working with someone in the know, who was giving us options, and gave me space to make the decision. He'd give a quote, and I would approach my boss who would ask about something else and I'd circle back to Rich. He always provided the information I needed to make the right decision." Pinnacle was finally sold on the APEXX 2 equipped with NVIDIA Quadro GPUs and SSD drives. He also added dual 4K monitors for each designer.

BOXX APEXX Workstation

Because every BOXX customer story has a happy ending, the conclusion to this one is that Joshua Raimond succeeded in getting Pinnacle Engines' design department up and running on BOXX workstations and everything is running smoothly. "The compliments came so fast, but there was initial hesitation that this would even work," he recalls. "No one really understood what the difference could be. Now no one is going to work on anything else. Wielding large assemblies, running FEA, and doing 1D simulation benefits greatly from having a fast computer, so it's really those background things. Running the actual CAD is trivial. It's everything else that comes from doing a lot of that CAD—that's the main determining step in my workflow. The screen real estate is amazing and makes work easier, while the speed of the BOXX enables users to spend time

on creativity, not wasting it on rebuild times and other ridiculous things. Simulation goes so much faster. It has just made everything so much nicer. We're better suited to focus on design. There really is a stress that has been lifted off of the designers. No one complains about speed."

As for the future, Raimond says the capacity of the design department, enabled by BOXX, has Pinnacle Engines well-positioned for a long time. But as the company grows and the department expands, Joshua believes that a BOXX workstation will be the first tool a designer would receive. "Make customers happy and you get return customers," Raimond says. "I'd buy another BOXX in a heartbeat." ■

Author's note: As this story went to press, I received this message from Joshua Raimond:

"Turns out I did buy another BOXX in a heartbeat. I now work at a Stealth Space Company designing the architecture and packaging of an entire rocket engine—and the very first thing I did was insure I had a BOXX computer before I did anything."

"To avoid traffic, I arrive at work at 10 am so there is a period of time in the early morning where my computer is not in use. A coworker (who runs test cells) wanted to use SOLIDWORKS, so he asked if he could log on to my BOXX system. I said, "Sure," and when he opened up the program he was blown away. He had no idea that SOLIDWORKS could run so fast and be so easy to use. His prior experience was with one of our Dells, which take forever to load a model, let alone try to do anything. His experience reminded me of what I encountered with my boss, Simon Jackson—the misconception that SOLIDWORKS is just slow. Simon's (and many other engineers' experiences) was that you could get in about six model edits per day. When your experience is that it just takes forever, you'll become convinced that no computer, no processor will fix it. It's just how it is and it was part of the initial resistance to BOXX. We weren't going to spend all this money on fancy computers that weren't going to improve anything. Now he sees that wasn't the case at all."

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Lorne Wilson, VP of Sales

After executive sales and marketing roles at both startups and large enterprise organizations. Lorne joined BOXX in late 2017 as VP of Sales. Responsible for all direct and indirect global sales, Lorne is committed to sales presence expansion and company growth. Previously, he served as Chief Sales Officer at cyber security provider BluStor and spent twelve years with Fujitsu as Senior Vice President of Sales, Marketing, and New Product Development.

Bill Leasure, VP of Marketing

Responsible for overall marketing strategy, Bill has over 20 years experience developing and deploying data-driven inbound, outbound, and account-based marketing programs. He has held top marketing, sales, and business development roles at Intel, Motorola, Dell, and several startups, earning numerous awards along the way. A graduate of the University of Santa Clara, Bill also holds a Master's Degree in International Economics from American University.

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BY: JOHN VONDRAK

THE ANIMATOR

Meet Webster Colcord, the animator and motion capture artist who relied on a battle-scarred BOXX workstation to bring **Ted** to life.

A native of Eugene, Oregon, animator Webster Colcord went to work for Vinton Studios right out of high school, cutting his teeth on projects like the Emmy Award-winning A Claymation Christmas Celebration and Michael Jackson's Moonwalker. This was followed by years of freelance and studio work that includes countless commercials and Hollywood productions like James and the Giant Peach, Antz, and X-Men: Day of Future Past. Most recently, Webster has earned raves for his outstanding motion capture work Seth MacFarlane's Ted films. Currently animation supervisor at Atomic Fiction (Star Trek: Into Darkness, Flight, Cosmos) in Oakland, CA, Webster generously agreed to share his time by taking a few questions.

Growing up in Eugene watching King Kong, The Seventh Voyage of Sinbad, Bakshi's Lord of the Rings (did you watch American Pop as well?) did you have any aspiration to become a filmmaker, or was it always the quality and creativity of the animation itself which inspired you? As a side note, did you ever see Watership Down? Like Bakshi's rotoscope stuff, the overall look of that animation really blew me away as a kid. A few years back, I found the DVD for my own kids and it scared the hell out of them at first, but they love it now.

I have seen American Pop, but not as a kid. That one wasn't in theaters very long, as I recall. Watership Down scared the hell out of me as well! I wanted to be a cartoonist, comic book artist, and at one time a make-up FX artist. I think it was more the desire to make monsters than to be a total filmmaker, but as I got older, I started understanding the visual storytelling techniques of film and I wanted to try my hand in it.

You were fresh out of high school when you created the "audition" sculptures for Vinton Studios. Had you been creating sculptures throughout childhood and had you ever attempted to shoot any stop motion with them?

In my teens I shot a lot of experiments both on film and video. For animation, you really had to use film back in those days. The single-frame recording capabilities of videotape were never very good. So I started with Regular 8mm, then Super 8mm, then 16mm. I tried all kinds of techniques in those early experiments; double-exposure, split-screen with live action, space shots, a little bit of rear projection, replacement animation, foreground miniatures, glass shots... none of it was very good. But yes, a lot of sculptures and little animation puppets –and a lot of pyrotechnics!

Yours is an impressive resume. Was the transition from clay to digital animation difficult, or did it seem like more of a natural progression for you?

It was difficult! I did have some prior experience getting slightly familiar with digital animation. My buddies at Hash Animation in Vancouver, Washington had given me a copy of their software (Animation Master) to learn on, and I had fooled around a little. At the time I made the transition in 1997, I had my own small animation studio in Portland, Oregon

and I was producing and directing commercials and interstitials. I had worked on a couple of feature projects, but it was quite a shock to suddenly be neck-deep in a big initial CG feature within a large-ish studio. That was Antz, at PDI (newly a part of DreamWorks at the time) and there were all manner of difficulties.

What I discovered was that Hash Animation Master was sort of advanced! At the time, most of our animation at PDI had to be done using a spreadsheet. There wasn't really a graphical manipulator, or poser, until later on. We were using the new SGI 02 machines, which were new and hot at the time, and I was learning Unix. It was really diving into the deep end of the pool!

For about a year, I struggled and then suddenly had an epiphany. It was that even though it was dimensional animation, I was hurting myself animating sorta' straight-ahead like you would do in stop-motion. The former cel animators seemed to make the transition easier, and that was because they were working pose-to-pose and locking those key poses down across the animation controls. I was also learning that In CG, your brain is pretty much the only muscle you're using, and you have to be very disciplined in organizing your work to be edited and iterated on later. Before that, I had worked fairly intuitively and loosely in stop-motion, where you actually get to use your body in your work. The whole exercise of learning CG made me more disciplined in stop-motion as well—more cerebral.

In addition, starting in a very structured studio where everyone was a specialist in their specific departments, where animators only do animation, was sort of coming into CG backwards from how artists learn CG today. Instead of learning CG from the ground up, I learned from a specific discipline and have been working backwards over the years to become a generalist. That has been a really interesting learning process, and I'm still just a remedial modeler!

You mentioned to CGSociety that after owning your own shop you were tired of working alone in your studio and that you wanted to learn new things and be part of a bigger team. Please explain that need or desire as I think some creators, in regard to the bigger team aspect, might want to go in the opposite direction.

Well, it's a tricky thing. If you tend to be your harshest critic, which many artists are, then you start to become paranoid about being in a vacuum and you doubt the accuracy of your own judgment. And by-and-large, it's easier to learn from others around you than from written documentation—more so because an animator sitting next to you has searched out the exact same problem you're encountering and has already done the legwork to find that (usually undocumented) work-around.

Of course, you also want to be locked away in seclusion and work on your "masterpiece." Animators tend to take it to the extreme though and spend months and years in seclusion, working on their films. You just get tired of being alone, I think. You want the "esprit de corps" of working in a group. Then after working in the group, you want to be alone. It's a pendulum.

Your work on the Ted films is incredibly lifelike and seamless. You already gave a great description of the motion capture process to CGSociety, so I'll not ask you to rehash that. If you could though, please add any additional information, especially regarding the challenges your workflow presents.

Well our VFX supervisor, Blair Clark, was adamant that we not do anything "too different" that would result in a change in the character, so we took incremental steps. We improved the look of the real-time hardware rendered Ted (which is what the crew sees on-set) and the post-vis Ted model,

It's really a standard workflow. We capture the motion, do a little processing, sync up the takes and send them to the VFX houses that use animation layers to enhance the acting. They also keyframe the lip sync and a lot of other stuff. For our post-vis, we use a slightly older method, where we use a multi-skeleton rig that blends the mocap and keyframe.

The only thing we're doing different is we're being very mobile about the capture set-up, doing it on location when possible, and the actor in the suit is also the director. That makes a huge difference and it's an unusual situation. Seth (MacFarlane) is very specific about what he wants and is using the tech to ensure the performance comes out how he envisioned.

Some of the locations were extremely challenging, and rough on the gear. We had some bad weather in Boston and cramped conditions, shooting in tight spaces—tiny bars, the diner, Tom Brady's bedroom. We had the dedicated BOXX that runs the mocap system in a protective case, but it can only shield so much from heat, dust, dampness, and bumps. And every day, it was on-and-off the truck. For those tight shooting spaces, we would have to take it out of the protective cart and set it up free-standing on the floor of a location.

Were there greater advances in technology (coupled with your own experience) that made the second film any easier?

and we re-designed the way we use the suit so that application time was cut way down. Every second counts on a live action set, after all.

In the middle of our Ted 2 the production schedule, however, Xsens, the makers of our mocap suit, released a radically better version of their system which uses much smaller sensors with great improvements in their software. So we used that suit for a big musical number featuring Ted and a huge cast of dancers. For that one sequence, four different dancers wore the new Xsens suit, each of them playing Ted in different sections of the sequence. That was really challenging, fun, and a real test of Xsens' new system. It worked really well.

Describe the experience of working on the BOXX system. How does it differ from other systems you've used?

Always very reliable and never any hardware problems that I recall. I do recall having a power supply in a machine, it wasn't a BOXX, go out at The Orphanage. It was kind of scary, a big "zap" and a burning electrical smell.

What workflow problems has the BOXX systems solved? In toher words, what it has meant for you in terms of time saved, deadlines met, etc.

The BOXX unit that we purchased in 2011 on Ted has been in and out of my professional life for four years

now. Because Seth MacFarlane's team produced the new Cosmos, I ended up working on the same machine doing pre-vis for the series. And when Seth was doing a promotional commercial that was a tie-in between his film A Million Ways to Die in the West and Ted, we did a couple of mocap sessions for that. During production on that commercial, the system was being unloaded from a truck (I wasn't there) and was dropped off the back and onto the sidewalk. The monitors shattered, but the BOXX made it through just fine, with one little scar from the event. We've never had it serviced and it has been working in all sorts of terrible locations since 2011. I'm just amazed by its durability!

Discuss the future of your work and if you see BOXX as being part of that future.

The tools for CG have evolved and gotten more user-friendly, for sure, but the learning curve is steeper. The advances mean that there's just more to know. You have layered innovations upon innovations. Overall, entry-level CG is more accessible. But for the big, challenging stuff, be it feature films or 360/real-time/VR, the complexity just keeps getting raised. It's no longer " live action background with CG creature", rather it's "photoreal city with dynamic camera and digital double constrained to moving vehicle driving XYZ different simulation packages."

And sadly, the majority of consumer-level machines have been dumbed-down for the masses, made so that the UI is pretty, but inside it's gutless. Or rather, the tools aren't there to produce, they are media consumption devices. In other words, many machines to view beautiful images, but very few that can create them at a high level. It's a weird time!

Editor's note: Since this interview, Webster has purchased his own BOXX APEXX 2 3402 workstation featuring an overclocked, eight-core Intel® Core™ i7.

CGSociety referred to you as "a true master of the art of mocap." That sounds accurate, but for business card purposes, I'd suggest "Mocap Master." Do you feel like you have this process mastered or, in your mind, is there always more to do and learn?

I am definitely NOT a "mocap master." I have been on the user end of mocap for a long time and of course I have a lot of experience specific to the Ted films and the Xsens/MVN system, so there's that. If you were to put a pile of optical mocap cameras in front of me and ask me to set-up a volume I would be helpless. I'm an animator benefiting from innovations in hardware and software that make mocap more accessible. ■

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