

DATRON

Making Things

Customer Case Story: Autodesk Technology Centers

Tips and Insights on Setting Up In-house Prototyping

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About This eBook

Autodesk established a network of technology centers to provide a unique Industry 4.0 experience for residency teams from various industries. DATRON CNC machines were part of the effort to provide rapid prototyping capabilities.

This eBook is both the case study and a reflection on that journey. We spoke to members of the Autodesk Technology Centers team to gain insights on why—and how—to set up in-house prototyping.

In addition to a behind-the-scenes look at how Autodesk established their residency program, this eBook features:

» Practical tips on setting up prototyping in-house

» Autodesk Technology Center Resident Profiles

» DATRON Prototyping Customer Profiles

» How the two companies continue to build on the promise of Industry 4.0

DATRON hopes to equip the next generation of engineers, designers, and brands to push the industry's potential.

If you're interested in participating in the Autodesk Technology Centers Residency Program, or would like to learn more about DATRON…
please reference the information at the end of this eBook. >

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SECTION 1

Introduction

Designers, makers, and engineers are developing new methods for fabrication and are creating things today that weren't possible 10 or 15 years ago.

Historically, the process of taking a digital design and creating physical parts and products made with real materials was complicated by physical limitations, like the number of unique parts required to make complex shapes.

By now, fabrication methods have surpassed the capabilities of digital design tools, expanding the possibilities of what can be built, how it can be built, and how to design for it.

Additionally, 3D modeling—and its implications on real world manufacturing—is changing very rapidly. Emerging tools allow designers to collaborate with their design programs to make smart decisions, leverage data to inform design choices, and integrate fabrication constraints earlier in the design process. As our material choices evolve and new fabrication methods emerge alongside an increasingly fluent digital workforce there are opportunities for the manufacturing industry to meet the future head on.

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Expanding What's Possible

Current 3D modeling allows for completely new design approaches like computational design and the Autodesk Technology Centers team is learning how to harness their tools (both digital and physical) to optimize them for specific purposes.

Companies like Autodesk are unlocking the ability to create previously incalculable designs while the industry is also expanding its view beyond design and manufacturing to workflow optimization; or how to create products more efficiently and effectively.

Designers and engineers are focusing on finding answers to practical questions like:

» How does the weight reduction of a part impact the amount of jet fuel used across an airline fleet?

» How can the design of a bracket improve structural integrity with less material?

» How can optimizing tool paths and cutting parameters reduce cycle time and tool wear?

When these questions can be answered on a large scale, with computer facilitated decision making, great new opportunities arise. Designers and engineers are setting their tools—and sights—towards new and different metrics to drive measurable outcomes that will impact the manufacturing process and Industry 4.0.

Making Industry 4.0 and Beyond

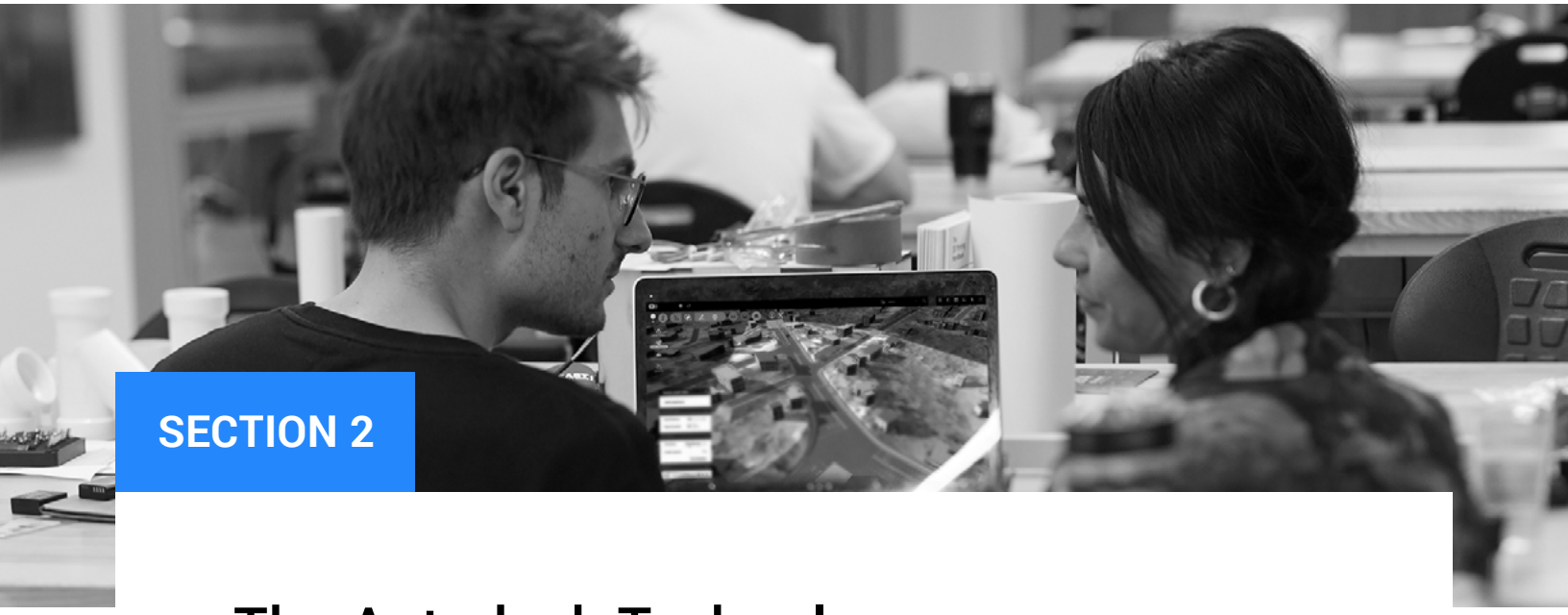
If you've ever driven a high-performance car, admired a towering skyscraper, used a smartphone, or watched a great film, you've already experienced some of the possibilities provided by Autodesk software.

Autodesk has strengthened their software and services by collaborating with like-minded organizations to deliver a comprehensive end-to-end manufacturing solution.

Digging deep into Industry 4.0, Autodesk advances the future of manufacturing, automation, and how to modernize work environments to meet the needs of people who want to make things. Anything.

Part of this advancement involved establishing the Residency Program at three Autodesk Technology Centers across North America to provide the training, tools, and space for both small startups and big brands to solve tomorrow's problems, today.

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SECTION 2

The Autodesk Technology Centers Residency Program

Why Start a Residency Program?

Autodesk is a software company motivated by a mission to help people move from design to making—seamlessly—across industries.

The Autodesk Technology Centers catalyze new possibilities for making through fabrication shops, an open-innovation Residency Program, and engagement within Autodesk. The Residency Program brings together dynamic innovators and supports them to shape the future of fabrication across industries.

Who Are Autodesk Residents?

The technology centers in Boston, San Francisco, and Toronto offer a Residency Program that provides open workspaces for teams from industry, academic, and startup communities. By striving to have an equal representation from these three sectors, diversity of thought and problem solving techniques lead to better outcomes for all residents. Autodesk also uses the technology centers to expand and deepen customer relationships. Customers can use the facility to solve problems, explore new fabrication strategies and experiment with new ideas.

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Residency proposals are reviewed on a rolling basis, and selected participants are provided with dedicated project areas in a technology center, access to advanced fabrication machinery, training, and connections to industry experts and the technology center community. The Residency Program provides a kind of digital fabrication playground without the prohibitive costs of entry.

It's About Community

The residency is an inclusive community designed to empower participants, embrace diversity, and reject intimidation.



The goal is to democratize digital fabrication and train diverse minds. The space was created not only for the engineer, but also individuals who present a range of learning styles and techniques.

Ultimately, the spirit of the residency is connection in support of key and lasting collaborations.

Set Up to Share

The Autodesk Technology Centers represent an investment in establishing a community based on shared insight, creative problem-solving, and collaboration in the name of innovation. Autodesk offers tours of the facility to showcase the sharing of ideas in a collaborative, open concept workspace.

The Technology Centers model on a regular basis what an ideal workspace might look like for those who are considering bringing prototyping in-house.

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SECTION 3

Why Bring Prototyping In-house?

Current industry trends show more companies are determined to bring prototyping in-house to optimize workflows, refine design iterations, reduce lead times, and protect intellectual property (IP).

And while securing IP in particular is huge, reducing the amount of time to get a product to market is also more important than ever. But these are only a few obvious reasons to invest in prototyping in-house.

Let's take a look at a few others…

A Philosophical Argument for Prototyping In-House

The magic of prototyping in-house results when you take a digital concept—without parameters like gravity or the complications of real-world challenges like material inconsistencies—and you make it real.

The advantages of investing in prototyping in-house include the following:

Build Design Skills Quickly

In addition to the feelings of inspiration and accomplishment that come from building a part with your own hands in real material, accessing on-demand prototyping tools during the design process teaches you a great deal about your design. Compared to relying on outsourcing that fabrication process and letting the fabricator learn a lot about your design, prototyping in-house is the ideal choice.

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Reveal Unseen Opportunities

Prototyping in-house encourages cross-disciplinary exchanges that benefit the entire design process. When you bring various disciplines together, new opportunities may emerge, contributing to faster problem solving, streamlined workflows and a quicker adoption of technologies and tools, which in turn, leads to expedited processes and new possibilities.

Inspire Excitement in Your Process

When considering prototyping in-house, it's not enough to just think about how to get from concept to reality and the tools required to make the process easier. Ensure that the people on your team understand the value of prototyping and the potential impact it can have on your processes.

In other words, if you only talk about the logistics of setting up in-house prototyping without presenting its game-changing possibilities, it might simply look like another expense.

Emphasizing the potential of what in-house prototyping can produce will get people on board; inspiring that excitement is essential to establishing a strong in-house prototyping process from the outset.

Start Strong

Setting up your own prototyping lab with new people, processes, and technology might seem daunting. Ultimately, "humanize" the process as much as possible.

Focus on the people involved and the resources available to you. Work with your team to build confidence, earn early wins, and achieve success at the start. Collaborate with other companies in your region or community by building bridges to advance both your own goals and knowledge base—and help your industry take important steps forward.

When you're just beginning to prototype in-house, there are a few practical things you can do to help establish strong processes from the outset.

These might include:

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Achieve Early Success

After you've created excitement with your team about bringing prototyping in-house, consider the experience you're about to create—especially when embarking on this process for the first time.

Avoid overwhelming them by beginning with laying out a simple workflow. By starting from the design and working towards the finished part, you can illustrate the process of prototyping in-house clearly. Choose something your team is already working on day-to-day to demonstrate the accessibility and ease of both the process and the equipment.

Make Things People Want to Interact With

The goal is to make things that people want to interact with in a useful way and prototyping is the most authentic way to test that. A physical prototype allows you to look at a part from all angles and feel it in your hands, bringing you closer to the experience of the end user.

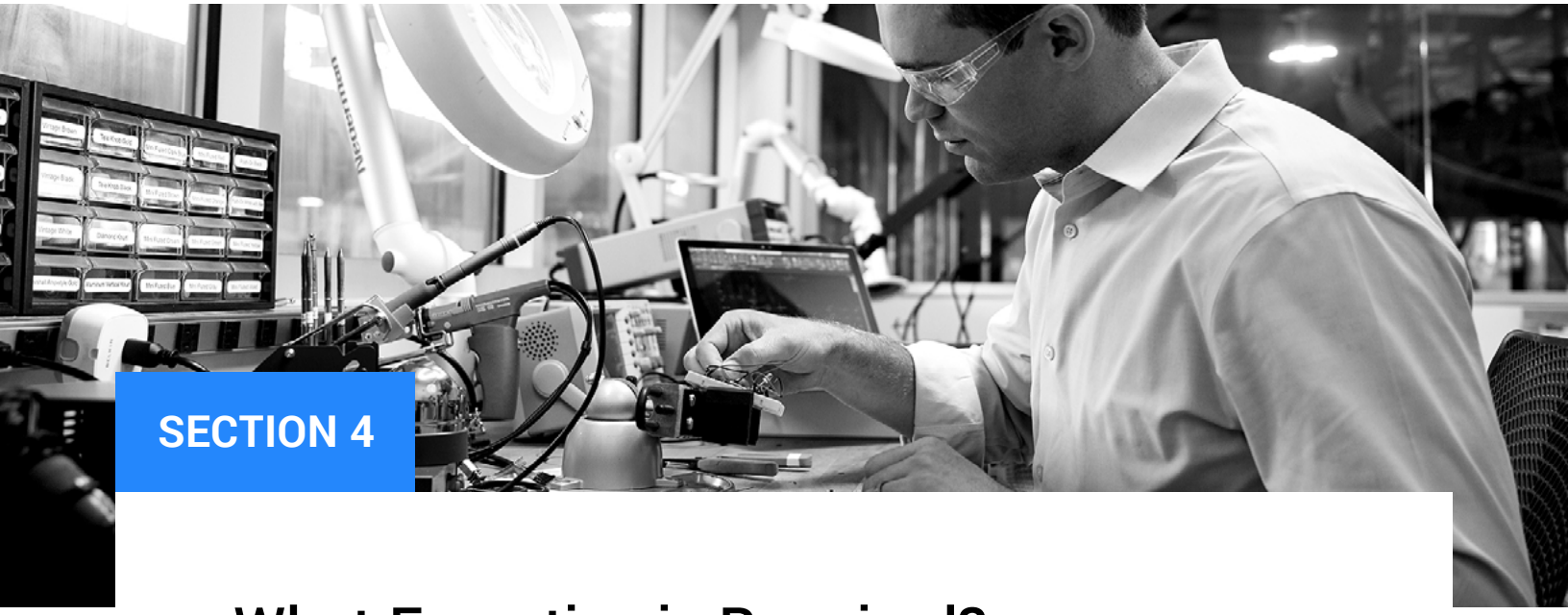


Make it Easy to Start

To support excitement, early success, and eager adoption, it helps if your prototyping process and tools are turnkey and easy to use. New users need an accessible entry point in order to feel empowered and build confidence.

Therefore, it's important they have a swift, positive feedback loop (first project) that will reinforce the importance and value of using the tools, which will motivate them to learn and use additional tools (build confidence) with increasing complexity.

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SECTION 4

What Expertise is Required?

Speaking of increased complexity, are users required to demonstrate a certain level of expertise in order to embrace and master the skills necessary for in-house prototyping?

Not at all.

In fact, the Autodesk team members we spoke to observed that the residents who succeed at the technology centers are those who stay curious and continue to learn, which builds their confidence using the software, tools, and machines.

In other words, expertise is not required, but a willingness to learn, practice, and advance professional prototyping skills certainly is.

Tip 1: Support New Users and Let Them Take Their Time

When you see new users, who seem really intimidated by machines, remember that as long as they're using them safely, it's okay to take time. Also be supportive of users who are really afraid to break things and help them develop a healthy respect for the equipment.

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Quickly Getting Up to Speed

Of course, you want to support new users and provide them ample time to get comfortable with the machines. However, you also have a vested interest in getting your staff up to speed on in-house prototyping processes to support the success of your operation.

To that end, it helps to provide a Quick Start Guide to keep teams safe and prevent damage to the equipment. You can think of this step as a smart shortcut, but also a way to present literature on best practices for optimal operation of the machines.

For instance, despite the intuitive interface of a DATRON, there are important aspects of using the machine, like powering it down at the end of the day, that require education and communication.

This is where having guides approved and published ahead of time ensures that the requisite information is delivered to everyone in the same format, keeping your team on the same page—literally.

QuickStart Guides are meant to support the hands-on training by walking a user through individual machines step-by-step, including the user interface, safety features, essential order of operations, and how to process material using the equipment.

Tip 2: Keep it Simple

When creating Quick Start Guides or other training materials for new users on prototyping equipment, focus on simple, human language. Sometimes jargon or more academic language can be daunting for new employees or other, non-engineer team members. Try to use inclusive language and promote thinking in simpler terms. Avoid “lawyer speak,” using vocabulary that only a certain subset of your team will understand, or overly complicating simple concepts.

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How DATRON Makes It Easier

We provide clear steps and easy-to-use documentation for new users to learn how to move from loading a program, to setting up the material, to cutting the part. The intuitive design makes it especially welcoming for new users.

Hands-On Experience Is Key

In addition to providing turnkey tools, accessible processes, and quick-start guides, effective training must also factor in a person's background and experience.

For example, a lot of architects and designers who primarily work in a virtual CAD space and may not have a lot of hands-on fabrication experience with a range of materials and processes.

Some of these users haven't had the opportunity to experience the demanding physical environment where one must pay attention to not only what they're doing, but also everyone else, for safety reasons.

Tip 3: Get Out of the Office

If possible, get some of your training outside of your work environment, so you're focused on learning the control, CAM software, or machine. If you're being trained in your work environment, you might get caught up in your day-to-day activities where it's easy to get interrupted and distracted.

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How DATRON Helps

To help with this, we offer training at one of our locations, and in-house with our customers—before they get the equipment.

Thankfully, that's something that can be taught through hands-on experience.

With something like a CNC machine, you're not just watching how the machine is cutting, you're listening and learning what the machine sounds like when it's running.

Part of bringing in equipment to create a prototyping environment is figuring out how to train new users in awareness. This is where the practical experience, provided by spaces like the Autodesk Technology Centers, comes into play to build a solid foundation and community of users.

Create a Clear Pathway of Learning

Autodesk's CNC Pathway is the bridge to learning the CNC machines. The Pathway spans three days, which are broken into four-hour blocks. This intensive dive introduces users to the steps required to turn a 3D drawing into the G-code that a CNC machine like the DATRON can use as instructions.

After taking the CNC Pathway, the Autodesk Technology Center workshop team provides residents with machine-specific trainings. For example, the DATRON class takes about three and a half hours and wraps up with the requirement that residents make a certification part upon class completion in order to prove what they know and that they are following our best practices.

At this point residents can start making their own parts; however, residents never run parts without rigorously testing their CAM in a simulation environment.

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Test in a Simulation Environment

The CAM environment is included with every install of Fusion 360. Toolpath simulation is always available and always free to all users. Autodesk puts a heavy emphasis on the importance of the virtual environment and necessity to protect the operator and machine.

This provides a chance to uncover challenges before working on an actual CNC machine. The simulation environment encourages experimentation to find out where things might go wrong, helping users avoid encountering these instances at the actual machine.

Consistent Training Builds Confidence

One important aspect of the Autodesk Technology Center training curriculum is unifying the training with a consistent visual language. It's important for new users to go from one class to the next and have a cohesive experience where all trainings are offered under one roof and connected by a thread of continuity.

> **"The whole program is geared towards resident success. We don't want to just make the machines and space available; we want to empower residents to use the equipment on their own and create a working environment that supports them to problem solve and focus on creation and innovation."**
>
> ***- Stefanie Pender, Senior Workshop Supervisor, Autodesk Technology Centers***

Part of this involves acknowledging the shift in mindset required to move from a digital modeling environment to a physical prototyping space, as well as the value of mastering G-code. And while consistency is critical to this training process, open communication in an environment that encourages questions from residents is also key.

The Requisite Shift in Mindset

It's important for designers and engineers who may have spent a lot of their career at a computer, to understand there is a shift in mindset that takes place when moving from a digital modeling environment to a physical space.

It's immensely helpful to physically get your hands on actual materials—it helps you tune into how the material properties affect what you're doing. Unlike strictly 3D modeling, you're not just plugging materials into a virtual environment where a design might look good, but it's impossible to machine or manufacture because you don't have the right tooling to deal with the material.

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The Important In-Between: Getting Behind G-Code

A critical step of your workflow, which follows drawing and modeling, but precedes cutting, is generating G-code. While it may not be glamorous, G-code is what makes your tool do what you want it to do. This step is fundamental to how your drawing translates into a physical object.

A common misconception of CNC machines is that you can go from drawing your part on the computer to sending it directly to the machine for milling. That's generally not the case. After you've drawn your part, you need to come up with instructions for the machine so that it knows exactly what to do.

Autodesk software helps designers and engineers make G-code happen in the CAM environment. The goal is to help users make good decisions when producing a part to prevent tool breakage and machine crashes.

> **"Similar to prototyping, we aren't running thousands of parts where machine downtime results in a catastrophic impact on productivity. We're making more bespoke parts and prototypes; generally speaking, the residents are highly motivated to save money by understanding these processes and making the parts themselves."**
>
> ***- Stefanie Pender, Senior Workshop Supervisor, Autodesk Technology Centers***

When designers and engineers are making parts and prototypes, they tend to reduce the complexity of drawings to increase the manufacturability of their parts. This means it's ultimately going to cost them less in the long run since the parts are cheaper to make at scale. As a bonus, they gain understanding of how things are made.

Tip 4: Leverage Small—and Quick—Wins

To improve adoption and become productive on new prototyping machines, new users need to have early success with creating physical prototypes. Building this confidence quickly can give them the assurance and inspiration that can drive them to tackle harder, more complex projects. It also helps get a physical part into a designer's hands quickly, as this can fuel them towards future success in leveraging prototyping for faster design iteration.

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How DATRON Makes This Easier

Our machines feature a more intuitive interface than any of the larger industrial machines, ideal for inexperienced machinists or those transitioning into CNC work.



Finally, it's crucial that you create an environment where it's safe to ask questions. Everyone who's involved needs to understand that there are no bad questions and that having critical reasoning skills can help prevent users from making choices that might injure them or damage the equipment.

Cut the Learning Curve with the Touch Screen

One of the goals of the DATRON neo and its next control was to open up accessibility for the non-machinist. A lot of designers and engineers see these massive machines, with a sea of knobs and buttons, and are immediately intimidated.

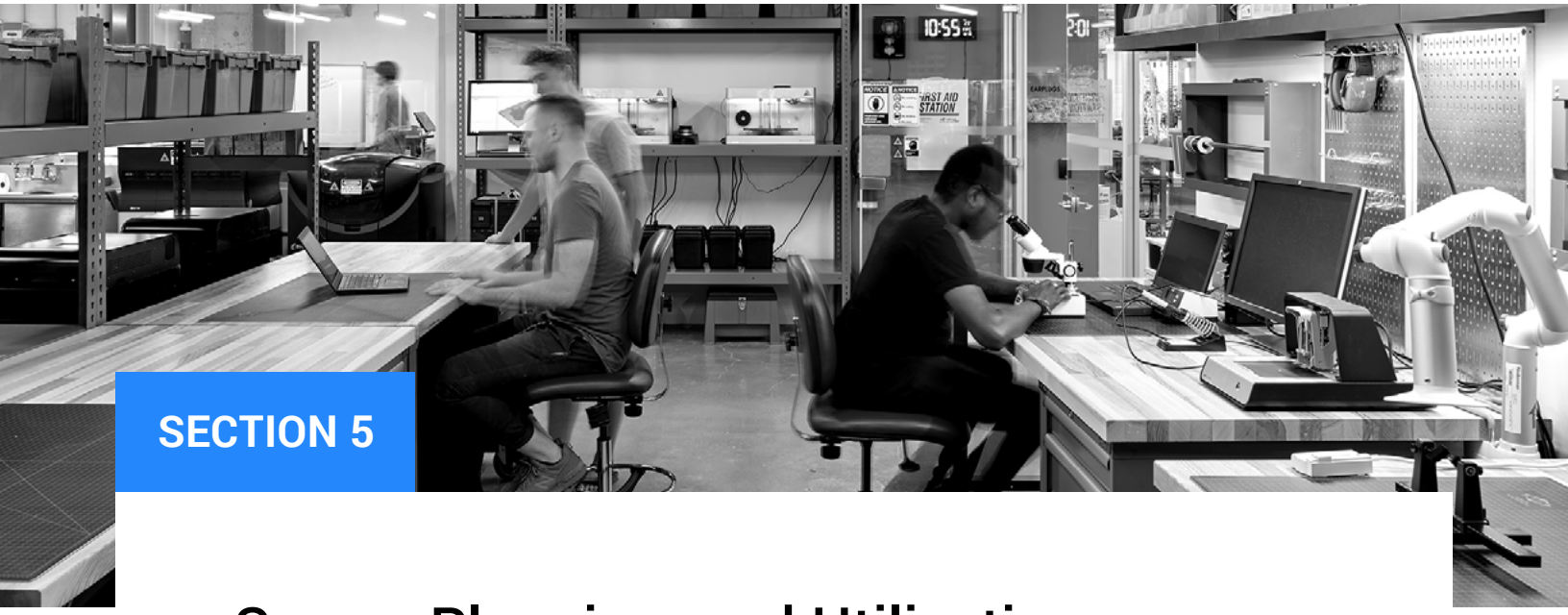
At DATRON, we understand this dismay and has taken a different approach to CNC milling machines by eliminating the intimidation factor. DATRON's touchscreen interface and tablet-like style feel familiar to even first-time users, which supports user confidence and easier, faster workflows.

Know Your Users' Experience Level

The Autodesk Technology Centers team reviews applicants' resumes and portfolios to determine their level of machining experience. Regardless, everyone goes through the same training; even if they've had 20 years in a machine shop.

To build from the same basic knowledge, it helps to know when a user is more experienced or needs more support getting started.

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SECTION 5

Space, Planning, and Utilization

Planning a productive prototyping space depends on the parts you're planning on milling, what machines you'll need, the amount of material you'll require ready access to, as well as the general workflow.

For example, in the early planning stages of the technology center in Boston, the Autodesk team recognized that the projects coming in would be pretty large in scale. This informed the amount of space and the types of material handling capabilities that would be required.

For instance, architecture and construction firms needed to be able to conduct material studies and build segments of structures at full scale, which meant the technology center required a substantial footprint and large-scale machinery.

Autodesk developed a full-service operation from ideation and modeling to machining/fabrication in order to realize completed prototypes, from raw material to having a piece leave the facility ready for installation.

Tip 5: Always Allow for Extra Space

Whatever you believe your prototyping square footage will be, make sure to budget plenty of space for backend infrastructure, material, and equipment storage space.

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How DATRON Makes This Easier

DATRONs are easy to move in and out, but you wouldn't just swap out a machine unless there was a reason to. With a DATRON, support is always available, and updates are offered on a continuous basis, so users don't actually have to swap out the hardware as frequently.

Inherent with our design, a DATRON has a more compact footprint than a typical CNC machine, so installation is easier, and more floor space is saved. In addition, a DATRON doesn't need a flood coolant system or chip conveyor. So, beyond just the footprint, you also don't need to save room for any of the typical add-ons.

Without identifying the prototyping plans up front, Autodesk would have run the risk of running out of space, causing the facilities to impede process.

The Right Equipment in the Right Space

When you're planning a space for making prototypes or products, you need to think long term. The technology centers cater to both large- and small-scale projects, which challenged them to determine what equipment would fit (literally) the space and budget.

Autodesk needed the ability to reconfigure the workspace quickly. Since most of the machines require support equipment (lasers require large power supplies, mills require chilling and coolant systems, electrical systems, and vacuum systems) these factors scale with the size of the equipment.

In order to be at the forefront of the industry the Autodesk team needed to be able to cycle all the equipment in and out with some regularity. Many of these machines weigh in excess of 10-15 tons, which requires detailed planning for moving them in and out of the building.

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> **"Since the technology center in Boston began with the goal to be able to make just about anything in architecture and construction, we focused on foundational fabrication methodologies, which meant we had to consider format size as well."**
> ***- Adam Allard, Senior Workshop Manager, Autodesk Technology Centers***

Originally, the team started with a 5' by 10' work envelope, which was key to specifying space. The material and size informed choices around equipment: the right size, the right capability, and the right capacity. It also drove discussions on how to get materials in and out of the space.

Think About your Workflows

At the planning stages, being able to get the work done can often get overlooked. Everybody wants the capability to make almost anything they can think of, so they often stack their lab or space full of equipment, resulting in tremendous prototyping potential, but inadequate space to actually do the work.

Once the Autodesk team had the equipment specifications and building design finalized, construction began. From the very first day when it was just a room of columns, the team had the opportunity to determine where every light, every plug, and every airdrop went.

This allowed for ample space to support workflows, safely and effectively.

Utilities: Think Bigger

Another key to running your in-house prototyping space successfully involves securing adequate power and utilities to support your operation. You need to plan beyond the machines, and consider how to support them with power, air, vacuum, and HVAC.

And remember, you'll always need more space than you initially thought.

Tip 6: Start Learning Early

When bringing a CNC machine in house, take time before your delivery to start familiarizing yourself with your CAD/CAM software so you can hit the ground running.

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How DATRON Makes This Easier

Autodesk and DATRON have worked together over the years to develop and maintain post processors to make the process of exporting your toolpaths and cutting parts seamless.

Planning Material Storage

When space is at a premium, you need to plan for certain accommodations, like how much material users can bring into the space.

Questions to ask include:

» Where are users going to put their material?

» How long are they going to keep it there?

» What are they going to do with their waste material?

Planning for material storage is a great way to help optimize manufacturing and prototyping workflows, while reducing waste.

Maximum Flexibility, Smallest Footprint

When planning your space, consider which of the existing technologies is right for you, with 3D printing and CNC machining being two of the most popular for prototyping. A CNC machine provides more flexibility and capability when it comes to the choice and selection of materials.

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Prototyping Software

Autodesk tools were created to help designers and engineers make anything imaginable.

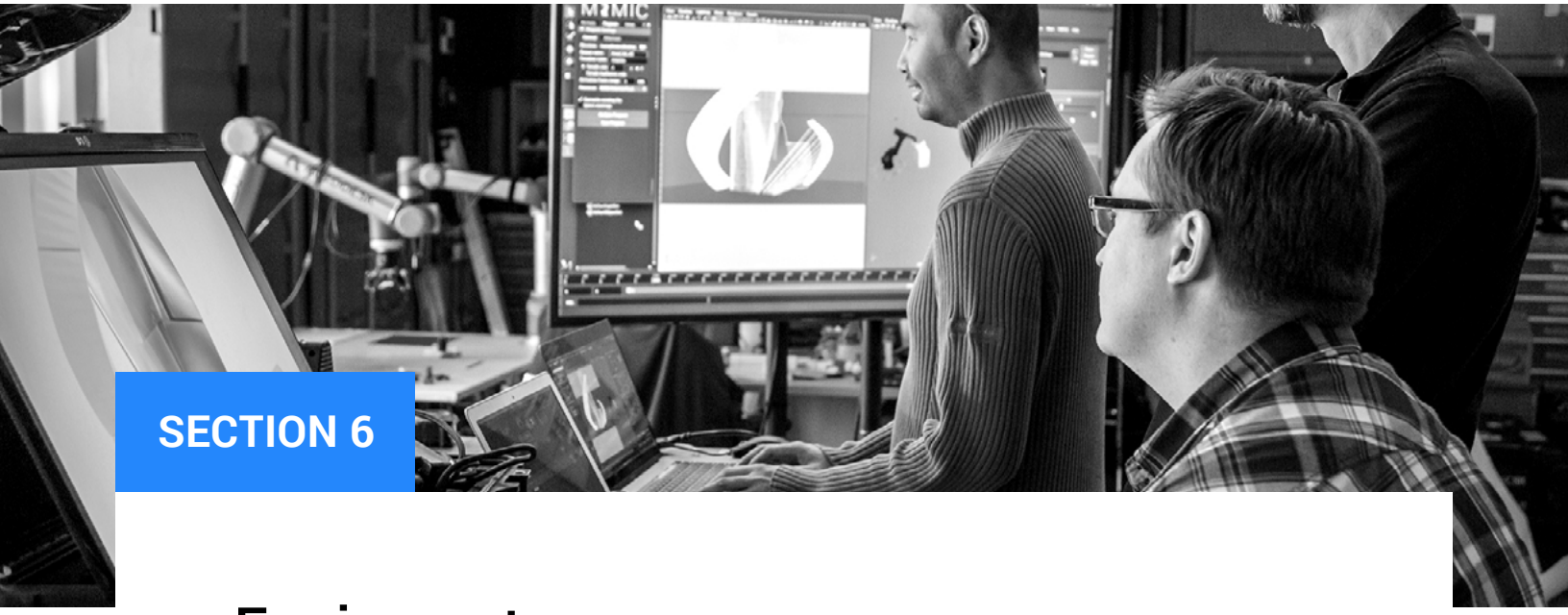
By plugging Fusion 360 into the front end of your prototyping workflow and using DATRON on the backend, you have a turnkey solution for prototype development.

Fusion 360 combines CAD and CAM into one digital tool, which allows you to use a single platform to design your part, create the CAM files, and load them onto the machine—a process that can take as little as five minutes.

Structure is an added bonus. An established workflow makes it much easier for you to grow and train your team.

For example, at the technology centers digital tool libraries in Fusion 360 are provided for all the CNC machines onsite. When you pick up a different tool, it's already in the software so you can simulate and verify your tool path to cut your part without any unintended collisions with the machine or tool.

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SECTION 6

Equipment

A critical component to setting up a prototyping lab is making sure you choose the right equipment matched to your specific needs.

There are many facets to deciding what equipment—and what capabilities—to bring in-house. Beyond functional requirements, you have to consider significant issues around safety, controllability, training, and maintenance. Some of the larger pieces of equipment are very maintenance intensive, and it can be a full-time job keeping everything running and within specification.

What equipment you choose depends on how you're prototyping and manufacturing. For different applications, look at additive, subtractive, and hybrid processes. Those three pillars will help you arrive at an understanding of how to build capability in your space.

Subtractive

Subtractive is typically the easiest choice, since it's been around the longest.

At the Autodesk Technology Centers, the team focused on milling and turning. They looked at machining centers: both three and five-axis, as well as turning centers, with and without live tooling.

The Autodesk Technology Centers determined for their three-axis machining center a 50" x 30" x 30" work envelope was the right fit. In addition, they wanted five-axis capabilities because of the flexibility.

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Additive

The additive side of manufacturing and prototyping experiences new and different innovations on a regular basis. Two materials used in additive manufacturing stand out: polymer and metal. Polymer has a relatively low barrier of entry.

On the metal side, there were a couple of different options to consider, like a Desktop Metal machine, which would be an economical option. While it's not a machine that actually gives you a truly usable metal part—it's "metal-like," giving you an idea of the finished part, but without the strength characteristics of a metal. Similar to the metal injection mold process, it has its place within prototyping industries for people who want to get quick insights and proofs of concept.

Hybrid

Hybrid machines leverage both additive and subtractive processes, so the user would be able to do metal additive initially, and then subtractive after. An all-in-one system, utilizes a DED (direct energy deposition) process. Basically, a MIG welder on a machining center builds up a part then post-machines it afterwards.

Everything above was focused on creating metal parts and prototypes. If you get into other materials, you would follow a similar decision-making process.

Tip 7: Don't Buy Sight Unseen

Some people look at a spec sheet, check the boxes, and buy a piece of equipment. With smaller equipment, this works. But with larger machines, you can really get stuck. Perform due diligence and research equipment before you buy.

Invest the time to go to the manufacturer and see the machine actually run—preferably on a sample of your own part or a similar process. Don't go with the initial machine. Ask a lot of questions, and get feedback from people who actually use the equipment.

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How DATRON Makes It Easier

Our vacuum tables make workholding simple and reduce setup and finishing time—you don't have to remove tabs or deburr your prototypes. In addition, DATRON next's camera probing interface makes locating your workpiece fast and simple.

Also, on a DATRON, installing fixturing is fast and precise - a high precision polymer concrete frame features precisely located mating conicals for fixturing to be installed quickly and repeatably, as opposed to a machine with a t-slot table on which a fixture must be trammed in each time it is installed.

The DATRON tool changer is covered during machining, keeping tools clean and ready to be used. On top of that, we offer ToolAssist, an externally mounted tool changer that allows storage for up to 143 tools. ToolAssist can even be loaded while the CNC mill is in operation—ideal for prototyping and production alike.

Finally, we provide North American support for both applications and service, so you can always connect with an expert to help you out.

Prototyping Flexibility with DATRON

When you're just starting up a prototyping lab, flexibility is important. This makes the DATRON M8Cube an ideal choice, with the neo being another excellent option, depending on your lab and part sizes. The work envelope is smaller on a neo, but it's still a very capable machine, able to fit through a standard size doorway.

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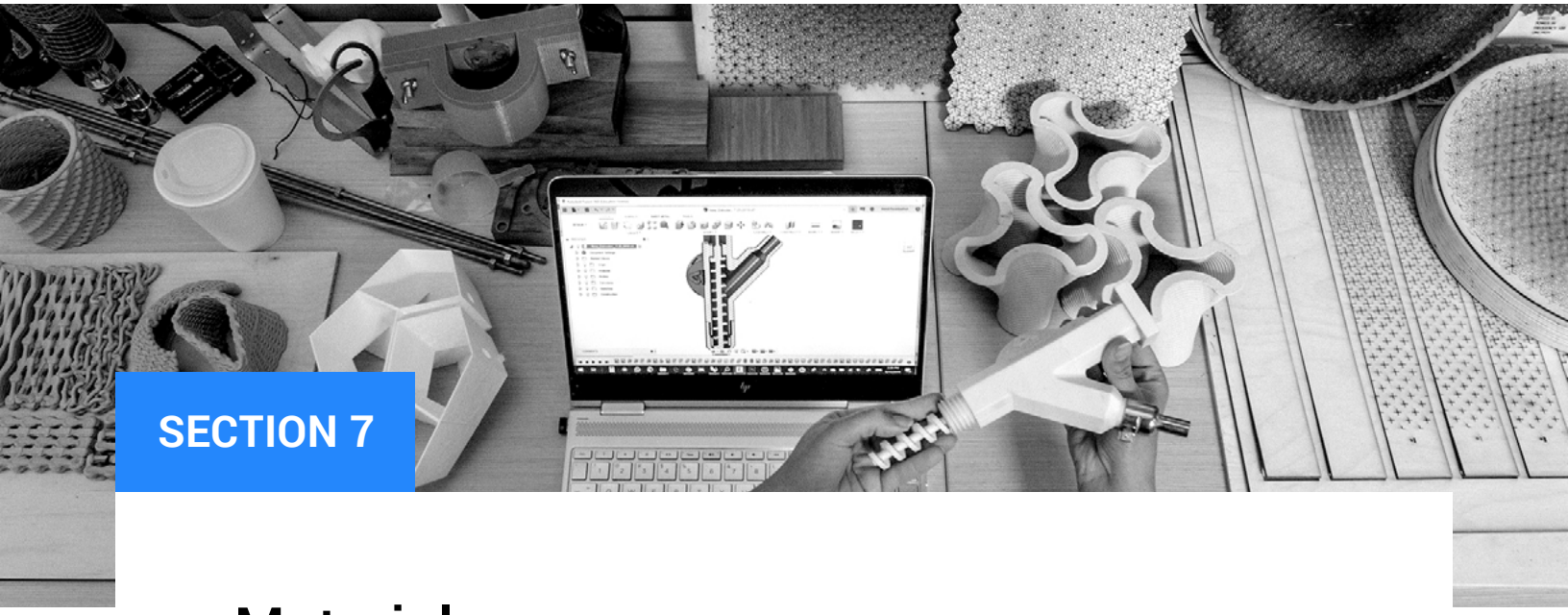
Evaluating rapid prototyping equipment involves identifying the quality of the part you want to create. For a relatively low investment, you can buy an entry-level 3D printer. But if you're planning to prototype a consumer device or a part that you expect to manufacture and sell high volumes of, iteration can actually take longer with a 3D printer. Since you might not get a good representation of what your final product will be in terms of material or quality, you may find yourself disappointed with the results. Furthermore, depending on the 3D printing material, your part may only be useful for proof of concept.

This is also true for lower-end CNC machines.

If you're creating a rapid prototyping environment and you're using a small desktop CNC machine—even if they seem to have most of the same specs on paper—one of the biggest hidden factors is that they require a lot of tinkering to achieve high quality parts or tight tolerances. These hobby machines require a certain level of skill to maintain, manipulate, and provide the results most designers and engineers are really looking for.

With a DATRON, you get to a high-quality finished part faster, with repeatable results.

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SECTION 7

Materials

When you're making prototypes, you really need to think about which different materials you intend to use. Ask yourself questions like:

» What are you trying to accomplish with the prototypes?

» Are you looking for a close approximation?

» Do you want something close to—or the exact—finished part?

» How fast do you want to iterate?

» Finally, how much wear and tear will your prototypes endure?

A Wide Breadth of Materials Requires Flexibility

Prototyping machines work with different materials like plastics, foams, plywood and ferrous and nonferrous metals—from magnesium, aluminum, titanium, hardened steel, tool steels, composite structures, including conventional composites like carbon fiber, Kevlar, and fiberglass—as well as non-conventional and experimental composites, different foams, and different natural fibers like flax and hemp.

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Prototyping in Volumes

When prototyping, 3D printing and plastics are very accessible and user friendly, but they don't always fulfill the need. For more durable prototypes, aluminum is great to prototype with because it's lightweight, easy to work with, and relatively inexpensive. And even if you're making prototypes for something that's going to see high repetitive stress or vibration, you can build a prototype in aluminum that will prove durable enough for testing and iteration.



If you're manufacturing components for prosthetic limbs, for example, and you need to build a proof of concept that's going to be used for a few hours, you could build that prototype out of aluminum.

Ultimately, since it will be utilized by the patient for years, you'd manufacture the finished piece using a medical grade, high-end alloy.

Tip 8: Consider the Total Life Cycle

Before purchasing equipment, think about the total life cycle of equipment and materials: the material costs, and safety management with equipment and materials. For example, with SLS 3D printing you'll need to think about how you'll safely take care of the hazardous materials from those printers.

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7



How DATRON Makes It Easier

Things like our unique probing system and integrated vacuum table really support this by making material set-up super easy—a place where a new learner might get bogged down and frustrated before the process even really gets going.

Moving Materials Around

When you're setting up your prototyping lab, keep in mind that you need the ability to take delivery of the type of materials your work requires, at the scale you need, which can be extremely large.

At the Autodesk Technology Center in Boston, there is a large gantry crane installed in the facility and the team utilizes forklifts, pallet trucks, machinery rollers, and a variety of backend logistics equipment.

This all ties back to planning and the need to have the appropriate amount of space to move materials around and store them, and provide adequate space for the people who are trained to operate your equipment.

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SECTION 8

Safety

Material Safety

We can't overstate the importance of safety when setting up and working in a prototyping environment.

For example, the Autodesk Technology Centers have an in-house environmental health and safety (EHS) manager, and before any group brings materials on-site, they have to obtain and submit the safety data sheet (SDS) for approval.

It is important to have very tight controls on:

» What is brought into the space

» Whether or not it's hazardous

» Necessary handling precautions

» What fumes or particulates can result from the different processes

» Safe disposal of waste material

Beyond those controls, work to ensure there is enough space around the equipment, fire extinguishers are accessible, and first aid kits are in place.

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At DATRON, we take safety one step further and have fully interlocked machines so users can't run the machines without the cabin door closed and locked.

Having the right people to enforce safety precautions and training to use the safety equipment is crucial.

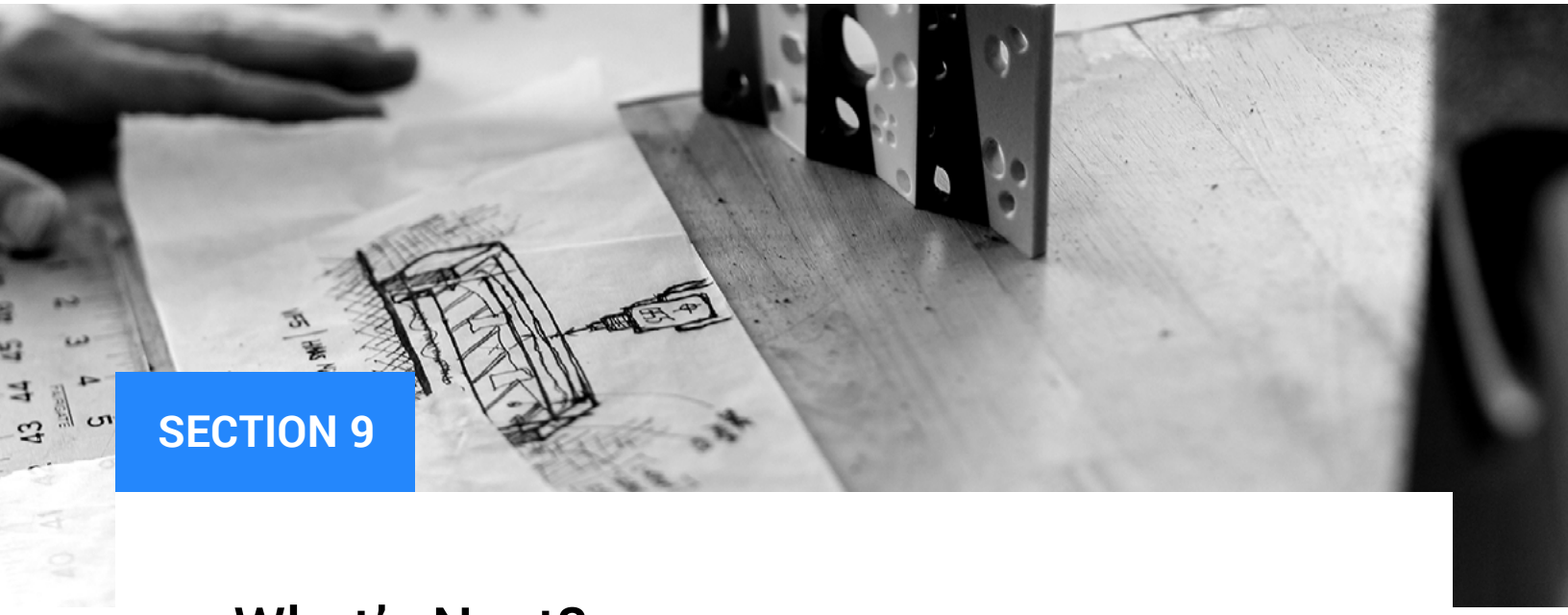
Safety Training

Regardless of how safe a machine is, it's important to teach users how to operate the equipment safely. The Autodesk Technology Centers provide trainings in a tiered process; the first training is online and covers general shop specifics like what PPE to wear. An online training platform is used to ensure that everyone has gone through the required trainings and understands the fundamentals.

Then, once a resident comes into the space, they participate in an on-site safety orientation with the EHS manager. They walk through the shops, talk about every piece of equipment, and identify the hazards of each.

Create the safest working environment possible so users can focus on what they want to achieve.

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SECTION 9

What's Next?

The future of prototyping, product design, and manufacturing presents some very exciting opportunities for Industry 4.0.

For example, manual processes like capturing assembly procedures, the ever-shifting bill of materials required, and process and quality data are becoming digitized. Some of the residents at the Autodesk Technology Centers are advancing the field with projects that include:

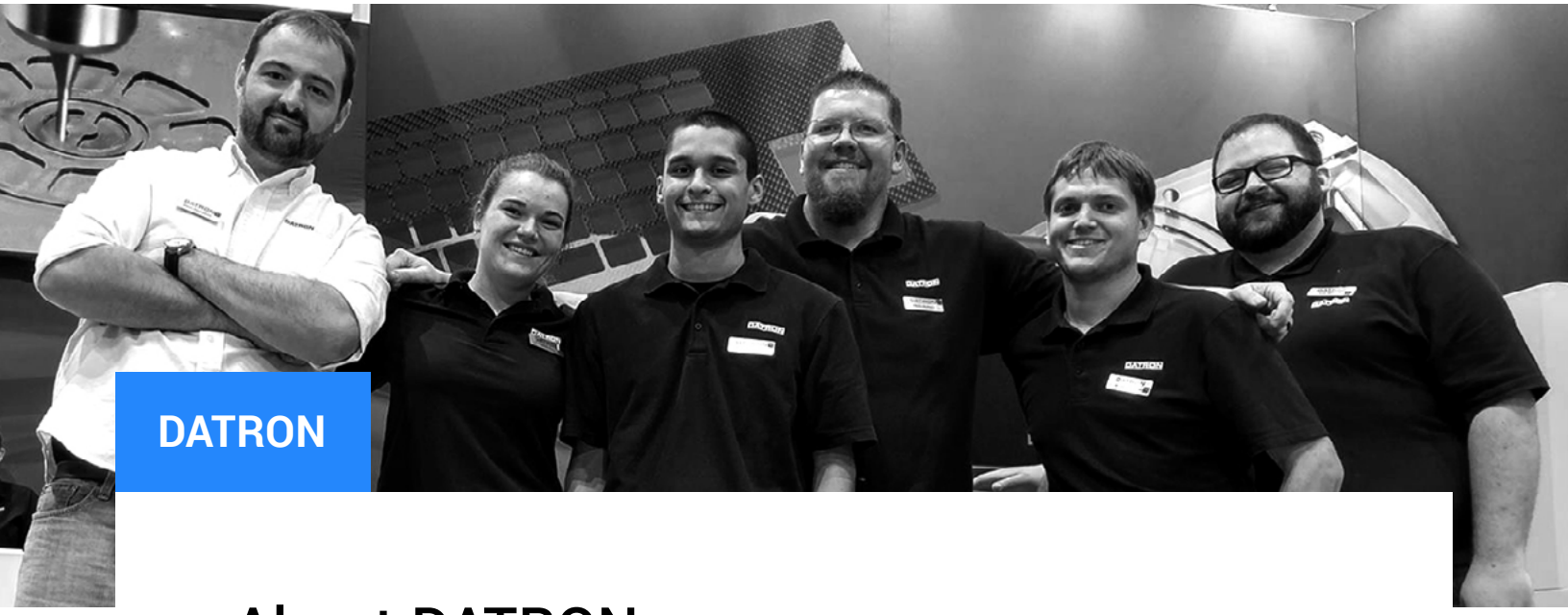
» Creating AI systems that track human activity on a factory floor.

» Automating Bill of Materials (BOM) generation, delivering costing and material savings.

» Developing a platform to automate assembly processes by creating digital interfaces for assembly workers in manufacturing.

For more information on how to apply to the Autodesk Technology Centers Residency Program…
Visit the website today! >

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About DATRON

Leading the Industry in Innovation by Optimizing Entire Prototyping Workflows

At DATRON, we've designed our CNC machines so designers and engineers can easily make their own prototypes, parts, and products.

Closely aligned with Autodesk's philosophy of empowering anyone to "Make Anything," we've aligned our people, our interface, and our prototyping and manufacturing equipment in a similar fashion. Our customers choose DATRON because of our up-front effort. We want our machines to serve our customers' purposes for their entire lifetimes.

Our high-speed prototyping solutions like the neo are flexible enough to provide a wide range of solutions in a single machine. The neo lends itself to rapid design iteration, especially for smaller parts, while our Cube series expands on the capabilities of the neo, and also accommodates work on larger parts. The large work envelope on Cube series machines is also ideal for having a wide variety of workholding prepared for any part at any time.

Our customers refer to our control, DATRON next, as a paradigm shift in the CNC world. As the industry focuses on optimizing time to save seconds off certain processes, our customers save hours—and sometimes days—on their entire workflow.

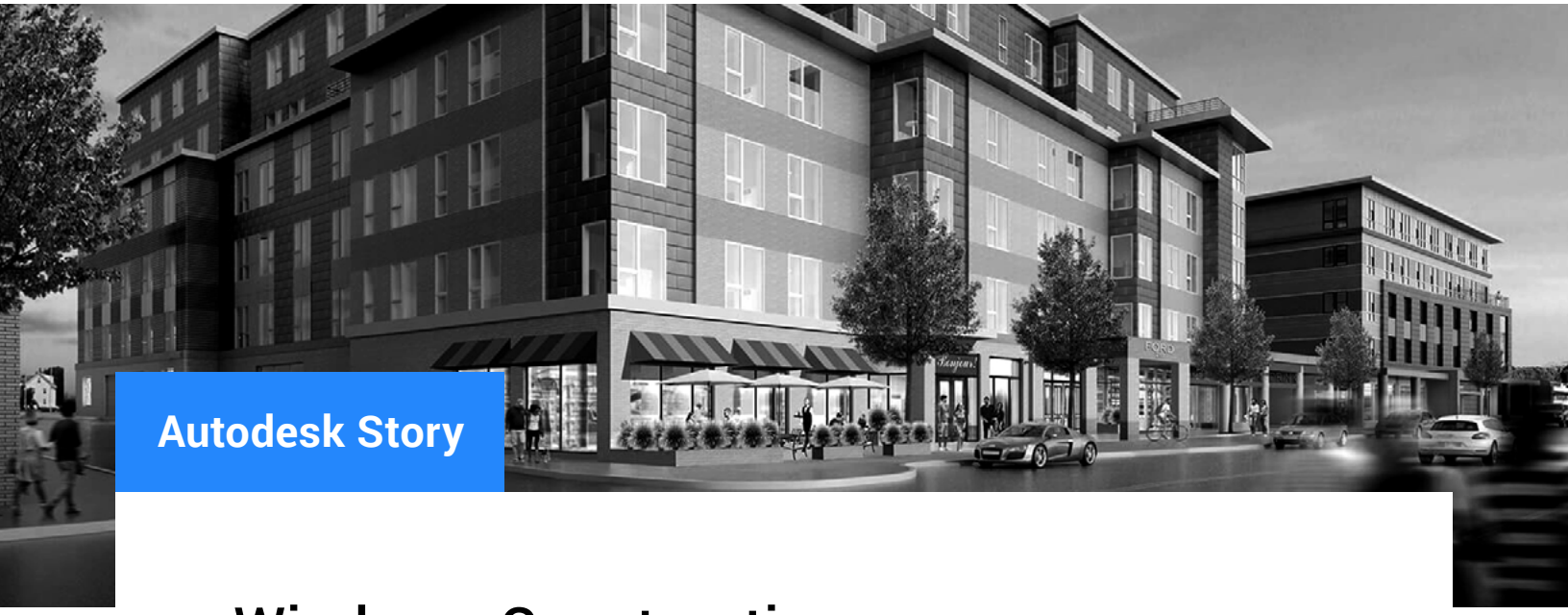
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About the Company

DATRON is a worldwide leader in providing innovative, precision high-speed manufacturing solutions to a wide variety of industries. With a history of awards for innovation and design, DATRON holds many worldwide patents for our ground-breaking designs.

All high-speed machining solutions are designed and manufactured in Germany to the highest standards. Machines are shipped directly to your facility floor whereupon DATRON Dynamics will install and train you and your staff to maximize your investment. Our responsibilities do not stop there; you can be assured of unparalleled support from our team of Application Engineers and Service Technicians for the life of your equipment.

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Autodesk Story

Windover Construction

About the Company

Windover Construction is a 100% employee-owned construction management firm providing comprehensive pre-construction planning, estimating, design-build, virtual design and construction, and construction management services for a diverse portfolio of clients. Windover uses digital technologies from Autodesk and DATRON to expedite their construction and refurbishment projects.

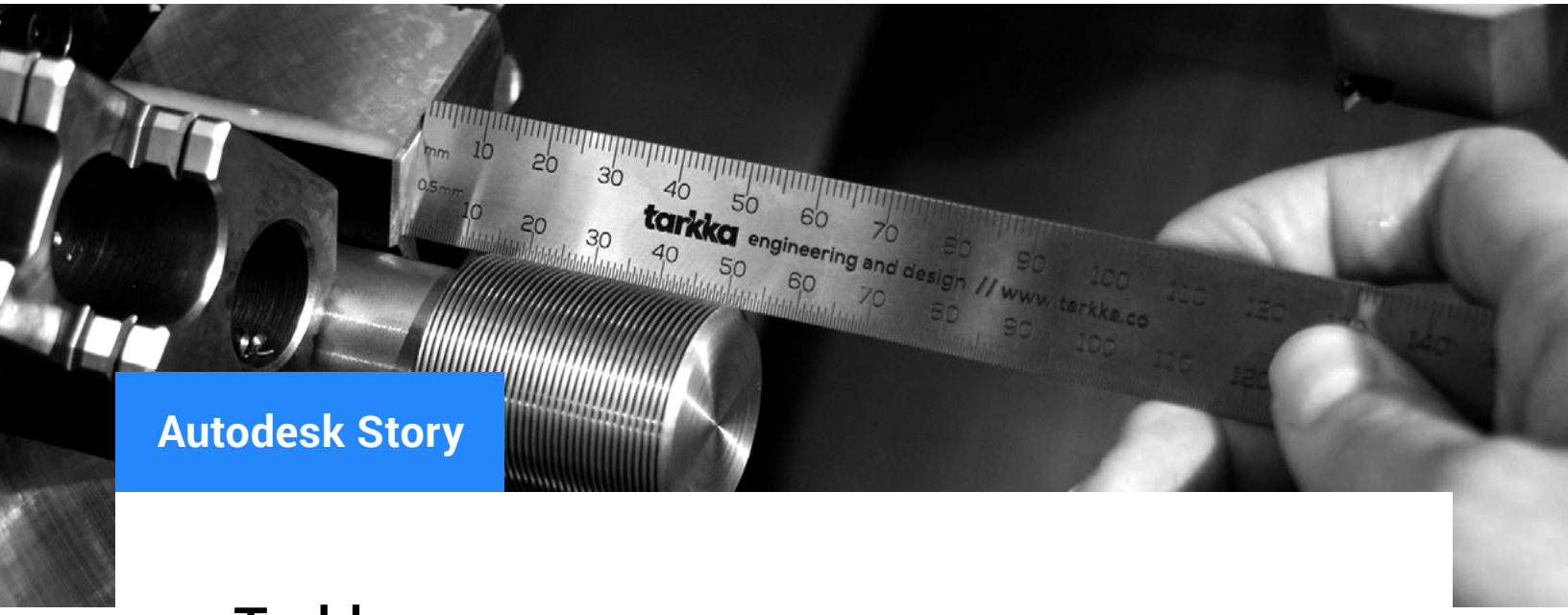
What They're Creating at the Autodesk Technology Center

As a resident of the Autodesk Technology Center, Windover is working on several projects. One of the more notable is the restoration of a historic 100-year-old façade featuring hand sculpted plaster that's been degrading due to weather over the last century.

To restore the façade, Windover's Virtual Design & Construction Team laser scanned the degraded exterior elements and then developed a detailed 3D model utilizing Autodesk software. Unifying BIM data with 3D printing, Windover was able to 3D print the original architectural facade elements with materials that would last for another 100 years with no maintenance needed.

On another project Windover utilized Autodesk software to digitally prefabricate 935 steel trusses at the Autodesk Technology Center, then Windover's field team assembled them onsite with mixed reality in 3 days only, reducing cost by 70%.

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Autodesk Story

Tarkka

About the Company

Tarkka is an engineering team developing innovative products and training with the goal of making advanced manufacturing processes accessible, approachable, and affordable for anyone.

What They're Creating at the Autodesk Technology Center

From their workspace at the Autodesk Technology Center, Tarkka is currently working on a modular CNC platform. Built on a standardized connector and rail system, the powerful yet low-cost system is capable of bringing manufacturing and automation to anyone—anywhere. They currently use Autodesk software to model their metal components, which they then create on machines like the DATRON M8Cube.

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Autodesk Story

Otherlab

About the Company

Otherlab is a private research and development company working on future technologies, one of these being soft robotics. The soft robotics team at Otherlab is dedicated to creating robust, low-cost fluidic robots that operate in environments as extreme as deep water, outer space, and everything in between. Otherlab's goal is to build robots with human scale dexterous manipulation for direct replacement of human labor in hazardous environments.

Otherlab uses pneumatic and hydraulic actuators to drive robotic motion. Since soft robotics is still an emerging field, Otherlab's robots are mostly made from custom components designed in-house. The materials used to make these robots differ from traditional robots, they are mostly made of plastics, fabrics, and rubbers. This requires developing new manufacturing processes. Because this is a new form of robotics—from code to machined parts—Otherlab is creating everything from the ground up.

What They're Creating at the Autodesk Technology Center

Otherlab is working with an Autodesk Research group on a project to see if robot design can be informed algorithmically by a workspace. Being at the Autodesk Technology Center has allowed Otherlab to rapidly prototype components, accelerating their soft robotics research and development. Otherlab uses Fusion 360 modeling and CAM software to create and process their models, and they use the DATRON neo to get high-quality and precision metal prototypes turned around quickly. They also use 3D printing for some of their pneumatic control components.

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DATRON Story

University of Washington

About the Organization

As part of the University of Washington, the Theberge Group is a lab that studies the chemical mechanisms underlying male infertility, prostate cancer, kidney disease, infectious disease, and more. They are at the forefront of the development of analytical chemistry tools that advance medicine, including biomimetic microfluidic systems for integrated cell culture and small molecule isolation.

What They're Doing with DATRON

To support their research, the lab creates a variety of microfluidics devices. These devices are about the size of a credit card, and within that footprint there are multiple wells or channels that hold fluids and culture cells. The materials used for the devices are typically plastic: often polystyrene and cyclic olefin copolymer (COP).

The lab has the option to 3D print some devices, but prefers to mill devices using the DATRON neo, because the neo allows them to work with standard plastics, like polystyrene, that are well-vetted within the cell culture community. Since a lot of their devices are used downstream for culturing cells, using a device material that's well understood is preferred. Most of the 3D resins don't have the history of standard plastics.

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The team at the lab, mostly composed of students, see the neo as a more precise machine than their previous CNC mill. There are also two key features of the DATRON neo they really appreciate. The first is the ability to mill with smaller tools at high RPM, which allows them to create small, precise features. Second, their neo is equipped with a powerful vacuum table that holds large sheets of plastic uniformly. Previously, they had to mechanically clamp the sheets, which led to material warping, leading to highly inconsistent results.

"We're just able to make things that we never could make before. The DATRON neo enables us to do really cool science and ask new questions with the devices we mill."

— Ashleigh Theberge (*Assistant Professor of Chemistry, Adjunct Assistant Professor of Urology University of Washington)*

The team chose the neo because they wanted a machine that was precise, but also usable by students. They didn't want to hire a full-time machinist to run the machine, and the neo had a great combination of precision and accuracy of a high-end mill, but was unintimidating for a student or user that had only been trained for a few days.

After using the Neo for some time, the team also discovered a few other benefits. These include:

» Increased adoption—and innovation. Because they've been able to train 20+ students on the DATRON, the lab's ability to innovate has grown.

» Excitement about the process. Because it's so easy to use, students have really embraced what they can accomplish. In fact, they don't use the older mill anymore, even though the old mill is in the lab.

» Scaling up production. The team can now make batches of hundreds of devices at a time, without having a person sit in front of the machine while it's running.

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DATRON Story

Mikros

About the Organization

Founded in 1991, Mikros initially designed and developed systems to cool the electronics in the first iteration of the International Space Station, and the astronauts inside. This included two key platforms: a micronozzle set that provided two-phase cooling electronics, and a single-phase water system and microchannels to cool the crew's cabin. Those eventually evolved into Mikros' current business segments.

Today, Mikros provides highly customized, high efficiency cooling for the electronics that are doing extremely heavy processing. These are typically in areas like data centers, artificial intelligence systems, high-heat lasers, and renewable energy inverters.

What They're Doing with DATRON

On the microchannel side, Mikros uses their DATRONs to create prototypes in support of their mission to provide more customized solutions to high-profile customers, faster.

Mikros currently uses a number of DATRON neos in-house, focused on developing assemblies for microchannel liquid cooling. To protect their intellectual property and optimize their workflow, Mikros typically handles all design, prototyping, testing, and fabrication for these assemblies in-house.

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Mostly working in copper, with some aluminum and stainless steel, Mikros is using the neo on assemblies and prototypes as small as 4mm wide, or as large 300mm wide. Mikros likes the neo because they needed a precision mill—and a high-speed spindle—to create their prototypes, and they need to keep their metal extremely clean. Since DATRON machines use ethanol as coolant, the parts come out of the machine clean and dry, which is a distinct advantage over conventional flood coolants. This means that prototype post-processing and cycle times are greatly reduced.

"DATRONs are user friendly enough that we can train people who are not machinists to operate the neos."

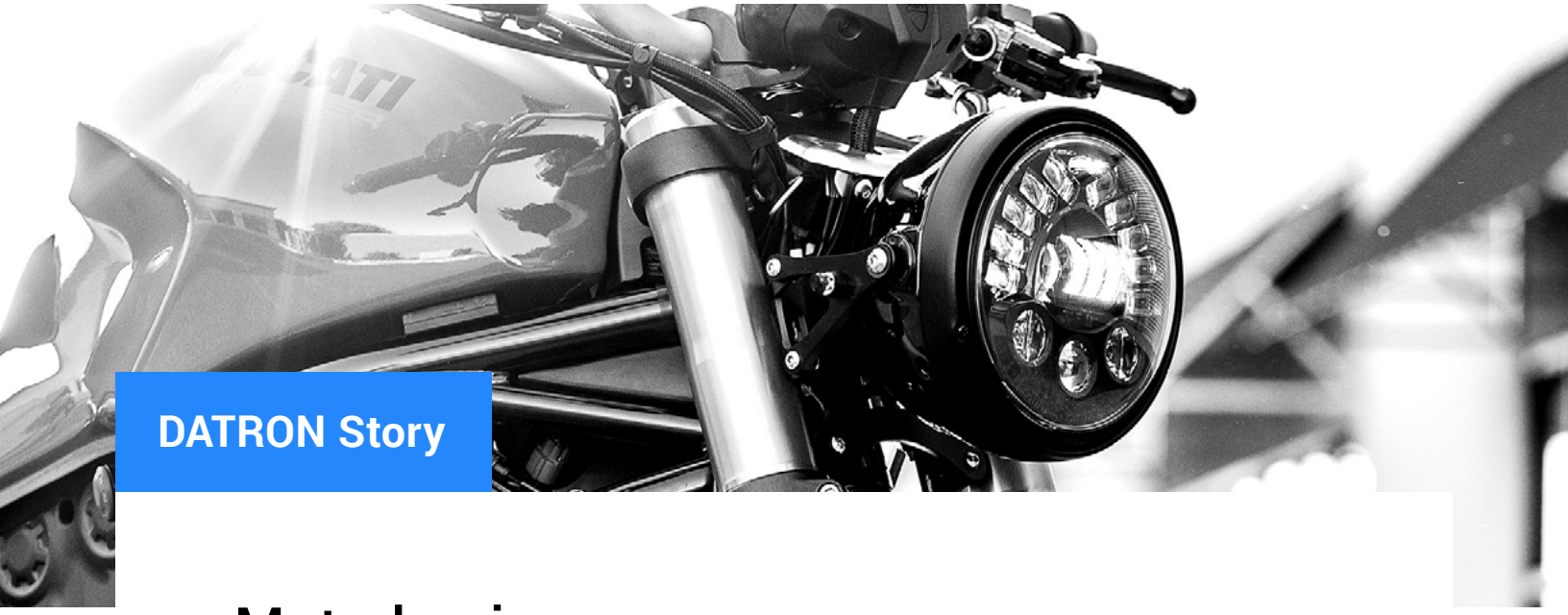
— Drew Matter (*Product Development Manager, Mikros Technologies)*

In addition, Mikros values the neo's small footprint, fast tool change speed, and the ground-breaking interface, next control.

The DATRON next control is helpful because Mikros wants to cross-train their assembly staff as much as possible. The DATRON neo and next control allow an assembly worker to take a part and walk it through nearly the entire process. They can take a raw piece of copper and work through their entire prototyping process without waiting for a machinist to intervene. The DATRON allows more of Mikros' workforce to participate in machining, which helps the entire area operate more efficiently.

In addition to this, Mikros is beginning to automate the neos using robots that will load and operate several machines at once. This is made easier because of DATRON's smaller footprint. The neo's small footprint lets Mikros put more machines together, reducing robot travel time. The smaller size also means they're easier to access and maintain.

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DATRON Story

Motodemic

About the Organization

Motodemic is primarily in the business of upgrading and modifying motorcycle headlights. The company began by designing and 3D printing parts but has now expanded that to metal prototypes and parts. Much of their work is centered around attaching or converting motorcycle headlights to more modern lights that are safer for the rider.

What They're Doing with DATRON

Motodemic makes parts mainly out of 6061 aluminum and Delrin, that range from small brackets to large adapter rings which allow aftermarket lights to drop directly into the factory light housing. These parts range between intricate pieces that measure an inch by an inch, all the way up to large adapter rings that measure eight inches in diameter.

When the company first started, Motodemic was sending out parts for prototyping almost weekly at a cost of anywhere from $300 to $1,000, which is a lot to invest when determining if a sub-$100 part is viable.

Time was a key factor for Motodemic. To move quickly in initial product development, they needed to turn prototypes around quickly and outsourcing could be costly, or take longer than they wanted. Often, if they needed something within a week, it could cost them three times the typical fee. Otherwise, they were waiting for as long as three weeks depending on how busy the outsourced prototyping partner was.

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In addition, there was a matter of "right amount of effort and finish." Sometimes Motodemic wanted to get physical feedback on whether their concepts worked the way they designed them. Even when they communicated to their outsourced prototyping partner that a part doesn't need to be finished quality—just needs to be functional—the partner would often still spend all the time and effort to produce a "finished" quality part. There was little to no capacity for rough design checks. This would add significant time to market, since each of these iterations could take two to three weeks—or more. Those weeks started to add up in time and cost.

"I saw the Neo at IMTS in 2018, and thought, 'Wow, that's really cool. The speed.' I was noticing the speed, but I was also noticing there was no coolant everywhere."

— Brad Wood (*Founder, Motodemic*)

When Motodemic got to the point in their business where they wanted to significantly elevate the quality of their products, they started to look at bringing prototyping in-house. At the time, their designs were too expensive to go through the standard outsourced prototyping and production process. So they started looking at equipment.

The key here was that they didn't want to become a machine shop. They had positive experience with 3D printing, and they wanted something that was as close in experience as they could find with that—but be able to work with real metals. They also didn't want a big traditional machine in their clean environment, nor did they want to hire a full-time machinist. They wanted something to work metal on that was high-end, could do fine and detailed work, and that their team could jump in and use with minimal training.

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Motodemic quickly found the DATRON neo, and were wowed by the speed, the touchscreen, the Fusion 360 integration, and small footprint. It fit what they were looking for perfectly.

"DATRON is more technology-forward on their control system. The next controller on my neo is the same controller they use on their super high-end model, which gives me confidence that when we're ready to move up to an M8Cube, their next model up, there's really not going to be a learning curve, because it's basically the same machine, just bigger."

— Brad Wood (*Founder, Motodemic*)

Bringing prototyping in-house allows them to control practically every aspect of their workflow. When Motodemic wants a rough proof of concept, they can make that, without investing in the time or expense an outsourced partner would add to it. And the cost savings isn't just in the one-time prototype cost, it's the fact that they aren't spending that money on something they believe should work—but won't. Motodemic can iterate—and innovate—faster, because they aren't constrained by time or cost associated with outsourcing anymore.

And they can do this quickly and easily with the touchscreen interface, and without the mess associated with traditional machine coolant.

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Credits

The following contributed to the creation of this ebook.

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