

SOLIDWORKS

WORKING WITH COMPLEX GEOMETRY AND ORGANIC SHAPES

Learn how industrial designers, digital sculptors, and mechanical engineers can create complex geometry and organic shapes with sub-D modeling.

BUILDING CONCEPTS WITH SUB-D MODELING, FAST AND EASY

COLLECTING FEEDBACK AND SIGNOFFS WITH EVERYONE FROM EXECUTIVES TO CUSTOMERS

SMOOTHING OUT TOPOLOGY OPTIMIZED GEOMETRY

TAKING COMPLEX GEOMETRY AND ORGANIC SHAPES TO PRODUCTION

SUMMARY AND CONCLUSIONS

IS IT HARDER TO DESIGN TODAY'S PRODUCTS?

Today, there is no shortage of challenges facing engineers. Schedules are getting shorter while budgets are drying up. Demand for smart, connected products is driving the addition of software and electronics everywhere. Product must be faster, lighter, and just plain better. Amid all these changes, geometry is getting more complex. Terribly complex.

Calls for more aesthetic products result in more organic shapes. The burgeoning use of topology optimization generates wildly non-prismatic geometry. Reverse engineering three-dimensional scans produce unruly forms. None come with handy features controlled with parametric modeling, and none can be tamed with direct modeling.

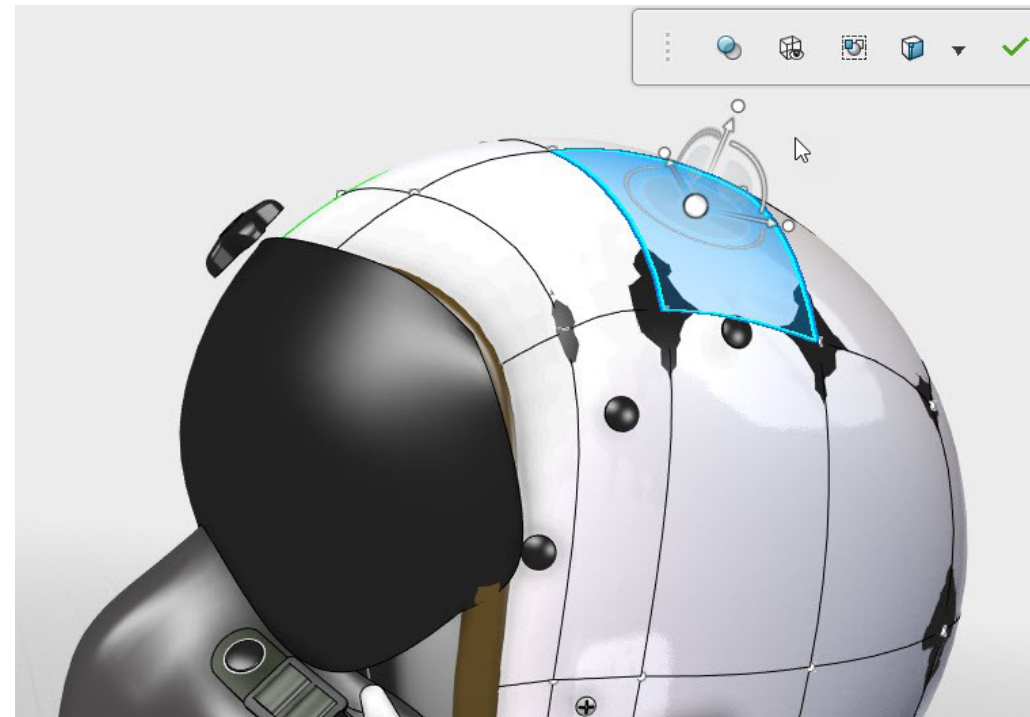
The price of dealing with more geometric complexity is steep. Remodeling these shapes is a tedious, time-intensive task. It undermines productivity. It steals the opportunity to design. Recreating something that already exists is a non-value-add task in the development process. Any change kicks off the whole cycle again, forcing engineers into a repetitive, difficult remodeling undertaking.

To help overcome these challenges, engineers can use new browser-based apps that are fully interoperable with SOLIDWORKS desktop and other **3DEXPERIENCE** apps. 3D Sculptor is a web-browser based, 3D subdivision (sub-D) modeling solution for creating stylized and organic shaped

models faster and easier. 3D Creator is a web browser based 3D concept modeling solution that allows users to create concept models. Both are fully interoperable with SOLIDWORKS Desktop and other **3DEXPERIENCE** apps.

How exactly do 3D Sculptor and 3D Creator address the rising tide of increasingly complex geometry? Answering that question is the purpose of this eBook. It is organized into workflows that engineers face every day. Each workflow details the traditional tools as well as the changes that 3D Sculptor and 3D Creator powers.

Today's geometry is getting more complex. SOLIDWORKS 3D Sculptor and 3D Creator provide engineers the right capabilities to still get things done fast.



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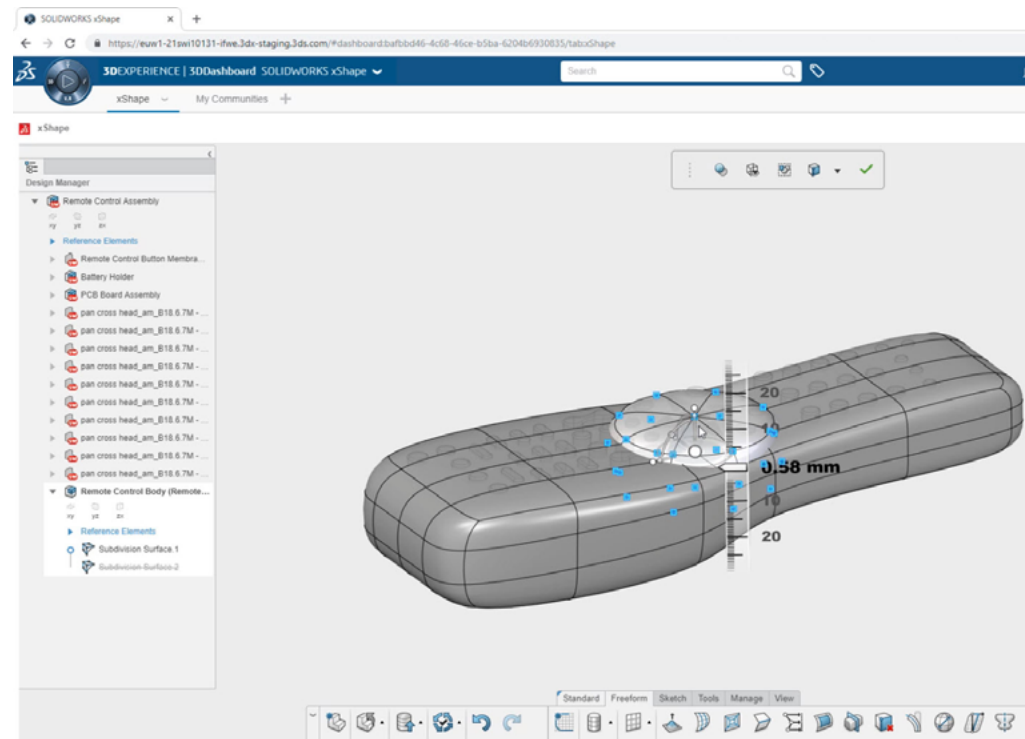
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The demand for complex geometry starts early in the design cycle, right in concept design. The need for organic shapes is diverse. For some, the need to make products aesthetic or artistic drive these new shapes. For others, ergonomic requirements compel a product's conformance to an intricate shape like a human hand. For yet others, engineering function or physics force a product into unusual forms. Whether you are an industrial designer, digital sculptor, or a mechanical engineer, the goal is the same: build out and iterate concepts quickly and easily. Today, however, the workflows for creating concept designs with complex geometry is anything but quick or easy.

One approach is to build up models with curves and surfaces using parametric modeling. This approach is painstakingly slow due to its incremental and progressive nature. All curves must be defined individually before creating a surface as a patch or sweep. Furthermore, the complex interrelationships in these models can be incredibly sensitive. Modify one dimension too much, and you have a cascade of feature failures. This approach is inefficient at best and disruptive at worst.

Another approach is to use a separate aesthetic surfacing application to create these shapes. The difficulty here lies in cleanly moving the model from one tool to another. Exporting and importing the geometry too often results in missing surfaces, misaligned curves, and a host of other problems. Everyone ends up spending an excessive amount of time fixing all of these issues. The challenges, however, don't end there. Concept design is inherently about change, exploration, and iteration. Modify the model in the aesthetic surfacing application, and the whole process starts again. The design must be exported and imported. The geometry breaks. An inordinate amount of time is spent fixing it; again.



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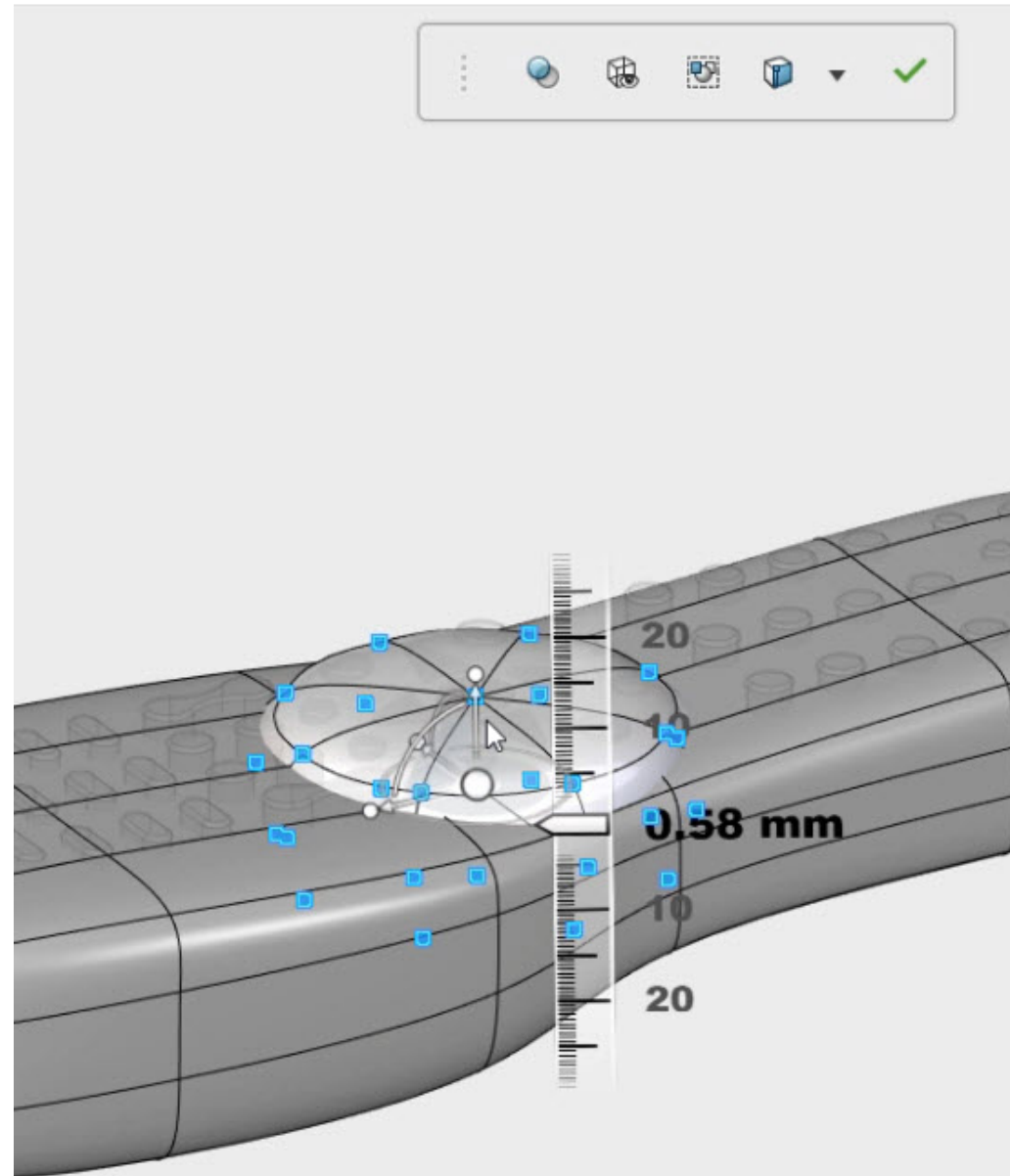
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3D Sculptor and 3D Creator address this workflow head on. 3D Sculptor provides subdivisional (sub-d) modeling to power the creation of complex geometry and organic shapes: fast and easy. You start with something akin to a ball of clay that you can push, pull, and stretch. You progressively add more handles that allow you to control the geometry with increasing fidelity. 3D Creator, which provides more traditional parametric modeling tools, augments this sub-d modeling approach. As needed, you can add curves and surfaces as features. You can mix and match these tools as much as you need to get the job done. These two apps, 3D Sculptor and 3D Creator, both work tightly with SOLIDWORKS and all the other **3DEXPERIENCE** apps. With these tools, you get the best of all worlds. You can create and modify complex geometry, fast and easy, and eliminate the non-value added tasks of the prior approaches.

Beyond the improvements to existing workflows, the flexibility of these tools empowers new activities. Mechanical engineers can explore organic shapes independently. Industrial designers and digital sculptors can experiment with fine-tuned parametric modeling. Each can expand their respective skill sets. These apps, 3D Sculptor and 3D Creator, make every role in concept design more productive.



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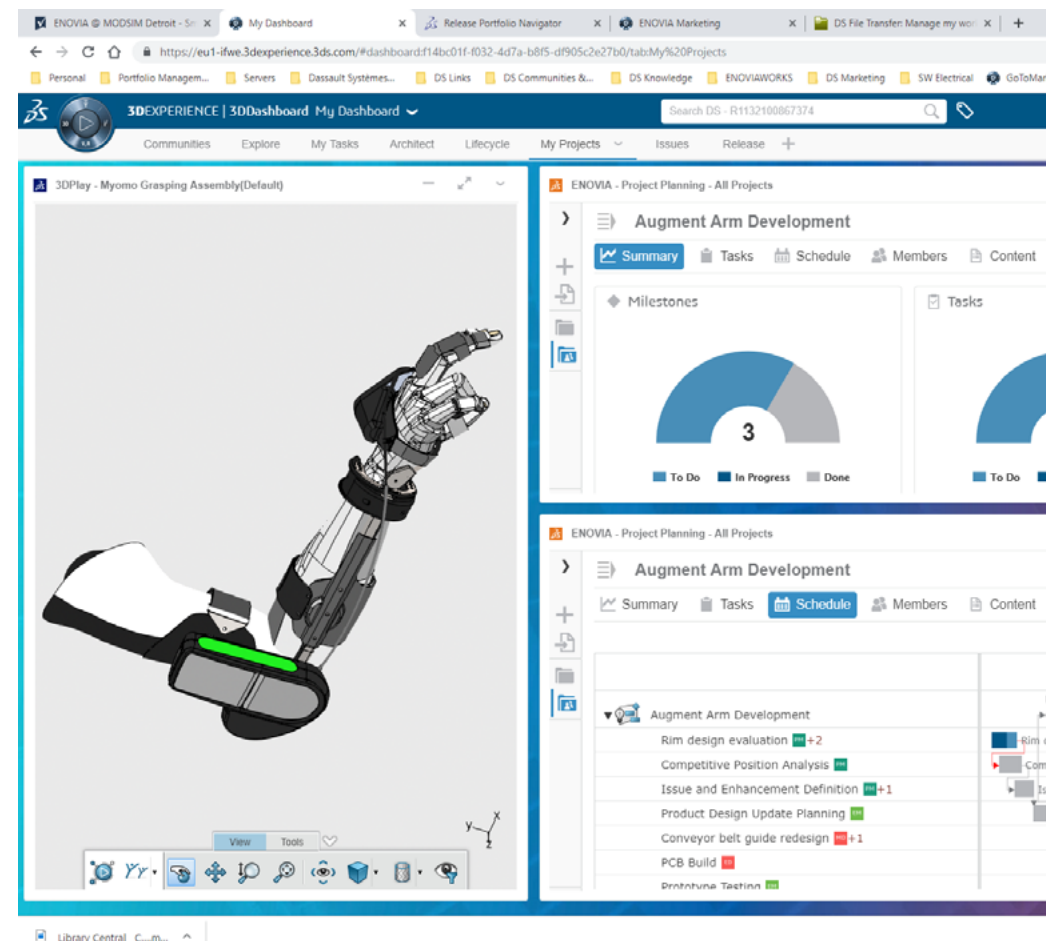
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Developing a concept is one of the first steps in the design cycle. The next one is to collaborate with a range of internal and external stakeholders to assess which design to move forward to detailed development. Subject matter experts provide input on manufacturability, cost, weight, and more. Executives contribute as well, giving their feedback and signing off on one of the concepts. A critical factor in this cooperative step is context. Responses from stakeholders often relate to specific sections of the design. A machinist might point out an underdraft that would result in a high-cost machining operation. A procurement agent suggests that switching to a functional equivalent material would result in a volume discount. An executive might require a change in colors. All of these people need to be able to visualize the design as well as attach comments or markups to specific pieces of its geometry. The objective is to get everyone to participate as quickly and as smoothly as possible. Unfortunately, there are significant barriers to that goal.

The most frequently approach used to enable this workflow today are file attachments and email. The first task is straightforward: attach a concept model to an email and send it out to all possible participants. After that, however, the problems kick in. Despite its ubiquity, email for collaboration has inherent shortcomings. Emails can be lost, forgotten, or deleted, adding significant delays in the review process. Email

attachments also have flaws: they fall out of date if the original model is changed. Likewise, feedback against the original may no longer be relevant. In addition, viewing concept designs requires specialized and unfamiliar 3D visualization tools that must be installed. All of this results in a messy, delayed, confusing workflow that undermines the original objective: get everyone to participate as quickly and as smoothly as possible.



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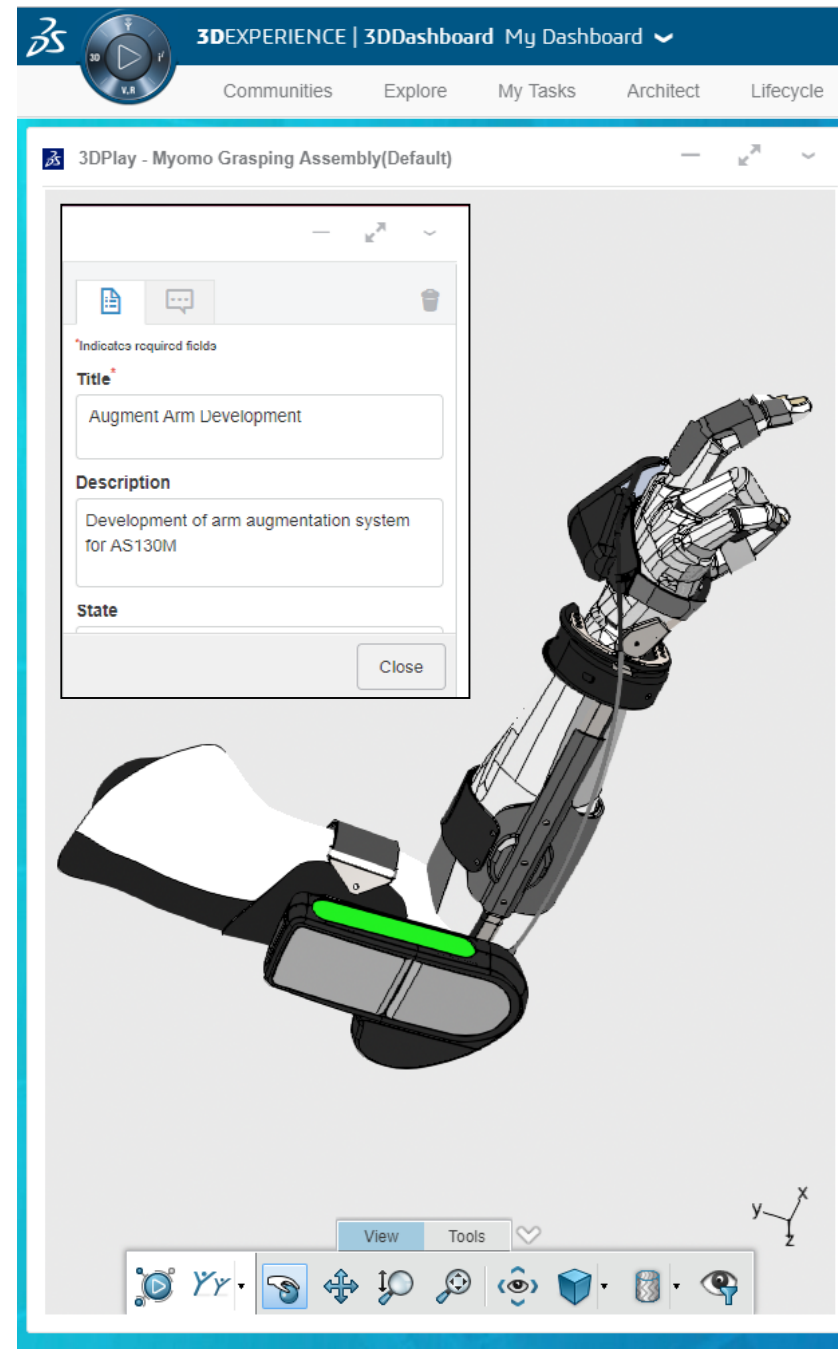
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This workflow is another area in which the new apps, 3D Sculptor and 3D Creator, can solve a variety of problems. Because they are browser-based, sharing is simple. Anyone can provide a simple link to subject matter experts and executives, no matter if they work inside or outside the company. Everyone can access the same up-to-date model simultaneously. That means providing feedback against the wrong version isn't even possible. Additionally, everyone can add comments and markups attached to specific geometry, removing all confusion about what feedback relates to what part of the design. Based on permissions, everyone can see each other's feedback. These apps, 3D Sculptor and 3D Creator enable that original objective: get everyone to participate as quickly and as smoothly as possible.

Note that 3D Sculptor and 3D Creator aren't just for companies that are running review and signoff processes today. They can enable this for companies that aren't doing it today as well. Running such a workflow allows companies to verify customer approval of designs and make better decisions earlier in the development process. It shouldn't be overlooked.



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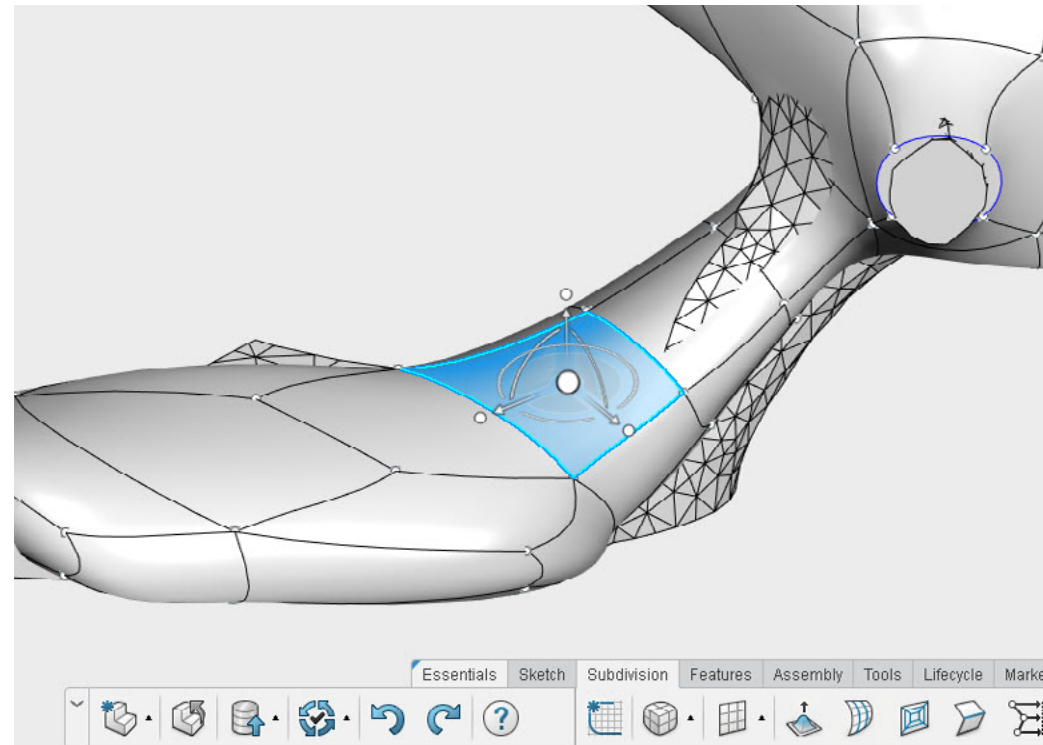
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In the last few years, the potential to use topology optimization and generative design in development has exploded. This technology can automate the creation of geometry based on structural simulations, removing sections of components that carry little to no load. The remaining material of the component is highly efficient from a functional perspective. Many companies are excited about applying this technology. Combined with 3D printing, engineers and analysts can create incredibly innovative and efficient designs. More companies are stepping forward with real applications every day.

Topology optimization and generative design, however, have some pitfalls. Namely, they produce faceted geometry that resembles a simulation mesh. Extensive modifications are required to prepare such models for manufacturing like machining or plastic injection molding. Unfortunately, making changes is difficult. There are no features underneath the geometry so it cannot be changed using parametric modeling. The end geometry is often wildly organic with few, if any, prismatic shape. As a result, direct modeling cannot be used to make changes either. Proponents of topology optimization and generative design are in a catch-22. They want to take advantage of the innovative new capabilities, yet they have few means to make the models manufacturable. All too often, engineers and analysts are forced to slowly and painstakingly remodel the design using parametric modeling.

With 3D Sculptor, there is a new streamlined way to get manufacturable models from topology optimization and generative design. 3D Sculptor's sub-d modeling allows you to create solid geometry over the top of faceted geometry quickly and easily. The critical enabler is the ability to add more controls to the geometry as needed. Anyone can tweak the sub-d geometry so it aligns closely with the faceted geometry. This approach is very similar to tracing an image with transparent paper. Of course, the 3D Sculptor app integrates with SOLIDWORKS and all the other **3DEXPERIENCE** apps. That means anyone can use the geometry developed with sub-d modeling as a SOLIDWORKS part. With this tool, you can realize the full potential of topology optimization and generative design.



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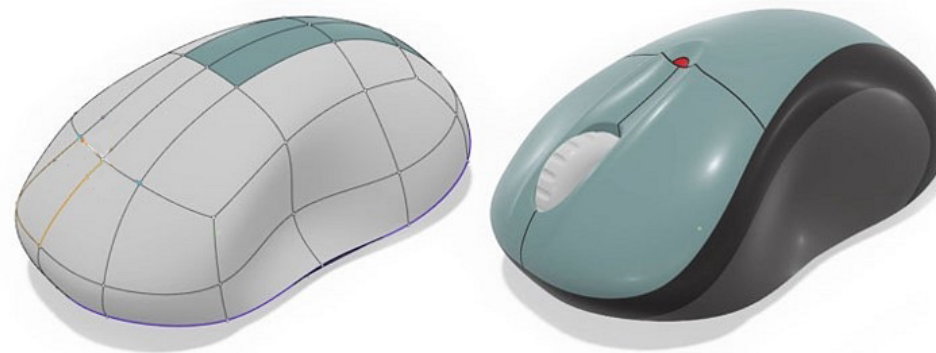
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Complex geometry and organic shapes are coming from many sources including surfacing tools, topology optimization results, and 3D scans. There's no doubt about that. At some point, though, those unusual forms must be turned into parts. Surfaces for a product must be broken up into many individual components. Some may become plastic parts. Others may be sheet metal components. They all must mount to some assembly. They all must conform to packaging. Engineers' objectives are to make this transition happen smoothly, quickly, and efficiently. Furthermore, they must be ready for a change to the original design. Transitioning from complex geometry and organic shapes into production parts is another stage of the design cycle with many deficiencies.

As noted earlier, the outer surface or shape of products are either created in separate tools or developed using curves with parametric modeling. Models built using the former approach must be imported, resulting in time painstakingly spent fixing broken geometry. Models using the latter approach are sensitive to changes, often resulting in cascading feature failures. Changes to the design initiate these processes, again and again, wasting time in the design cycle. Additionally, model files are often shared as attachments in emails. This approach introduces more risk for errors as emails might be lost, deleted, or misplaced or the file is out-of-date. These approaches do not support the engineer's objectives to make the transition smoothly, quickly, and efficiently.

In contrast, the 3D Sculptor and 3D Creator apps integrate seamlessly with SOLIDWORKS and the rest of the **3DEXPERIENCE** apps. The geometry created in 3D Sculptor using sub-d modeling is quick and easy to make. That geometry transitions smoothly into SOLIDWORKS and any other **3DEXPERIENCE** app. Once the surface or shape is broken down into components, SOLIDWORKS can be used to develop machining toolpaths, create plastic injection molds, engineering documentation, or any other deliverable needed to take the product to production. Furthermore, changes made in one place show up in all apps. There is no recreating models. There is no fixing broken geometry. These browser-based apps make sure everything is up-to-date. Overall, these capabilities directly support the engineer's objectives to make the transition smoothly, quickly, and efficiently.



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To date, incorporating complex geometry and organic shapes have been a painful and challenging ordeal. It has resulted in significant time-wasters such as recreating models, fixing broken geometry, working against out-of-date files, delayed feedback, and many other detriments. The release of 3D Sculptor and 3D Creator is aimed directly at improving four distinct workflows that eliminate these issues.

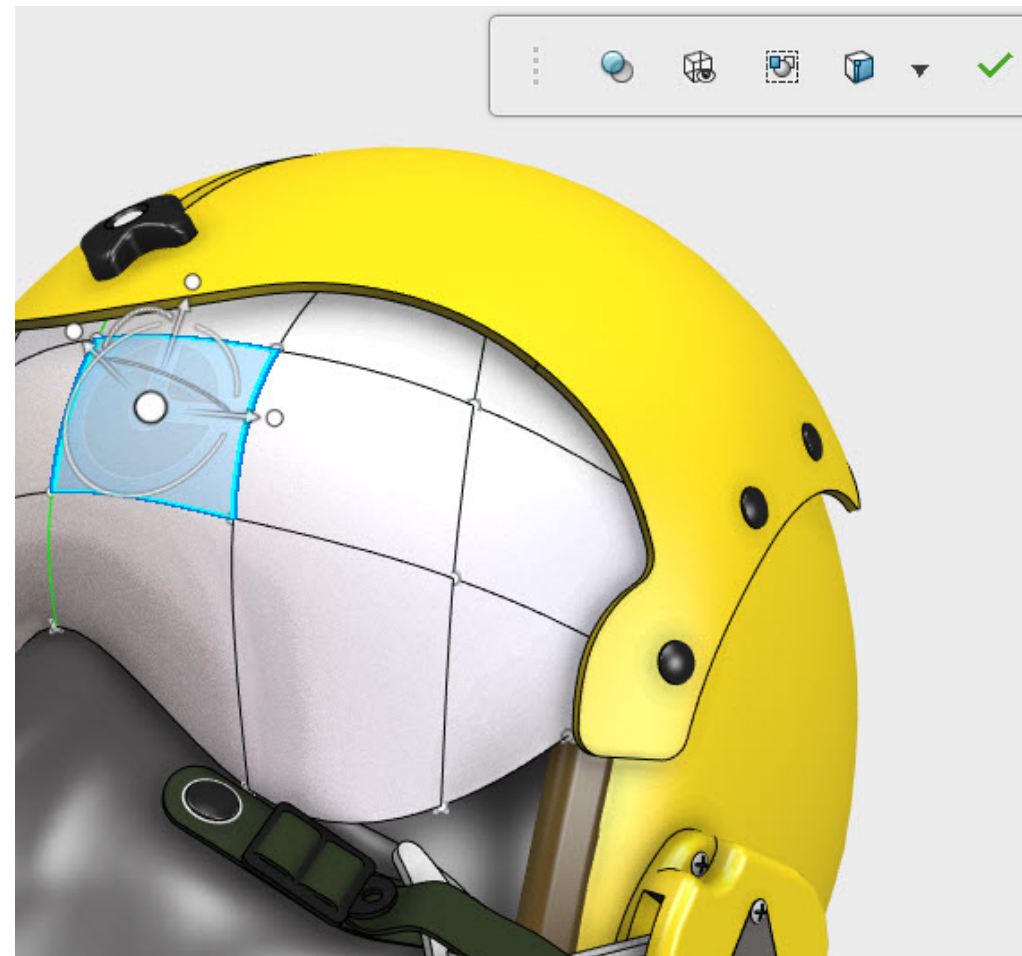
In concept designs, industrial designers, digital sculptors, and mechanical engineers can create complex geometry and organic shapes with sub-d modeling through 3D Sculptor and parametric modeling through 3D Creator. These apps allow anyone to build out and iterate concepts quickly and easily. When it comes to reviewing and signing off on concepts, 3D Sculptor and 3D Creator offer serious advantages. The apps allow internal and external subject matter experts as well as executives to provide feedback in the context of the design through a web browser. Everyone can participate quickly and smoothly.

Topology optimization and generative design represent a significant opportunity to increase innovation while creating efficient designs. With 3D Sculptor, anyone can develop smooth geometry over the top of facet geometry, much like tracing. This capability eliminates that painstaking and arduous recreation of geometry.

Finally, engineers must split all of this complex geometry into individual parts for production — models created in 3D Sculptor and 3D Creator transition smoothly, quickly, and easily into

SOLIDWORKS and any other **3DEXPERIENCE** app. From there, engineers can produce parts for use with machining, tooling design, documentation and much more.

Dealing with complex geometry and organic shapes in the design cycle has often been difficult. However, the 3D Sculptor and 3D Creator apps streamline the process and eliminate non-value add tasks. Isn't it time to try it out?



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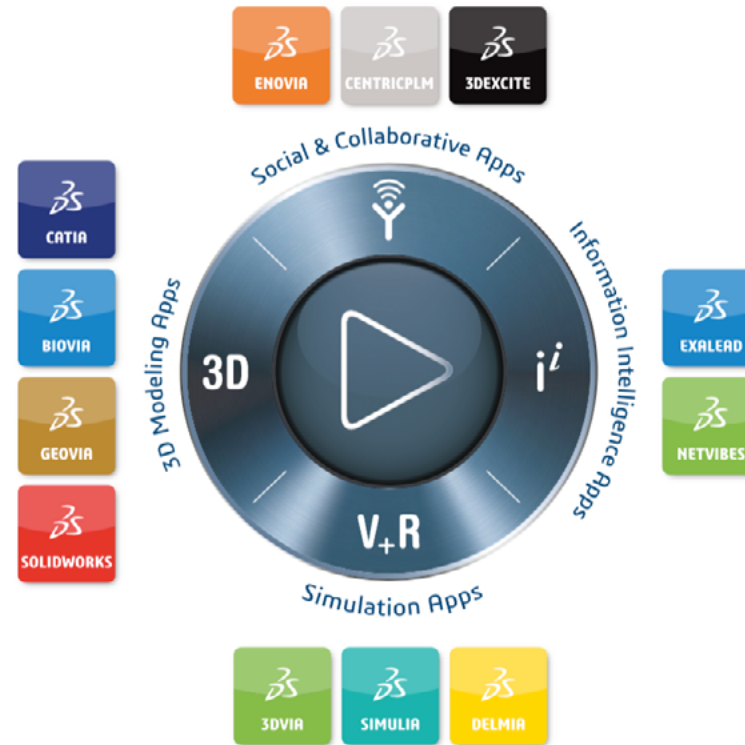
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Dassault Systèmes, the 3DEXPERIENCE® Company, provides business and people with virtual universes to imagine sustainable innovations. Its world-leading solutions transform the way products are designed, produced, and supported. Dassault Systèmes' collaborative solutions foster social innovation, expanding possibilities for the virtual world to improve the real world. The group brings value to over 250,000 customers of all sizes in all industries in more than 140 countries. For more information, visit www.3ds.com.



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