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HOW SOFTWARE AND THE CLOUD ARE REVOLUTIONIZING 3D PRINTING

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Stop us if you've heard this one before: 3D printing is in the midst of a sea change. And you can take that how you want. Either 3D printing itself is poised to become more user-friendly and reliable or 3D printing is having an increasingly tangible impact on the way real companies that make real things do real business.

While both are true, there's still a fairly large gap between grand predictions and the reality of day-to-day printing.

Someday we'll do amazing things like print organs as if it's no big deal. Today, it's probably more important to focus on what's at the front of the mind of anyone 3D printing with any regularity: workflow and visibility aren't great. That means someone has to build a solution that makes it easy to coordinate print jobs across the enterprise, transfer files in a manner befitting of the 21st century, get rid of dumb STLs, and support machine operators with the tools necessary to supply usage analytics to whomever pays the bills.

That's how you scale innovation. Maybe a beachhead for business processes isn't breathtaking. But approved business processes spur adoption and it just plain makes people's lives easier. Sound like something you could get behind?

WHAT TO EXPECT FROM THIS EBOOK

We'll take it in three parts, drilling down as we go:

1. What conditions exist right now that are driving the 3D printing revolution?

2. Of these conditions, which can be considered trends? Where do we expect these trends to take us?

3. Given where we're headed, what nascent innovations do we expect to drive the revolution even further as they mature?
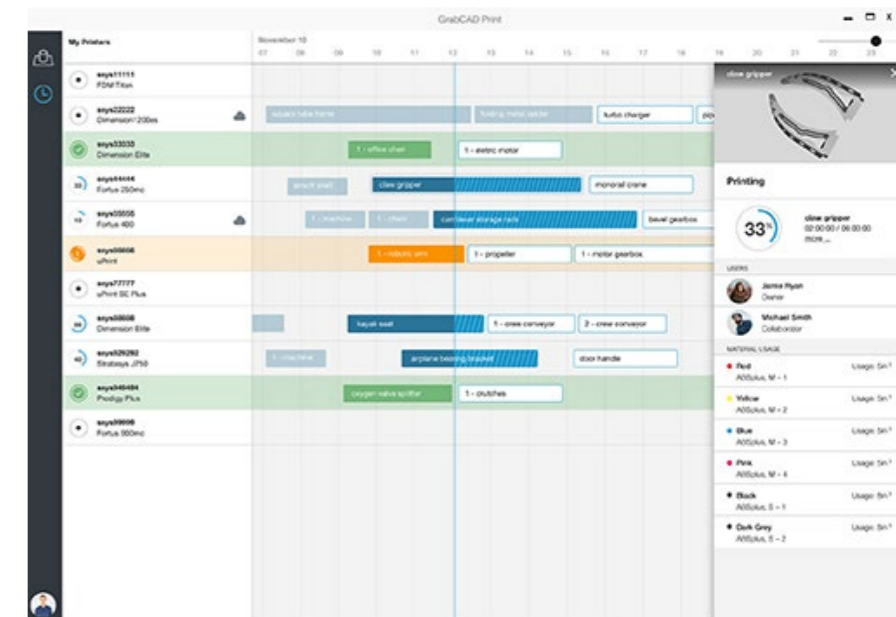
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WHAT'S THE COMMON THREAD?

As we move along the three sections, we'll be sure to note the roles of software and the cloud in each section. Here at GrabCAD, very little needs to be said about our commitment to cloud utilization. From the Community, to Workbench, and now to GrabCAD Print – it's very much in our DNA. It's only natural that we see the cloud as major driver of 3D printing's modern revolution.

As many of you already know, the cloud isn't that exciting without purpose-built software meant to run on it. In addition to noting where the cloud is nurturing the next stage of 3D printing's evolution, so too shall we note where cloud software has or is poised to make major changes to how companies 3D print.

IN SUM:

Great content

Connected people, projects, and printers

Simplicity (why can't 3D printing be as easy as file/print?)

Informative (Business Intelligence)

Ok. With that out of the way, let's get started.

WHAT'S SO REVOLUTIONARY ABOUT RIGHT NOW?

Before we get ahead of ourselves, it's important to note that nobody makes adjustments to "business as usual" for no reason. Context is both omnipresent and paramount. 3D printing technology has been around since the 80s. Why are we talking about a revolution forty years later?
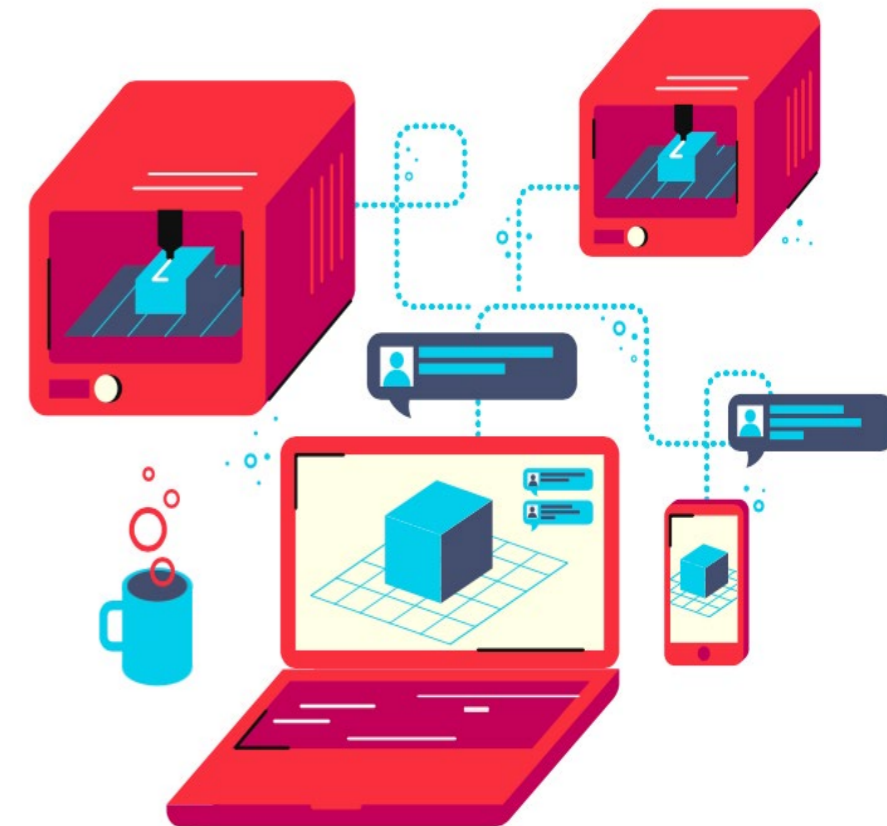
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Again, context. What's happening right now? Condensed to a single sentence fragment – everything the world needs to support an ecosystem of transformative hardware. What does that mean?

Let's make a list:

- Thanks to **vibrant internet communities** (GrabCAD, Thingiverse, etc.), 3D printing content has never been easier to find. Why spend hours modeling a bracket from scratch when someone else has not only done it for you, but prepped the model for printing and uploaded it for public consumption? The happy consequence here is that engineers are freed up to work on new and more complex parts, not simple parts that already exist.

    - Ready-to-print models means **you don't have to be a CAD engineer to get into 3D printing**. That's a pretty significant barrier removed.

- Companies both large and small are leveraging these communities to **crowdsource novel design concepts**. It's clear that decision-makers understand that design challenges offer a viable supplement to internal engineering resources.

    - While it's nice that crowdsourced design challenges from big name sponsors generate publicity for 3D printing, the real benefit is that it inspires an entire generation to learn about how to design specifically for 3D printing.

    - Design for 3D printing opens up an entirely new set of design possibilities to the designer. Suddenly things like organic structures and complex microlattices become not only a reality, but an essential part of the designer's toolkit.

- **Mass customization via 3D printing** has allowed enterprising companies to offer unique products made to fit individual consumers. From electronics to medical devices, mass customization is proving itself with each new application.

  - Honda Access: Manufactured customized accessories for cars, motorcycles and other items for different markets. Available accessories for any given Honda model range between two and three hundred items.

  - Total knee replacement: Individually Customized Total Knee Replacement. One in five patients are not satisfied with the results of their total knee replacement surgery.

    » Two of the leading causes of dissatisfaction after surgery are **residual pain** and **functional limitations**. Both of these issues can be addressed by a better implant design.

  - Still, despite offering consumers more options and better performance, enabling entirely new business models, and generating considerable buzz, **mass customization has been a minor driver of 3D printing revolution to date**.

    » It can be difficult to separate hype from reality with mass customization. Because it's a more "sexy" application, it does lend itself to overexposure. But with the right business processes, mass customization becomes instantly more credible.

WHERE ARE WE GOING?

Predictions can be tenuous, but let's consider the number of models in the GrabCAD Community. In January, 2011, there were very few. In 2016, there were right around two million.

Nothing about these numbers (particularly when compared with the ever-increasing number of members – over 3 million at the time of this writing) suggests that 3D printing content will be more difficult to access in the future. Thingiverse is no less healthy. The nice thing here is that each community is designed for different applications – one for professional engineering and one for more lighthearted FDM adventures.

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Design challenges are everywhere

It's not just us running design challenges (although we do have quite a few). GE and NASA each run their own design challenge programs in addition to participating in third party programs. 3D printing companies like MakerBot and Cubify have dedicated programs as well. Point is, designers interested in solving real world 3D printing design challenges have ample opportunity to do so.

Mass customization

A major obstacle to widespread availability of mass customized products is the price of the scanners that capture the individual. But like most hardware examples, that price is likely to come down over time. The scanners themselves are also likely to get smaller and easier to handle. Companies that make 3D scanners have built sophisticated software pipelines to go from scanning, to digital model, to physical model. Investments have been made – it's unlikely that 3D scanning companies will abandon their investment. As for the software, it will not only improve, but move to the cloud.

WHICH INNOVATIONS ARE ABSOLUTELY CRITICAL?

Shared office printers

Right now, there are really only two options for 3D printing in the office. The first option is that a single, dedicated printer is assigned to an individual or group. The person or group alone is responsible for ordering materials, performing maintenance, and ensuring the machine is printing as much as necessary.

The other option is a "print lab," where all of the company's 3D printers are kept in a central location and operated by a small team. This is not at all dissimilar to how 2D print labs were created at the inception of that technology.

But when's the last time you walked into a modern office (outside of a professional commercial printer) and got a tour of their 2D print lab? Probably never. Instead, when you need to print something you select a printer on your floor and click print. You and everyone else on your floor have that in common. It's called a **shared office printer**.

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The same will happen with 3D printers. The fact is that a shared office printer is more economically efficient than individual printers or a dedicated print operator in a lab.

But there are barriers. For starters, you need software that is intuitive and doesn't require training. Remember trying to "install a new printer" before the process was perfected? It wasn't exactly a great experience. If the goal is to get non-CAD engineers into 3D printing, the printing experience has to be easy.

Likewise, it should be optimized. You need software that automatically optimizes the print schedule and observes "printer etiquette" so that everyone's parts are printed on time. The software has to maximize (and, preferably, optimize) the space used on the tray unless the user specifically requests to print a one-off. In that case, that user better have a very good reason for monopolizing resources and holding up the queue.

Intuitive software and shared office printers will be a major driver of 3D printing adoption – an integral component of the 3D printing revolution.

Analysis apps

If you know how to perform FEA on 3D printed parts in a useful way today, you're probably in line for a very decent payday. Analysis apps provide more certainty of a part's performance, enabling companies to 3D print **actual production parts** in more applications.

We're not there yet. Yes, there is complicated geometry involved and, yes, there are a lot of variables at play. Mechanical properties of 3D printed parts do vary from one machine to the next and one print to next. There's also a serious lack of material property data out there in the ether. Still, there's no reason to believe that the analysis community won't get there eventually. If the demand is high enough, engineers will figure out how best to analyze 3D printed parts.

And when they do, the availability of reliable and familiar analysis apps will be a major driver of the 3D printing revolution.
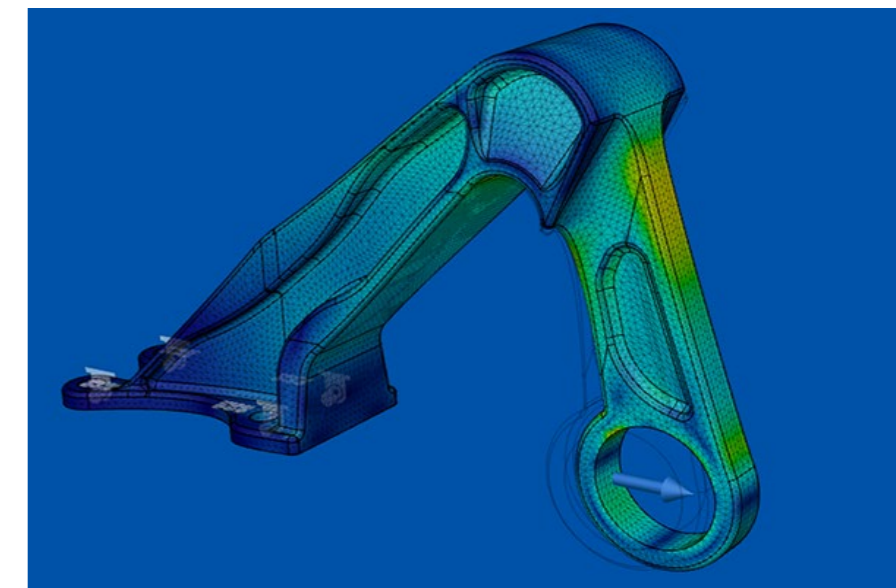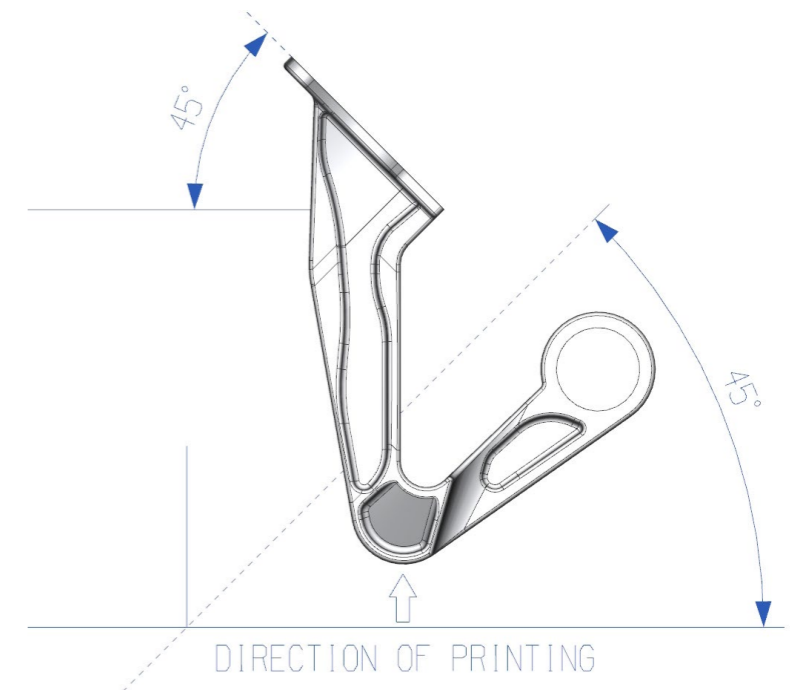
"Flowing Bracket" CC BY Javier Valdes.

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CONCLUSION

What are we to conclude? It's hard to get away from the notion that innovations in 3D printing hardware have spurred corresponding software innovations. As hardware evolves, so too shall software. However, as they often do, the two are likely to evolve at different speeds. There's great potential for 3D printing software to make great strides towards improved user experience, reporting capabilities, and print prep.

Get started with GrabCAD Print today. Register here.

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