ENABLING DESIGN AGILITY WITH CAD-IN-THE-CLOUD

HOW BIG ORGANIZATIONS CAN EMULATE MAKERS AND STARTUPS

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Is It the Age of the Maker and Startup?

Based on today's headlines, you might think so. Based on unprecedented access to bleeding edge technologies, including cloud-based services and 3D printing, makers and startups are able to quickly explore and prototype new designs. It's product development in the small, done on a dime. But it's proven to be innovative as well as successful.

Larger organizations, however, have a decidedly different reputation. With the need to coordinate far more employees, product development proceeds at a slower pace. Often with more established processes, it also seems to be bureaucratic. In contrast to makers and startups, larger organizations run product development in the large.

Today, however, running a slow and bureaucratic development process won't cut it, regardless of your organization's size. Right now, we're in the midst of significant changes to how products are developed and launched. They are coming to market in dramatically new and different ways. The barriers to entry are lower than ever. There is undeniable proof that innovation can happen anywhere.

Some organizations see these changes as threats, with competitors finding new ways to disrupt a market. Others see them as opportunities to drive profitable growth. Either way, the imperative is the same: every organization must become more agile in product development.

Of course, technology has an important part to play in this change. Computer Aided Design (CAD) software applications have been used by engineering organizations for decades now. For these tools, important advances have come in the form of Direct Modeling that allows users to push, pull and drag geometry as opposed to tweaking parameters and crafting feature-based models. While those advancements have been welcome, it simply hasn't been enough, especially in the context of collaboration amongst distributed ad-hoc teams.

Fortunately enough, the next major wave of innovation for CAD software is breaking on the industry. CAD software, offered as a service from the cloud, termed CAD-in-the-Cloud, is ready to be used in production design, engineering and manufacturing environments. Explaining how these new CAD-in-the-Cloud services work and impact today's design challenges is the purpose of this eBook.

Ultimately, product development agility isn't the sole realm of makers and startups. Large organizations can also leverage bleeding edge technologies to design innovative products faster and at lower cost.
What is CAD-in-the-Cloud?

Today, there is a constant stream of new technologies that could be applied to the product development process. Defining them, much less keeping up with them, is a serious challenge. So before we dive into the needs of increasing agility in product development, let’s define the primary technology discussed in this eBook: CAD-in-the-Cloud.

Today, there is little argument over the definition of Mechanical CAD. It is a class of software that helps engineers design and document their components and products. Almost invariably, it does that by providing capabilities for users to create 2D or 3D geometry. That geometry, in the cases of 2D Sketches, 2D Drawings and 3D Models, can then be used to create drawings and other documentation. In other cases, users can edit the geometric entities in drawings or documentation directly.

In addition to the creation of 2D and 3D geometry, there are more discipline specific capabilities that are offered by CAD, including: piping and cabling routing, integration with Printed Circuit Board (PCB) design, aesthetic design and more. Furthermore, CAD technologies are often integrated with Computer Aided Engineering (CAE) or Simulation software as well as Computer Aided Manufacturing (CAM) software. Another type of software that is related to CAD is Product Data Management (PDM). These software systems manage the artifacts created by CAD software as well as other items.

To date, practically all activity related to CAD software has occurred on the desktop or laptop. CAD software is installed on local hard drives, where they can be updated with new releases, typically one every year to eighteen months. It uses compute resources local to the computer upon which it is installed. The artifacts created with the CAD software are saved to the local hard drive as well. Additionally, organizations must purchase perpetual licenses to run CAD software.

CAD-in-the-Cloud offerings, however, are different in many ways. They are installed on remote servers (i.e., the cloud) and then accessed through a browser or lightweight client. The software is updated with enhancements on the remote server on shorter cycle times, often in the range of every six to eight weeks. It uses compute resources on remote servers as well. Additionally, the artifacts created with CAD-in-the-Cloud offerings are saved to the hard drives on those remote servers. And last, but not least, CAD-in-the-Cloud access is based on subscriptions, the number of which can be increased or decreased based on need, instead of licenses.

In addition to the capabilities provided by CAD software, CAD-in-the-Cloud also offers additional functionality, including data management, sharing and collaboration tools.

All told, CAD-in-the-Cloud provides CAD capabilities but in a new model. Furthermore, because it is based on the cloud, it can offer new capabilities as well.
Design and Engineering Agility

The most tangible thing that comes out of the design phase is engineering documentation: specifications and drawings used by manufacturing and suppliers to make physical products. But producing documentation is not a means by which to design products. Fundamentally, CAD technologies should help in that endeavor, not hinder it.

Underlying Need

At its very core, product design is about two critical activities: iteration and evaluation.

The first is the means by which engineers develop good designs. It includes iteration and exploration of alternatives and options. You try one possibility and find it feasible, but try another option and find it falls short. You try yet another and find it works best. Therein lies the key to design and engineering.

The second is the means by which engineers check the form, fit and function and other considerations of their designs. You need to ensure it all fits together. Costs must be checked. You must make sure it doesn’t break in its operating environment. Also, you may need to compare many designs against one another to find the one that best satisfies all requirements.

Traditional Solution

For most of the last few decades, CAD technologies have fallen short of enabling design and engineering agility. Parametric Modeling approaches, based on building 3D models progressively out of interdependent features, offered powerful design configurability. However, it also required meticulous planning and forethought, which runs counter to the fundamental nature of design. As a result, designers and engineers turned to graph paper and 2D Sketches for iteration and exploration. By the time someone started building a 3D Model in CAD, most design decisions had already been made.

In recent years, however, important advancements have been made. Direct Modeling approaches, which allow users to push, pull and drag geometry without predefined features, allow engineers to iterate and explore with little constraint. Furthermore, freeform 2D Sketching also enables engineers to flesh out designs quickly and easily. In combination, CAD is now being used for true design purposes.

Despite all of these advancements, some problems with using traditional desktop CAD for design still exist.

One issue is continuity from one design form to another. 2D Sketches, frequently used to capture concepts, should be used as the basis for 3D Models. Surface Models, often used for aesthetic design, should also be used to build 3D Models. Yet they are often built in different CAD applications, requiring translation that often breaks geometry. That, in turn, results in hours spent fixing or even recreating the models.

Another issue lies in manual data management. Traditional desktop CAD applications save their models and drawings as files that need to be checked in and out of PDM systems as formal deliverables. Yet, only one of the many design alternatives and options explored during the design process are kept in the end. PDM systems infrequently provide temporary sandbox environments to support these activities.
Enabling Design Agility with CAD-in-the-Cloud

CAD-in-the-Cloud Advantage

With the evolution of CAD-in-the-Cloud offerings, whole new areas of functionality have emerged. Three of these areas are particularly applicable to design and engineering agility.

A notable characteristic of the CAD-in-the-Cloud offerings to date is that they provide integrated functionality within a single tool. This often includes capabilities such as 2D Sketching, Surface Modeling, Parametric Modeling, and Direct Modeling. That means no translation is required to progressively mature design geometry from one form to another. Those 3D Sketches and Surface Models can be used to directly create 3D Models for detailed design, eliminating the need to fix or recreate geometry.

Additionally, moving CAD from the desktop to the cloud necessitated another evolution: integrated data management. With CAD-in-the-Cloud, there are no files to manage; all of the data and file-like information exists on the servers that provide the cloud-based service. That required the integration of data management capabilities directly into the CAD-in-the-Cloud offering. But that functionality wasn't just moved into the cloud. It evolved as well. The data management capabilities integrated into CAD-in-the-Cloud automatically track every change to a design, but also manage every iteration that an engineer explores.

Last, but not least, the elastic compute power available in the cloud provides some additional advantages for design and engineering agility. Compute intensive activities like working with very large models and assemblies, generating complex high-end ray tracing renderings and solving large simulations can be completed far more easily and faster. That shortens the time that engineers must wait for these assessments to complete, allowing them to make meaningful decisions much faster.

Customer Story

WindPax is a startup that produces a series of small-scale portable power generating wind turbines. Their team of designers and engineers, mostly based at West Virginia University in Morgantown, has hectic schedules across which they try to coordinate the design and development of their products.

“We have no centralized office. We’re spread out all over the campus. Yet we have to find ways to get on the same page,” states Justin, its President, Co-inventor and Founder. “In the past, we used a generic cloud-based file sharing service. It’s great for documents and spreadsheets, but our CAD models always got messed up. We’d always have to go back and figure out what went wrong,” Justin continued. “With our CAD-in-the-Cloud, Autodesk Fusion 360, the changes to all of our models are automatically managed, even with all of our designers and engineers.”

“Also, we don’t have to worry about wasting time when moving designs from one tool to another. We do our aesthetic sculpting, design, rendering and animations right in Autodesk Fusion 360,” said Justin. “It’s seamless overall.”
**Design Collaboration Agility**

In this modern era of products, no one designs alone. Partners, suppliers, customers and many more parties all have real needs to get involved in today’s design process. Unfortunately, CAD as a desktop application has traditionally offered little support for design collaboration.

**Underlying Need**

There is little doubt that today’s products are only getting more complex. Part counts are still rising. Innovation is often coming from software and electronics. The effect on supplier relationships is transformational. Where most suppliers have been traditionally seen as commodity suppliers, they now not only offer unique technologies but critically important intellectual property as well. As a result, manufacturers need to pull suppliers into the development process far earlier and deeper than ever before. That translates into two activities.

First, manufacturers need to share data and information with suppliers more completely and more frequently than ever before. Second, suppliers and manufacturers need to have an open communication channel through which they can collaborate and correspond. Both carry serious implications for CAD software.

**Traditional Solution**

Per recent studies, findings show that 70% of respondents from Lifecycle Insight’s 2013 3D Collaboration and Interoperability Study share design data through email, representing a serious security risk. Alternatively, many organizations are turning towards increasingly popular cloud-based sharing services. While effective, they provide little to no capabilities allowing suppliers access to the data without CAD.

In both scenarios, there are very few options to corresponding on design data. 3D Visualization tools allow users to open design data and mark them up with notes and highlights. However, getting such correspondence back to the manufacturer in any accessible format is challenging. Back and forth correspondence is practically impossible.

**CAD-in-the-Cloud Advantage**

One area where CAD-in-the-Cloud offerings differentiate themselves from their desktop counterparts is sharing and collaborating on design data.

Because 2D Sketches and 3D Models are created in the cloud, they already exist in a secure location from which they can be shared. Quite literally, such design data can be shared with anyone with Internet access anywhere in the world.

Collaborating on design data in CAD-in-the-Cloud is also advantageous compared to desktop CAD. As applicable, only viewer and markup functionality is exposed to the user in a browser. They are provided merely the functionality they need to do their job: no more and no less. This addresses the need for access to CAD applications.

Staying up to date on design changes is another area of advantage for CAD-in-the-Cloud as well. Manufacturers share an intelligent link to a particular part or product, which always exposes the latest version of the design. Suppliers don’t fall behind on design iterations.
Customer Story

Modbot is a San Francisco based startup that aims to “put industrial quality robot building blocks into the hands of everyday inventors for almost any purpose that requires intelligent motion.” Their platform, composed of modularized hardware, a mobile software application for control and a virtual robot builder web app, can be used for almost any purpose.

From a design process perspective, a key activity is packaging electronics into the mechanical hardware. Adam Ellison, a founder and mechanical engineer, checks to make sure that the electronics work of Daniel Pizzata, the other founder and electronics engineer, fits into his mechanical housings. “Not long ago, we were sketching cross sections in notebooks and checking for interference and fit,” stated Adam. “That simply took far too much time and had a lot of potential for error.”

They now use a CAD-in-the-Cloud service, Autodesk Fusion 360, for their design. “We can now not only check packaging very quickly, but we can have a lot of different design concepts running in parallel. We don’t have to worry about the files. We’re working far more quickly now,” states Adam.

The advantages of a CAD-in-the-Cloud service aren’t solely focused on design, however. “As we scale up in terms of personnel, a CAD-in-the-Cloud offering like Fusion 360 offers some significant advantages. We just pay for more access with no big upfront cost. There’s no big software install we have to worry about. It’s really flexible,” states Adam.
Financial and Technical Agility

Today, technology plays a large part in enabling processes and critical development activities. As such, the costs to acquire such technologies and the IT resources needed to support them have become important operational issues. This is another key area where traditional CAD is inflexible and CAD-in-the-Cloud offers sizeable advantages.

Underlying Need

Today, staffing in engineering organizations has changed. They often have the need to ‘flex’ the number of engineers and designers working on a project as critical deadlines loom and issues arise. That means the organization’s need for CAD will ebb and flow over time.

From an IT support perspective, agility is also important. Budgetary monies have been cut in every department, with IT staff consolidated into central roles that support many departments.

Traditional Solution

When it comes to the finances, traditional CAD is a costly and committed endeavor. Such software is obtained by purchasing perpetual licenses for a fixed amount. New versions of CAD applications, often full of important enhancements and new capabilities, are typically released every twelve to eighteen months. To gain access to those capabilities, every desktop must have the latest release installed locally, a time-intensive endeavor.

CAD-in-the-Cloud Advantage

From both a financial and IT perspective, CAD-in-the-Cloud offerings are dramatically different. CAD-in-the-Cloud can be accessed through a fixed per-user monthly subscription. Additionally, as engineers transition in and out of design activities, the number of subscriptions for an organization can be throttled up and down depending on need. Furthermore, the financial commitment is often only on a monthly basis. There is no upfront capital expenditure, saving the organization a significant amount of budget.

From an IT perspective, CAD-in-the-Cloud requires practically no maintenance. The software service provider makes incremental but valuable updates on shorter cycles, often on a six-week cycle. There is no need to schedule the installation of a new release with the IT department. New capabilities are available immediately.
**Implications for the Organization and Individual**

Technology can offer intriguing new ways to make organizations more agile. But ultimately, it needs to offer tangible and quantifiable benefits. So far, we’ve seen how CAD-in-the-Cloud is advantageous compared to desktop CAD applications. Here, we’ll explore how to measure it.

### Implications for the Organization

For the organization, there are two distinct benefits to using a CAD-in-the-Cloud offering:

1. **Error Avoidance Derived from Quality of Design**: CAD-in-the-Cloud enables designers and engineers to explore and iterate on more design alternatives. It also allows manufacturers to share and collaborate with suppliers and partners more extensively. While those two advantages don’t directly translate into hard savings or increased sales, there are derived benefits. Developing more fully conceived and vetted designs reduces the number of downstream errors that translate into scrap, change orders and lost contracts. Track these Key Performance Indicators (KPIs) as a means to measure the impact of CAD-in-the-Cloud.

2. **Reduced Upfront and Ongoing IT Spending**: CAD-in-the-Cloud services do not require an upfront purchase of perpetual licenses. Furthermore, the monthly subscription fees can be throttled back as necessary. That translates to hard savings that can be applied elsewhere or to the company’s bottom line.

### Implications for the Individual

The benefits of CAD-in-the-Cloud aren’t all about the organization, however. Improving the agility in all of these areas also provides some benefits to the individuals involved, including:

1. **Recouping Personal Time**: Improved design agility means catching and addressing any errors that would normally get downstream. It also means developing and releasing better designs. In all, this translates to fewer design emergencies that come back to their desk, wrecking their schedule and requiring them to work the weekends and nights.

2. **Empowering Independence in Non-Technical Roles**: Greater accessibility, both in terms to the data and the capabilities to interact with that data, is a great boon for non-technical stakeholders in development. They no longer have to track down engineers to load up the design and review it on their screen. They can utilize any device to increase their responsiveness. This is a boon to engineers as well, as non-technical roles often ask engineers to pull up CAD models for viewing needs.
Summary and Conclusion

Today, we’re in the midst of significant changes to how products are developed and launched. Regardless of whether your company sees these changes as threats or opportunities, the imperative is the same: every organization must become more agile in product development.

Design and Engineering Agility

Fundamentally, product design is about the iteration and exploration of alternatives and options as well as checking that design’s form, fit and function. CAD-in-the-Cloud offerings augment Direct Modeling approaches with automated sandbox-like data management tracking and the capabilities to mature concepts into detailed designs and beyond.

Design Collaboration Agility

No manufacturer designs and develops products alone anymore. Today, they must integrate suppliers, partners and customers much earlier and far deeper into the design process. CAD-in-the-Cloud supports these needs by securely sharing design data from where it was created. Additionally, those without CAD access or knowledge are provided the tools they need through a browser or lightweight tools.

Financial and Technical Agility

Engineering’s need for CAD varies every day, so there is little need to purchase licenses for CAD software that may sit idle for months at a time. Furthermore, understaffed IT organizations can find little time to upgrade desktop and laptop-based CAD, leaving valuable enhancements unavailable for months. CAD-in-the-Cloud is often provided as a subscription-based service, meaning organizations can throttle the number of seats available up and down over time. Furthermore, the software provider upgrades these offerings in the cloud with no effort required by corporate IT staff.

Implications for the Organization and Individual

CAD-in-the-Cloud offers numerous benefits to both the organization and individual. Through error avoidance, the costs associated with scrap, rework and change orders can be lowered. Furthermore, switching from licenses to flexible subscriptions can save hard monies as well. For individuals, avoiding the proliferation of errors translates to recouping personal time spent working nights and weekends.

Product development is changing. The modern age calls for modern tools. CAD-in-the-Cloud is a feasible option.

For more information on CAD-in-the-Cloud, visit the Autodesk Fusion 360 site. Underwritten in part by Autodesk, all concepts and ideas developed independently, © 2014-2015 LC-Insights LLC.