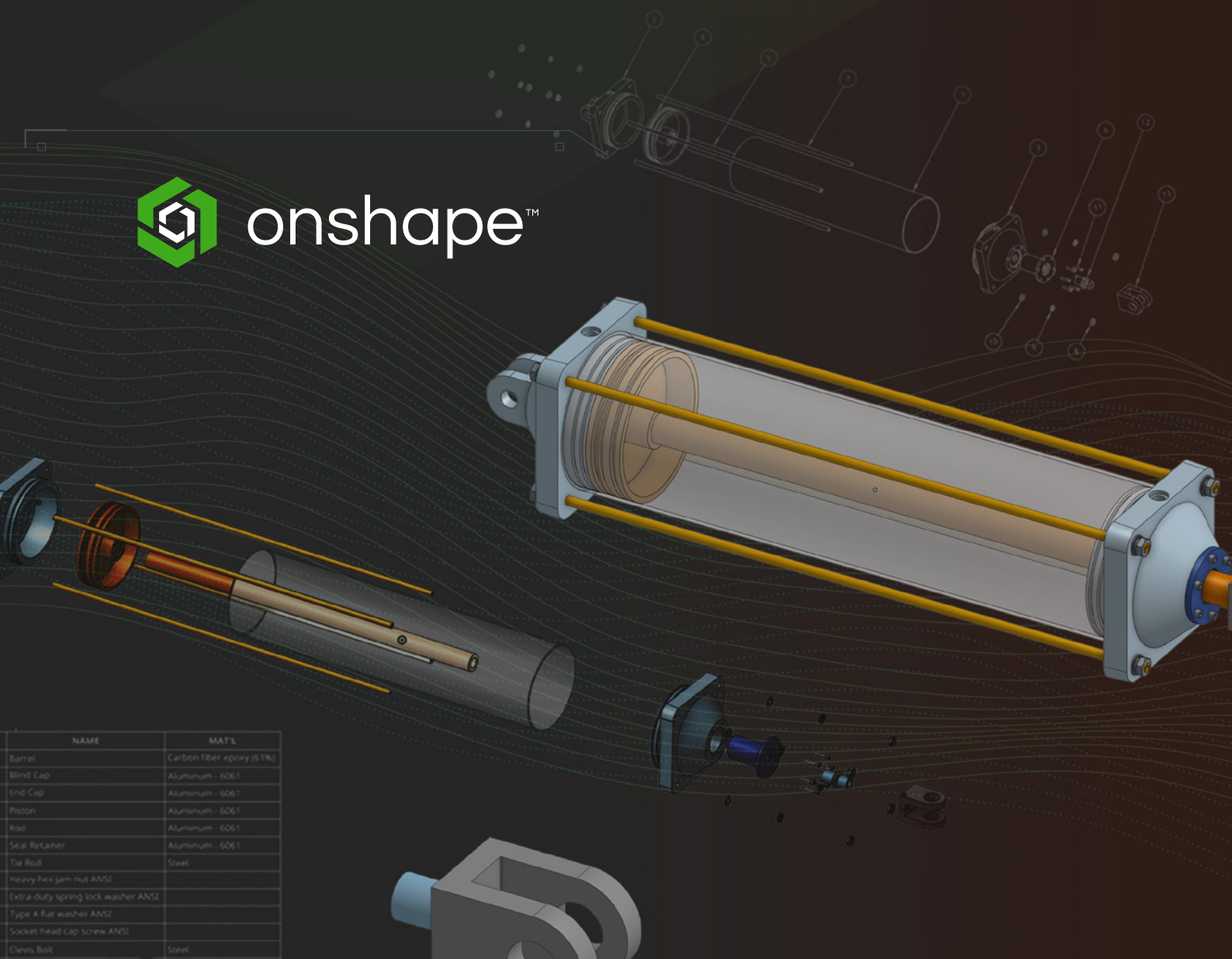


How Onshape's Cloud-Native PDM is Transforming the CAD Industry

Learn How Onshape Addresses One of the
Major Gaps in CAD - The Need for a More Secure
and Efficient Way to Manage Data



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NAME	MAT'L
Barrel	Carbon Fiber epoxy (51%)
Blind Cap	Aluminum - 6061
End Cap	Aluminum - 6061
Piston	Aluminum - 6061
Rod	Aluminum - 6061
Seal Retainer	Aluminum - 6061
Tie Rod	Steel
Heavy Hex Jam Nut ANSI	
Extra duty spring lock washer ANSI	
Type A Flat washer ANSI	
Socket head cap screw ANSI	
Clevis Bolt	Steel

Background

Design data is a company's most valuable asset, and yet, many businesses still rely on outdated and cumbersome methods to manage their data. When asked why businesses continue to employ less than ideal methods of data management, many will respond back with: "Because it's the way we've always done it." But what if we could change such notions?

Like all technologies, digital data management has evolved allowing for traditional data management methods to be superseded by superior methods that are infinitely more efficient and capable. However, old ways for managing data can be a hard habit to break and adopting new methods for data management can prove to be difficult and expensive to acquire and maintain. More often than not, changes to data management offer a solution to old problems, but also introduces an entirely new set of challenges.


Unlike its competitors that tack on PDM systems to core CAD products, Onshape is universally recognized for its revolutionary approach to managing design data because data, version and release management is built into its very architecture thereby eliminating the need for PDM systems. In other words, Onshape developed its data management layer first, then built CAD modeling functionality around that to create a cloud-native, data management platform that doesn't use any files.

There are numerous benefits to this approach of managing data and in this whitepaper we'll explain the nuances of database file management systems and how this approach is vastly superior to manual file management (DIY) and even expensive PDM systems.

Optimizing Data Management With The Cloud

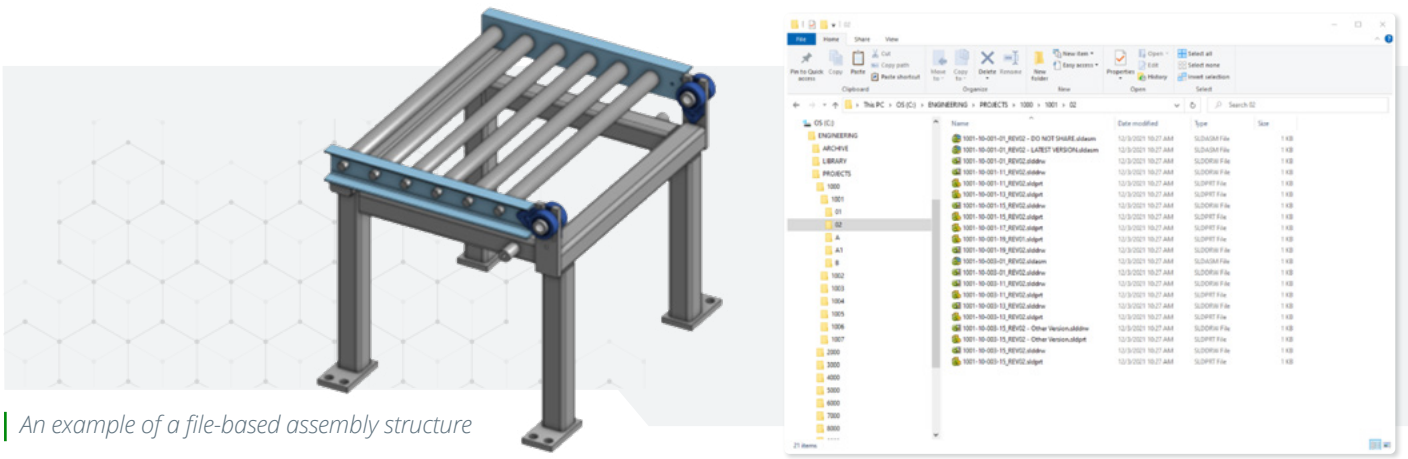
With a modern SaaS infrastructure engineers, managers and enterprise administrators of Onshape do not have the day-to-day hassles of file versioning, size, formats, access, references and traceability which are irrelevant to design. Onshape's unique and modern cloud-native architecture, which stores users' interactions in a non-relational database, exceeds industry standards for optimal data management: security, collaboration, consistency, flexibility, scalability, and a seamless workflow.



Data Stored in Database	Cloud-Storage	 onshape™ Cloud-Native
Data Stored in Files	Desktop CAD	Cloud-Hosted
	Software Runs as a Desktop Installation	Software Runs as a Cloud Instance

The Nightmarish DIY Approach to Managing CAD Design Files

In the beginning (a long LONG time ago), before digital design tools were developed, data management consisted largely of managing physical drawings that were stored in drawers in physical cabinets. With the advancement of digital technology, designers successfully moved away from physical paper drawings to digital files which were stored on their localized hardware; however, this process of trying to manage files through folders and subfolder structures can become quite unwieldy as products or assemblies become more complex.



An example of a file-based assembly structure

For example, the image above represents a 3D model of a simple conveyor pivot system and all the files associated with that system. In circumstances like this, a designer would have to manually manage all of the files on their hard drive.

Most engineers or designers would agree that computer files are an extremely insecure method of storing data. Files are easily mis-filed, corrupted, or overwritten. Managing files using Windows File Explorer or other file managers is inefficient, especially when you're trying to find the latest revision of a drawing to manufacture or you have multiple designers working on the same project.

This nightmarish file scenario is the reason why every CAD vendor developed a PDM system to help manage the numerous files that are associated with one design.

An ideal data management system would require user authentication to access any design data. It would also provide flexible authorization (permissions or rights) that could be expanded or restricted as needed during the design life cycle. Granular permissions would grant read, edit or copy rights that were controlled by the owner of the design. The ability to share design data and then instantly revoke access from any location would provide ultimate control of a company's intellectual property. It comes PDM systems to the rescue! But is PDM helping the design process or hindering your ability to work faster?

PDM Systems Are a CAD'ers Dream! Or Are They Your Nightmare?

To help mitigate the inherent issues with the DIY data management approach, many companies buy a third party PDM in addition to their CAD system; however, PDM systems are actually slowing down the design process. Speed or quality - you can't have both...or can you? The term PDM database is misleading. Actual CAD data is not stored in a PDM database, but its pointers are stored in files on a file server with all the shortcomings of file-based systems.



All PDM databases use what is called a [relational database](#). These databases store metadata in fixed tables with rigid schemas and pointers linking multiple tables together. For a CAD file, a table may state what type of file it is, where it is stored, list all of its custom properties and have links to the assembly or project that it belongs to. This means that finding files is fast, but in order to work on them they must be checked out and have them copied locally to a hard drive.



Checked-out files are locked by the PDM system to prevent others from checking them out, editing them and overwriting changes. Nobody can work on a file until it is checked back into the PDM system and unlocked. This mechanism ensures that those who have files checked out can be easily traced, files can be revision controlled and conflicts between design teams can be avoided. In practice, this system of checking CAD files in-and-out of a digital lockbox further worsens [PDM system issues](#), interferes with workflow, and reduces product-to-market speed. The bigger the team and the more agile the design process, the bigger this problem becomes.



Once CAD files are checked out of a PDM system, they are uncontrolled. They can be copied and emailed, posing another huge security risk and the possibility of a supplier manufacturing the wrong version of a part. Users must then choose between speed or quality because with PDM systems you can't have both. So, what is the alternative? Is there even an alternative or must engineers and designer live within the constraints of their technology?

What Are the Advantages of a Database Data Management Approach?

You don't have to sacrifice speed or agility for quality. Onshape's built-in database data management system allows you to design without ever having to worry about any design file or data being lost, overwritten, or corrupted.

A database (DB), in the most general sense, is an organized collection of data. More specifically, a database is an electronic system that allows data to be easily accessed, manipulated, and updated. Modern databases are managed using a database management system (DBMS).

An advantage of the database management approach is that the DBMS helps to create an environment where users have better access to more and better-managed data. Such access makes it possible for end users to respond quickly to changes in their environment.

■ There are several advantages of a Onshape's database management system over a file-based system that include:

- **Collaboration** - Simultaneous, concurrent, multi-user access to data is available ("users" can be defined as multiple threads and/or multiple processes).
- **Security** - Database systems can impose access constraints limiting those with permission to read or modify data. Each user has a specific level of access, which limits some of the ways data security can be compromised (i.e., leaked sensitive information, network attacks, misuse of data, and more).
- **Transaction Support** - Database transactions guarantee complete failure or success of an operation. This includes automatic recovery of the database to a consistent point in the event of an abnormal termination of the application, such as computer crashes and power failures.
- **Concurrent Access** - The ability to share data by controlling access to data items; many users (process or threads) can access data concurrently.
- **Expandability, Flexibility, Scalability** - A database system can scale easily to accommodate larger datasets.
- **Standards Enforcement** - One example of this advantage would be to use the DBMS for all data storage requirements for an application. Multiple data structures can be manipulated using the same API functions that can lead to reduced application development times and reduced maintenance costs in the future.
- **Interoperability** - Connectivity through industry standard protocols allowing tools to access and analyze data.

Onshape's architecture enables unique capabilities and delivers a PDM system which is always 'On'. With Onshape's built-in PDM there is no more waiting for access, no more check-in/check-out, yet, a full and detailed history of all users changes are recorded.

STABLE AND RELIABLE ONLINE ACCESS

SECURE CONTROLLED SHARING
INSIDE AND OUTSIDE YOUR COMPANY

MULTI-USER REAL-TIME COLLABORATION

BRANCHING AND MERGING
DESIGN VARIATIONS



FULL HISTORY OF ALL DESIGN CHANGES

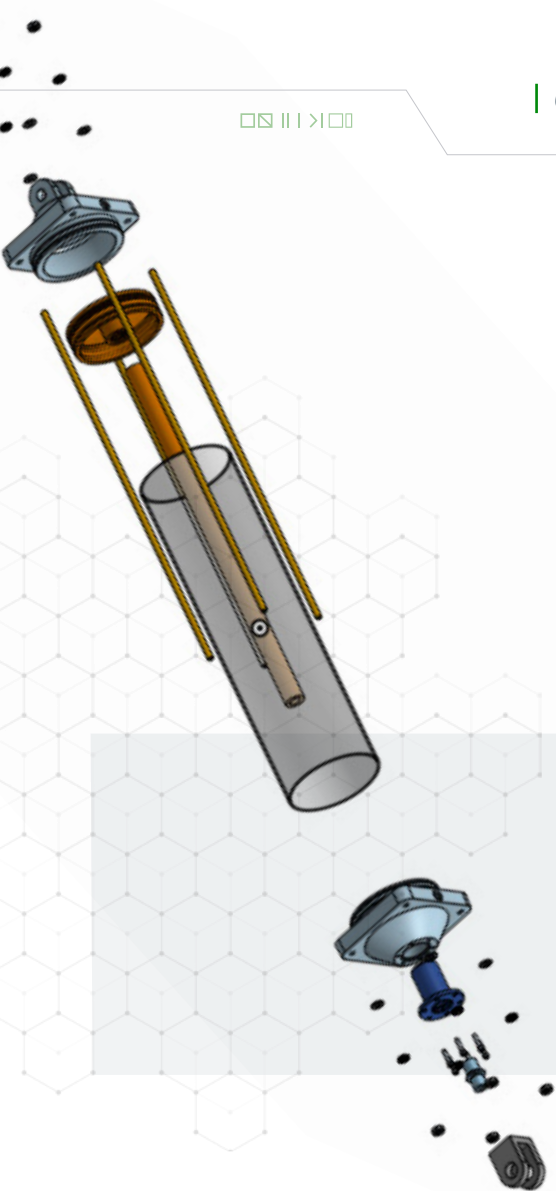
INTEGRATED RELEASE MANAGEMENT
WITH MANAGED WORKFLOWS

NO INSTALLATION AND SEAMLESS
UPGRADES

FLEXIBLE LICENSE PROVISIONING
AND EASY ADMINISTRATION



| Onshape's architecture enables unique capabilities



The reality is that Cloud-Storage and Cloud-Hosted PDM systems provide an incremental benefit to DIY file management systems, but in the end, they suffer from some of the same challenges because they are subject to the same issues of managing design files.

The basic unit of objects in Onshape's Cloud-native built in PDM are documents not files. Documents, as dynamic storage containers, can contain parts, assemblies, drawings, mechanical BOM, images and other associated data for the products design.

Onshape's release management with managed workflows allows for multi-user access and simultaneous editing. In addition, multiple release candidates can work parallel to one another for approval.

Can your PDM do that?

Challenges of File-Based PDM Systems



Lack of Object Relationship

Relationships between different object types are required by most applications. Classic PDM systems have no object concept, so have no ability to manage relationships. Conversely, a Database Management System is designed to provide and manage object relationships.



No Concurrent Access

Multiple users or applications accessing the same file will need the file system lock arbiter mechanism for resolving conflicts. Traditionally PDMs do not notify waiting applications when another lock releases. The application ends up pooling or managing the sharing of data through its code. On the other hand, a Database Management System allows concurrent access to data efficiently, resulting in faster access to data and overall better application performance.



No Indexing Capability

PDMs do not index and store objects, they index and store files. Needing fast access to objects, implemented through a file system, means the application needs to manage index information. A DBMS manages indexing for the application seamlessly through the database schemas. What is stored in the PDM database is data about data, otherwise known as "metadata."



Flexibility Issues

As applications get more complex so does the data management. PDM solutions are tightly coupled with the initial application requirements and are extremely hard to redefine and change. Using a DBMS allows an application development team to focus on the core competencies of their application while taking advantage of a data management solution that addresses the complexities of managed data.



Outdated File Check-Out System

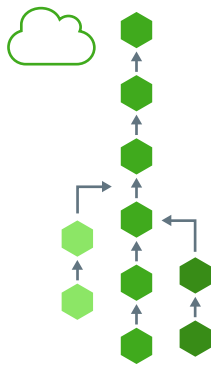
Checked-out files are locked by the PDM system to prevent others from checking them out, editing them and overwriting any changes made by other team members. Nobody can work on a file until it is checked back in to the PDM system and unlocked. This mechanism ensures that those who have files checked out can be easily traced, files can be version-controlled and conflicts between design teams can theoretically be avoided. In practice, this becomes [more of an obstacle than a benefit](#) as locked files prevent others from working, forcing them to wait until the files are checked back in and unlocked before they can get edit access. This forces a serial design workflow causing bottlenecks and unnecessary delays. DBMS addresses this issue by showing real-time edits, eliminating version control issues.

Onshape, the Better Way to Do Data Management

Onshape's non-relational [cloud storage](#) system is the only CAD data management system that can offer data security, team CAD collaboration, and seamless workflow, all built-in and for the same price as your traditional CAD.

So how exactly does Onshape manage data?

First, what's in Onshape's database is the one and only source of truth. It's replicated and backed up to prevent data loss in case of disaster, but the database itself manages that. Viewed from outside the database, there is only one copy of each document. No questions about whether we're looking at the latest version or whether copies are out of sync. No copies of data are accidentally left on a flash drive somewhere or emailed to someone.



ADVANTAGES OF ONSHAPE'S DATA ARCHITECTURE

- **Database is the single source of truth**
SECURE | REPLICATED AND BACKED UP
- **Internal, Unchangeable IDs for documents, versions, tabs, etc.**
NO BROKEN REFERENCES
- **Append-only editing**
NO DATA LOSS WHEN MACHINE FAIL | RESTORE TO ANY PREVIOUS POINT
- **Edits stored as flexible, incremental changes**
SIMULTANEOUS EDITING | MERGING | LOW STORAGE COSTS

Another benefit to having all of the data in one place is having unchangeable IDs, which can be assigned to everything a user wants to reference. Despite the fact that you can name your document whatever you want, it still has an internal ID. When you put a part of that document into an assembly in another document, the internal document ID never changes. So, a reference never breaks because you renamed a document or put it in a different folder. Even if you delete the document with the part, that reference still lives, going beyond the grave, so that your assembly doesn't break.

Be Organized Where it Counts

One of Onshape's most important precepts is "customers shall not lose their work"

To make this statement true, when you edit an Onshape model, we don't overwrite anything, we only append your edits. If a desktop CAD system crashes or the computer shuts down while saving and overwriting a file, that file could end up corrupt.

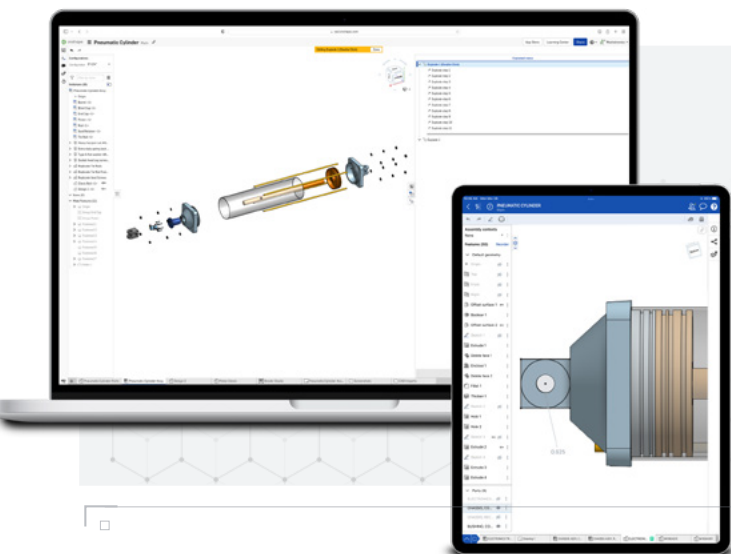
With Onshape, if the modeling server writing your edit to the database fails, or the database machine itself fails (remember, hardware failures are a fact of life), well that edit may not get written, but all the previous ones are fine. Meaning, you don't have constantly save your work with using Onshape. Onshape also provides you with access to all the previous states in the form of the document change history. So, if you accidentally over-constrain a complicated assembly or delete some key features and can't figure out how to fix it, you can restore to the state prior to the problematic issue.

The final piece of the puzzle is how Onshape stores the edits themselves. When the user makes an edit, Onshape stores it as a minimal set of changes to that hierarchy. If they edited a fillet radius, Onshape just stores that change (as opposed to, say, replacing the entire fillet). And these changes are flexible as to when they can be applied. For example, if you deleted some other feature, you could still apply the fillet radius change. And this simple flexibility forms the foundation of simultaneous editing because, for most pairs of edits, it doesn't matter which comes first. It also forms the basis of branching and merging as Onshape can take all the edits on one branch and apply it to another.

Design conflicts in Onshape can still happen due to geometrical constraints but not due to multi-user simultaneous editing. Edits are stored per user and reflected for users in real-time.

If there is a geometric merge conflict, you can easily fix it or revert back.

There is also a compare tool to preview the before and after merge. Onshape's architecture enables more parallel teamwork and reduces the friction in the design process.



Onshape saves edits and actions

not files which explains why Onshape uniquely can provide teams with a full design history and analytics with a PDM system that is always 'On'.

[LEARN MORE ABOUT ONSHAPE DOCS](#)

Data Management and Data Security with Onshape

Onshape was designed from the beginning to address the visibility, flexibility, and control issues that cause the security problems inherent to traditional CAD file-based systems.

Onshape's highly available, distributed database architecture stores all design data in modern NoSQL databases. These databases use geographically distributed servers with multiple replicas for high availability and are backed up every four hours for disaster recovery. Backups are restored every three weeks and every model is automatically checked for integrity against new versions of Onshape software. This also validates that functionality introduced in new releases will not break existing models.

Engineers design through standard web browsers such as Chrome, Firefox and Safari on desktops / laptops and through fully-functional apps (not just viewers) on iOS and Android mobile devices. Operating systems don't matter: Windows, MacOS, Linux and Chrome OS provide the same design experience and work equally well. CAD data never leaves the secure cloud environment unless permission to export has been explicitly granted by the data's owner. Everyone working on a project is always collaborating on the latest design. All data access is recorded in a permanent audit trail. Multiple users can securely collaborate on the same design simultaneously from any location that has Internet access.

Some CAD vendors have introduced a "new" type of file storage system – the so-called "fileless," "no file" or "zero file" database. The end user only ever interacts with the PDM interface and never sees the actual CAD files. However, the files are downloaded in the background when a user wishes to work on them. If you know where to look, you'll find them hidden in an obscure area of your hard drive. While these files can be technically referred to as a cache, they still contain the editable CAD data and each file must first be downloaded before the CAD system can open it.

Making a clear distinction between files and different types of database storage is a complex issue. Some may dismiss this as semantics, but there are clear advantages to one particular method of data storage. In any case, these are the finer details that engineers should not have to worry about or get involved in.

There are definite advantages to fileless data storage. First, there is a central file store so that anybody can get the data they need without having to worry where any of the files are located (the same as regular PDM, really). Second, the graphics are cached WebGL files and are sufficiently hidden and obscured so that they can only be opened by the installed CAD system (in this case, Onshape) and, therefore, cannot be emailed.

In a nutshell, Onshape securely and efficiently manages data with virtually no overhead.

Taking Advantage of Onshape's Unique Data Management Architecture

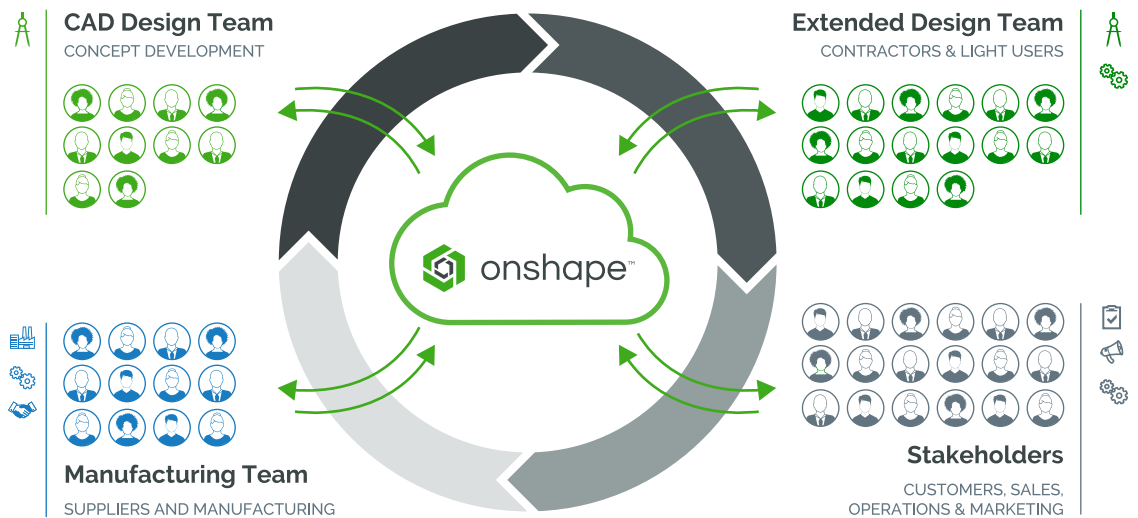
The architecture of a system usually has significant implications on aspects such as functionality, security, reliability, performance, scalability, and how quickly new features can be added, and bugs fixed. So, when making early architectural decisions, Onshape considered all of these factors.

Onshape employs a unique document-oriented database architecture which supports various forms of data and completely flexible schemas in a distributed non-relational database.

This fundamental difference is what enables real-time CAD collaboration, simultaneous editing, instant and secure sharing, version control and **release management**. Onshape's approach is so unique that no other product development and data management platform compares. There are never any files to deal with in Onshape. Finally, unlike competitors, live design data never leaves the Onshape product development/data management ecosystem, ensuring absolute data integrity.

CAD **collaboration in Onshape** allows entire design teams to simultaneously work on the same project, same assembly, same part and even the same sketch. At the same time. Nothing is locked so no one on the development team is ever blocked. All design activities are carried out in parallel – as changes are made, every action is recorded in the database and instantly updated wherever it's used. There is no save button, no check-in/check-out, no accidental overwrites, and no waiting around for someone else to finish their work before other work can be started.

ONSHAPE IS CLOUD-NATIVE PRODUCT DEVELOPMENT



This enables teams to co-design complex parts and assemblies without having to be physically in the same location. Since every design change is recorded, conflicts are easily resolved. Your team can experiment as much as they like, either in the same workspace or in their own branch, confident in the fact that any errors or bad decisions can always be undone. In short,

Onshape gives you unlimited undo/redo allowing designers to explore design ideas without fear.

With dedicated servers, data encryption, and third-party security testing, [Onshape protects your CAD data](#) when sharing with colleagues, suppliers or customers. Just like Google Docs, all you need to do is enter a person's email address, set view or edit permissions and press "Share." Clicking on the email link will open your design in a web browser or on a mobile device. No software or downloads are required. This enables design teams to work together from anywhere and design reviews to be carried out in real time on any device. Everybody works on the exact same document, not different copies of the data.

Some of the other features and capabilities that provide additional benefits via Onshape's unique database architecture, and fileless data management platform deliver include:

- **Version Control:** A version is the state of an entire document at a particular point in time. The geometric data (and the accompanying properties like Part names, etc.) of that version is unchangeable. You can, however, change the properties of a version
- **Where Used:** This command allows users to discover which specific assemblies and drawings are being used. This is particularly helpful when you need to make a change to a part or assembly in production and need to understand the ramifications of that change.
- **Document Management:** Onshape captures the state of every tab in a workspace every time an edit is completed (by all users working in that workspace). This information is also preserved for versions. This means that for every document there is an infinite record of states in which it has existed.
- **Revision Management:** Any part, Assembly, Drawing, and any file in an Onshape document can be revisioned and released in Onshape.
- **Change Detection:** Onshape intelligently checks for geometry or metadata changes when releasing a previously released Assembly or Drawing. Releasing unnecessary design changes causes extra work and mistakes. Onshape's change detection clarifies the changes you perform and enables you to only release essential revisions.

Summary / Conclusion

Onshape was specifically created to address the shortcomings of traditional CAD and PDM systems. Onshape's design platform is comprised of several modern computing technologies that provide visibility and insight into all phases of the design process. Secure access to design data, from any location and any device, provides engineers the flexibility to do their best design work. Strong authentication and fine-grained authorization technologies provide control over intellectual property.

Onshape's SaaS product design platform, and the team behind it continually gauge and react quickly for leveraging new technologies and bring the best new features and capabilities for leveraging the benefits of cloud-native, fileless data management.



ONSHAPE LIVE 21

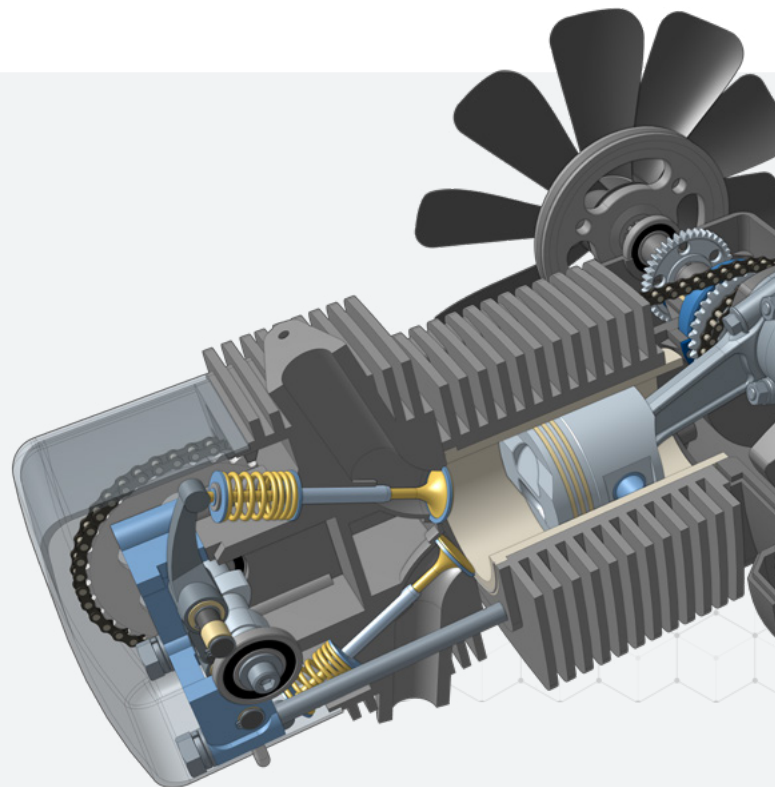
**UNDER THE HOOD:
How Onshape's
Cloud Architecture
Actually Works**

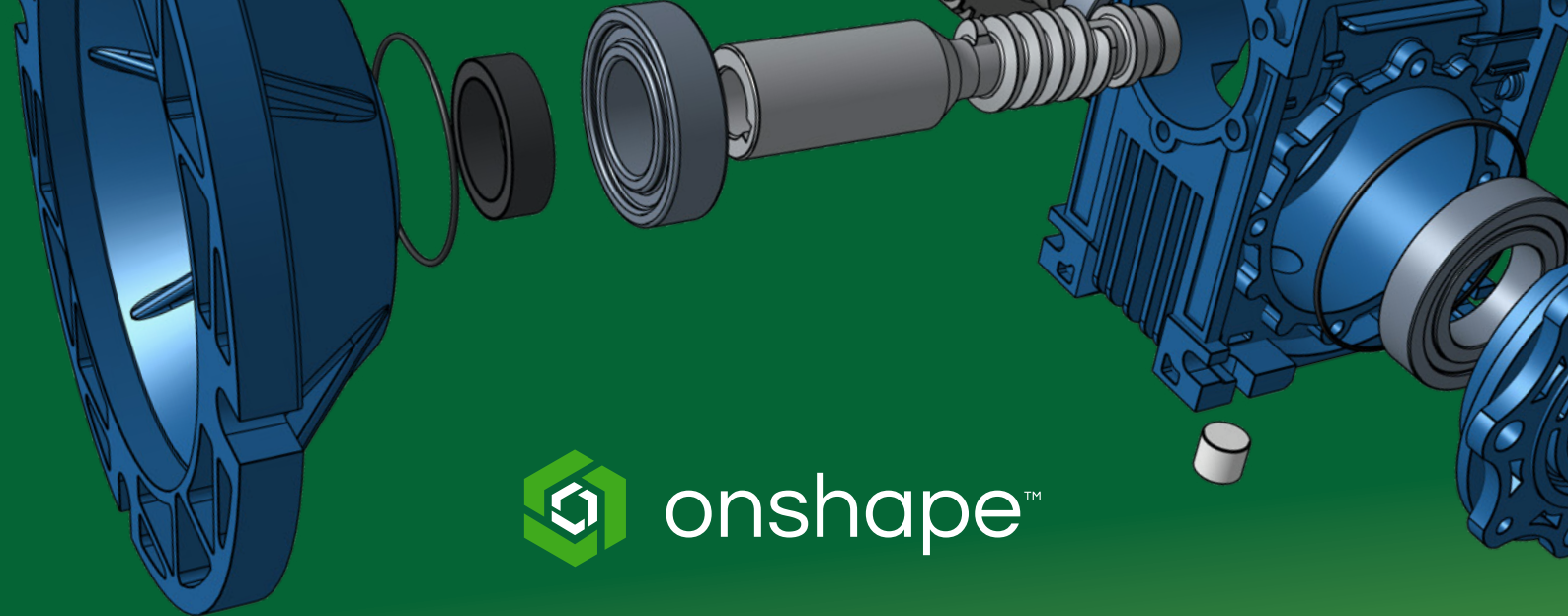
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**Sign up for a free
Onshape Professional Trial
and experience the benefits
of agile product design today!**

Click the button below and start enjoying the many benefits of fileless cloud-native data management with Onshape.

[REQUEST AN ONSHAPE TRIAL](#)





Be More Agile With Onshape

Your customers want more product differentiation and more innovation – and they want it now.

Cloud-native Onshape helps companies of all sizes, from enterprise to startups, eliminate the product development bottlenecks of traditional file-based design software.

With today's rapid pace of technology, it's no surprise that speed-to-market usually wins. Onshape is the only Software-as-a-Service (SaaS) product development platform that combines a powerful CAD system with integrated data management, real-time collaboration and business analytics. Executives and managers can get up-to-the-minute progress reports on a project's status and built-in version control prevents costly delays and manufacturing errors.

Product specifications and drawings can be instantly shared with your manufacturing team or suppliers to get the best possible product to market before your competition.

Sign up for a free Onshape Professional Trial and experience the benefits of agile product design today!

GET STARTED

Onshape is a [PTC](#) Business.