

Design for CNC with Fusion 360 & Bantam Tools

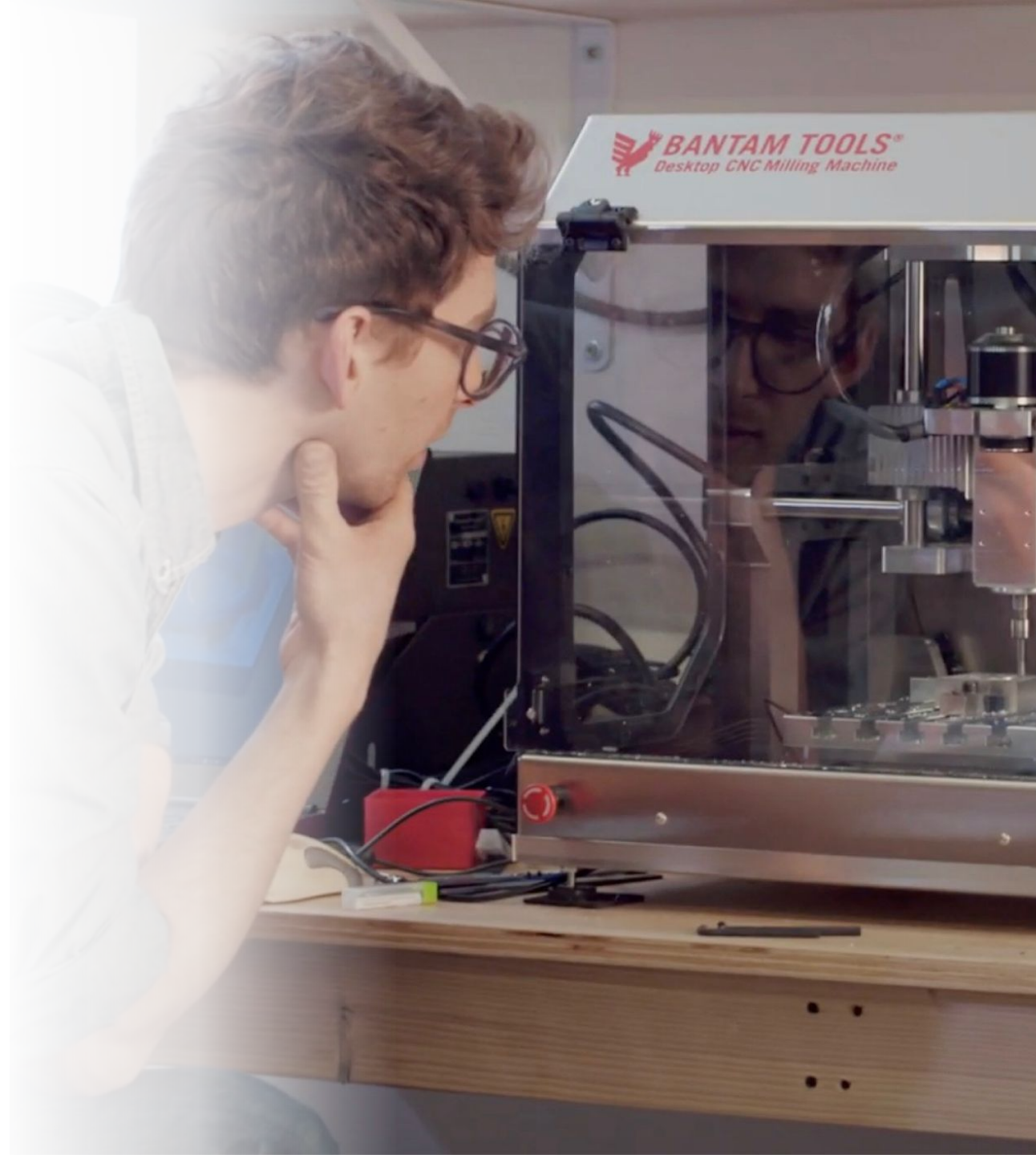
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Technical Consultant

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AGENDA

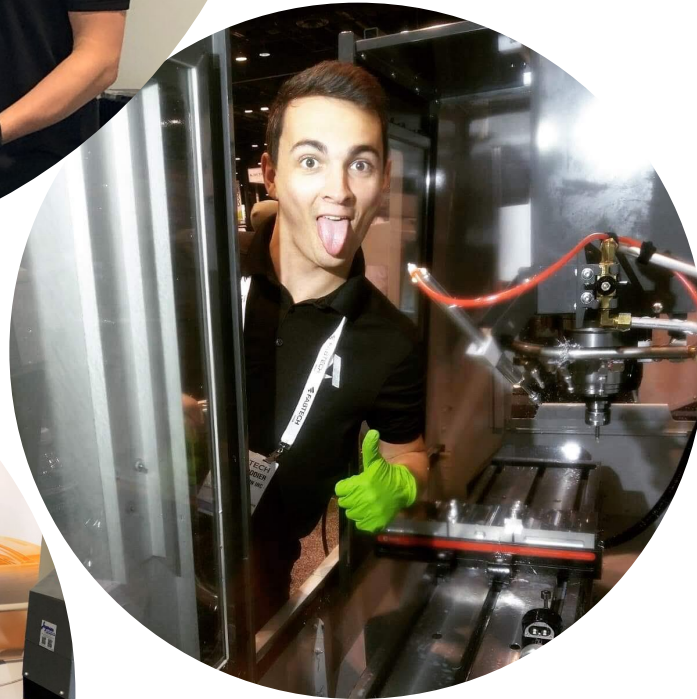
- Challenges for CAD users
- How is a Part Programmed?
- How is Fusion 360 Different?
- Introduction to Fusion 360
- Introduction to Tooling
- Design Considerations
- Manufacturing Considerations
- Software Demo
- Rendering in Fusion 360
- Q&A



Graham Goodier

About me:

- Based in Birmingham, UK
- Technical Consultant
- Been at Autodesk for 5 years
- Started off working with FeatureCAM
- Now a Fusion 360 expert
- Regular user of CNC Machinery
- Travel regularly between USA and Europe for Fusion events (pre-Covid!)



The background features several 3D CAD models of mechanical parts. On the left, a large, light blue, curved component is shown. To its right, a white, angular part is visible. In the foreground, a blue, curved part is shown, and to the right, a blue, angular part is visible. The models are rendered with a grid pattern, indicating they are CAD files. The overall scene is set against a light blue background.

Challenges for CAD Users

CHALLENGES FOR CAD USERS

- Changes in a CAD design often don't adjust designs correctly
 - Geometry relationships are purely dimensional
- Constant importing/exporting of CAD models is time consuming and can lead to a mix up of versions
- Collaborating between teams can be difficult
 - Changes - and who made them - on collaborative projects are also difficult to track
- CAM considerations – designers may not be aware of manufacturing constraints required for a design
- CAD users often have to learn separate CAD and CAM software for design and manufacture



The image features a 3D rendered scene of several blue mechanical parts, possibly gears or components of a machine, arranged on a highly reflective surface. The parts are rendered with a smooth, metallic blue finish and are shown from various angles, creating a sense of depth and perspective. A prominent white, semi-transparent rectangular box is overlaid on the left side of the image, containing the text "How is a Part Programmed?". The background is a light, neutral color, which makes the blue parts stand out. The overall aesthetic is clean and technical, typical of a presentation or educational material related to manufacturing or computer-aided design (CAD).


How is a Part Programmed?

HOW IS A PART PROGRAMMED?

- A **CAD model** is produced, depicting the part to be cut
- **Stock** material is determined from the part size
- A **Setup** (Work Co-ordinate System) is determined that the machine tool uses as positional reference
- **Tools & Machining Parameters** appropriate for the job are selected
- **Toolpaths** are created based on the features of the part, taking into account the stock material
- **Simulation** of toolpath helps avoid gouges/collisions
- **NC Code** is output using a post processor
- NC Code is input into the machine controller and the part is **cut on the machine tool**

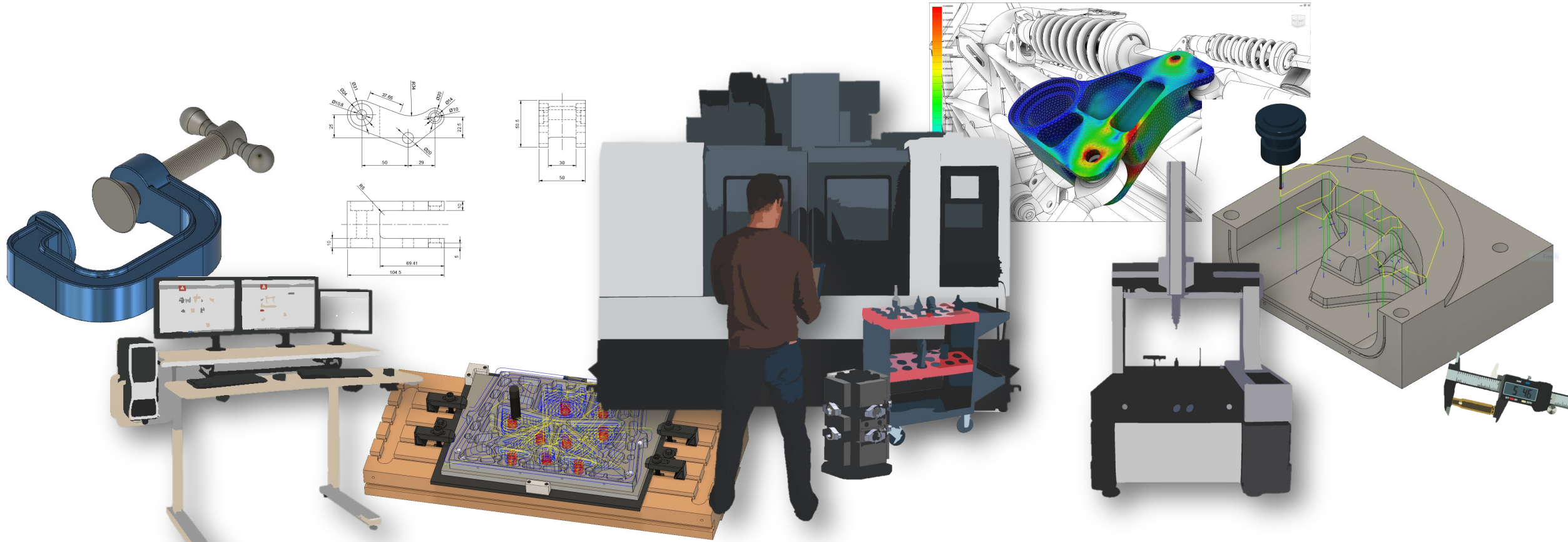


What is Fusion 360?

The background features a complex, abstract design with various shades of blue and white. It includes curved, layered shapes that resemble architectural or organic forms, some with fine grid-like patterns. A prominent white semi-transparent trapezoidal shape is positioned in the upper-middle section, serving as a container for the text.

How is Fusion 360 Different?

HOW IS FUSION DIFFERENT?



SCOPE → DESIGN → PROGRAM → PREP → SETUP → RUN → INSPECT → USE

Engineer to order product

Imported Geometry

Sales adjusts order size, Nest

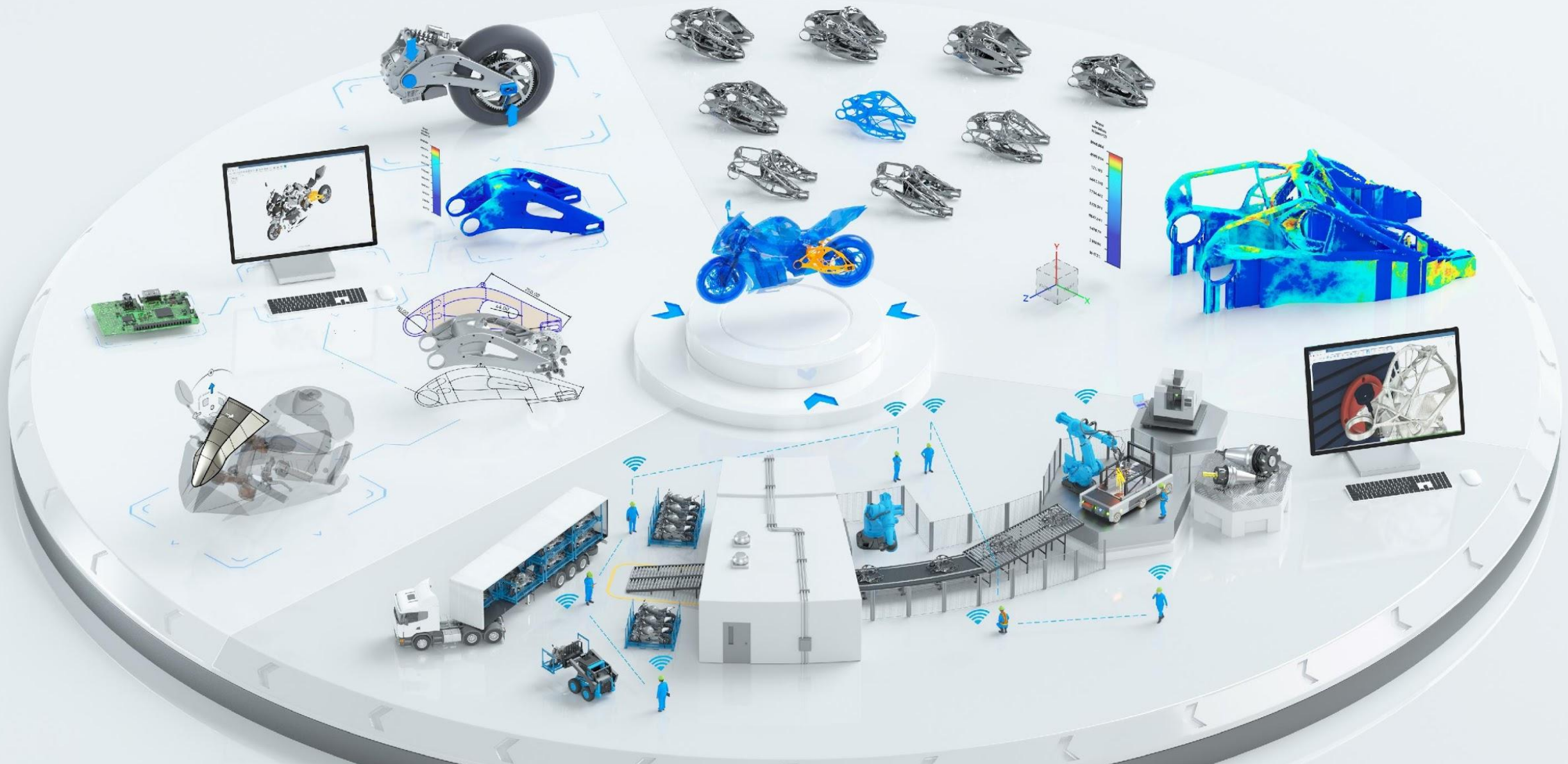
Change in Schedule

Change Tools / Holder

Adjust Speeds & Feeds

Adjust mating components to fit

As-Built Solid for OEM

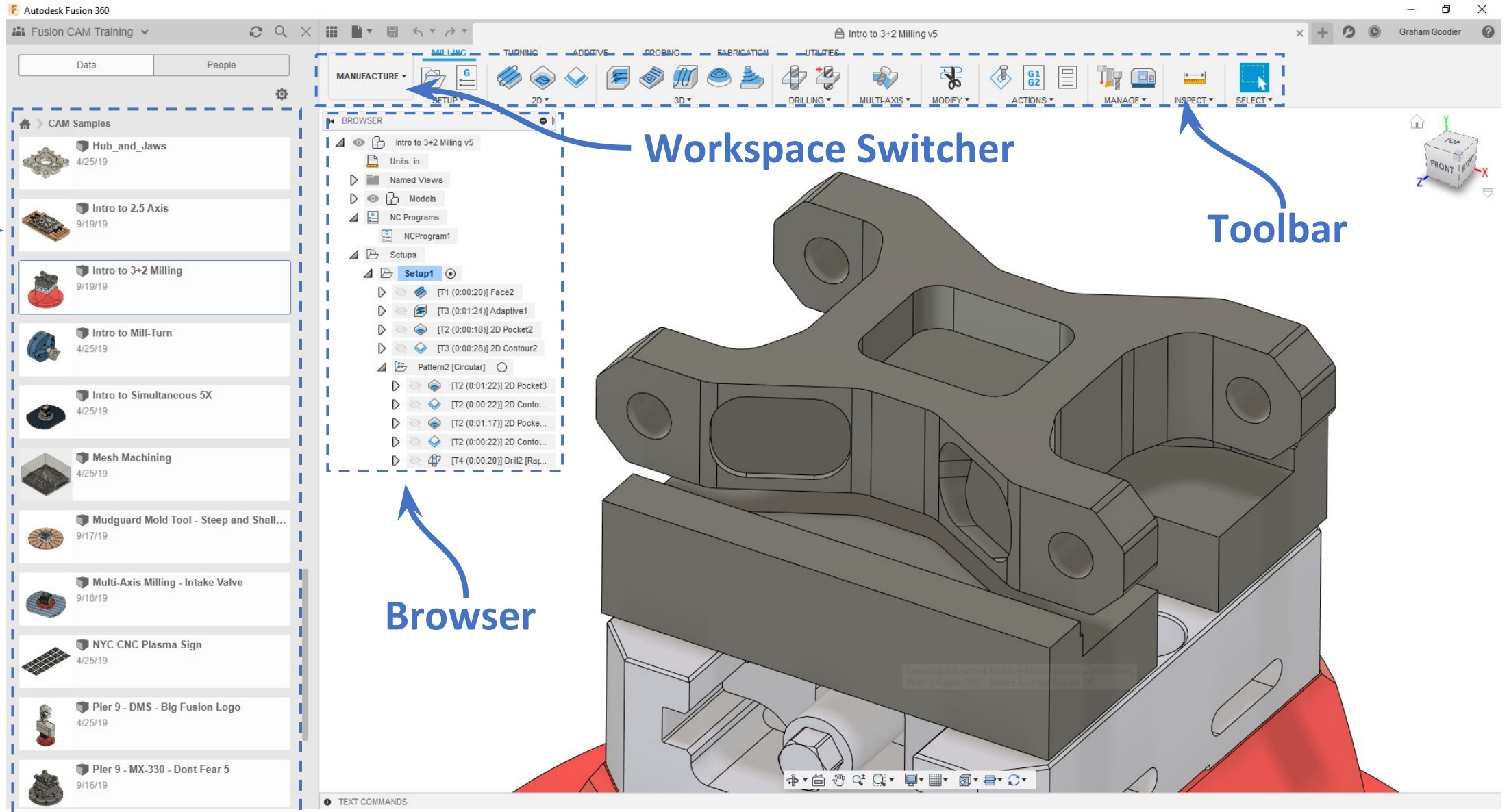


CONVERGENCE OF DESIGN & MANUFACTURING

The image features a 3D rendered scene of blue mechanical components. In the foreground, a large, curved, light blue part with a fine grid texture is visible. Behind it, several other blue parts are stacked or arranged, some showing a similar grid texture and others with smoother surfaces. A semi-transparent white rectangular area is overlaid on the upper left portion of the image, containing the text 'Fusion 360 Workflow'. The background is a soft, light blue gradient.

Fusion 360 Workflow

FUSION 360 LAYOUT

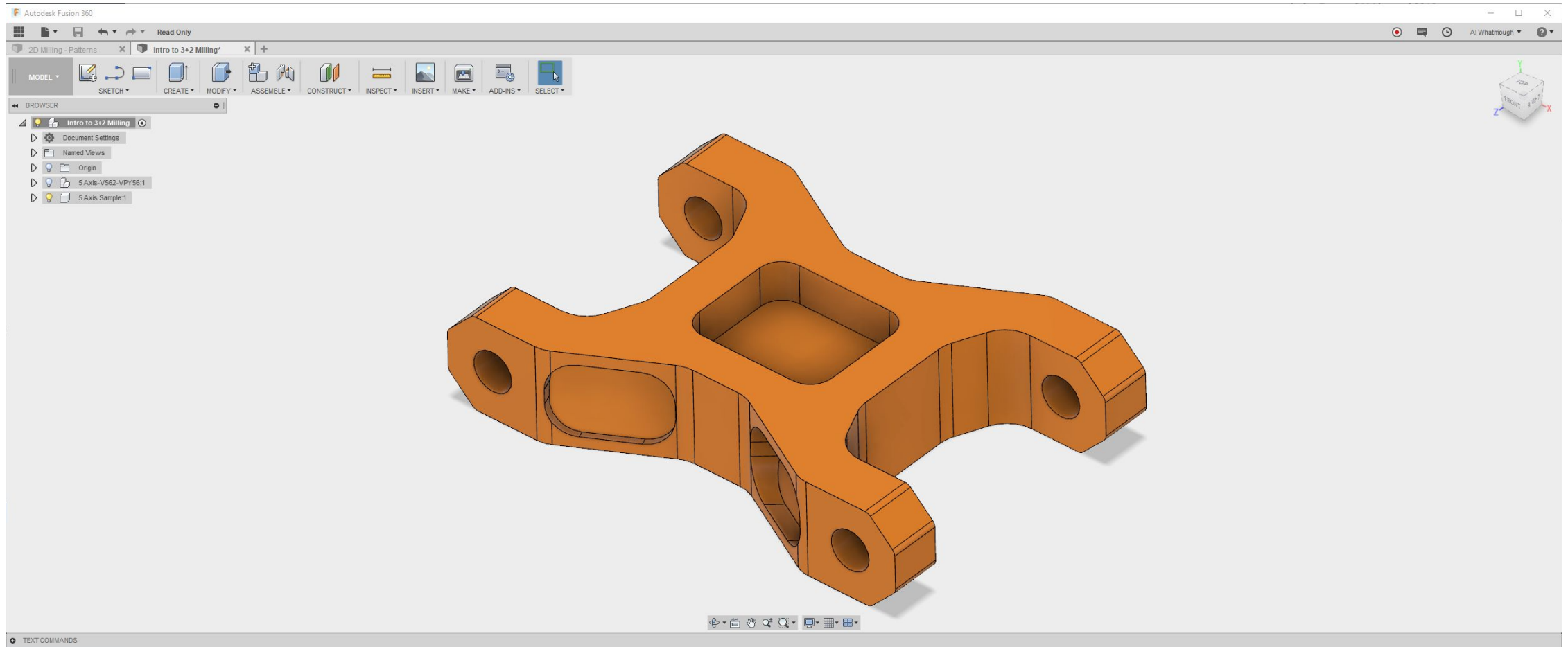


Data Panel

Workspace Switcher

Toolbar

Browser



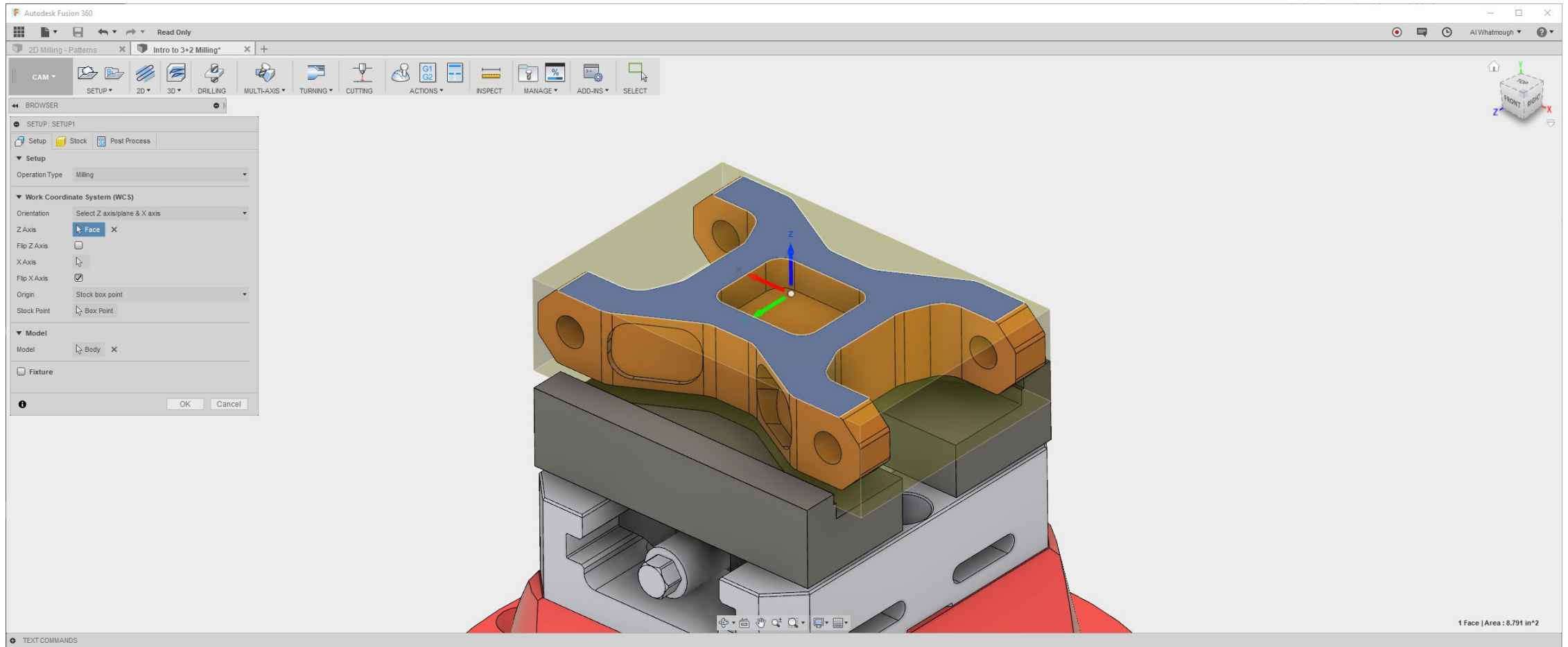
**Create/Open CAD
Data**

**Define Job
Setup**

**Define
Operations**

**Simulate
Toolpath**

NC Code



Create/Open
CAD Data

Define Job
Setup

Define
Operation

Simulate
Toolpath

NC Code

ADAPTIVE : ADAPTIVE1

Tool Geometry Heights Passes Linking

▼ Passes

Tolerance: 0.004 in

Machine Shallow Areas:

Optimal Load: 0.2 in

Minimum Cutting Radius: 0.05 in

Machine Cavities:

Use Slot Clearing:

Direction: Climb

Maximum Roughing Stepdown: 1.25 in

Fine Stepdown: 1.25 in

Flat Area Detection:

Minimum Stepdown: 0.5 in

Minimum Axial Engagement: 0 in

Order by Depth:

Order By Area:

▼ Stock to Leave

Radial Stock to Leave: 0.02 in

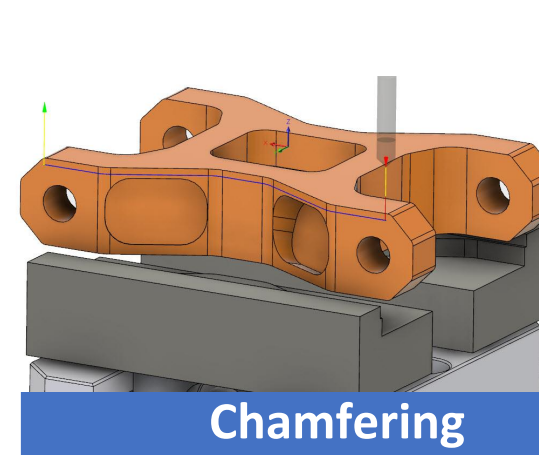
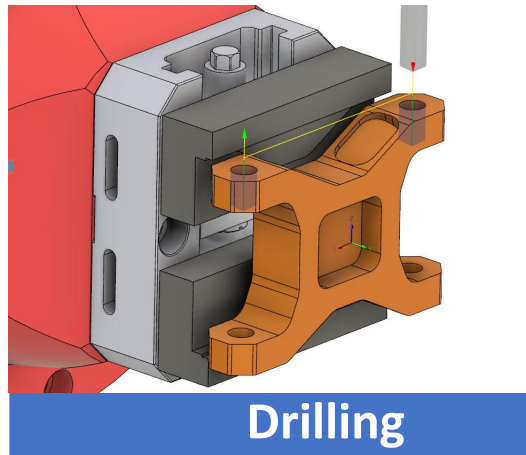
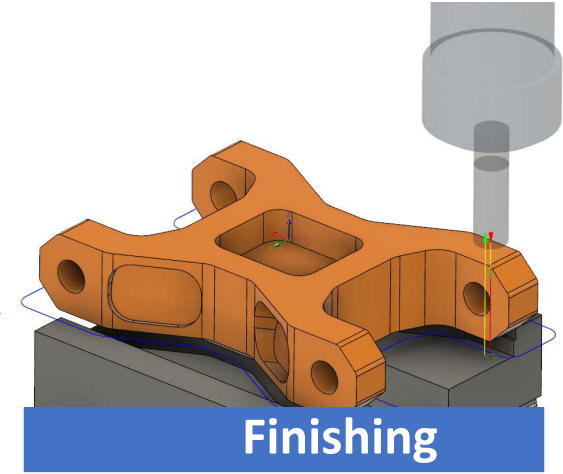
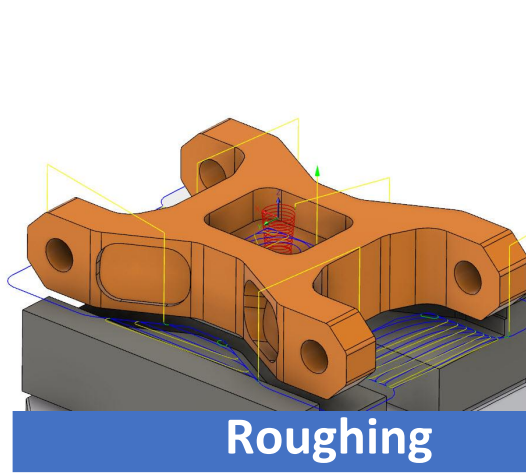
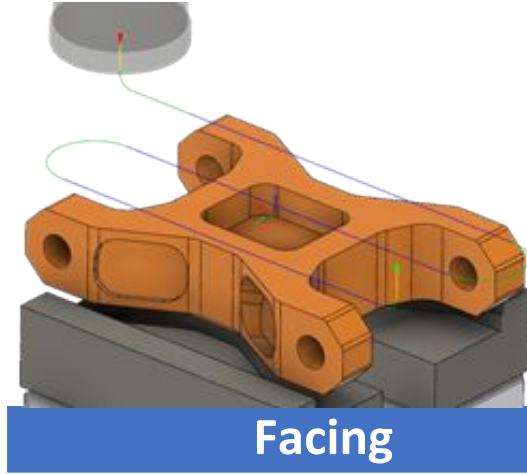
Axial Stock to Leave: 0 in

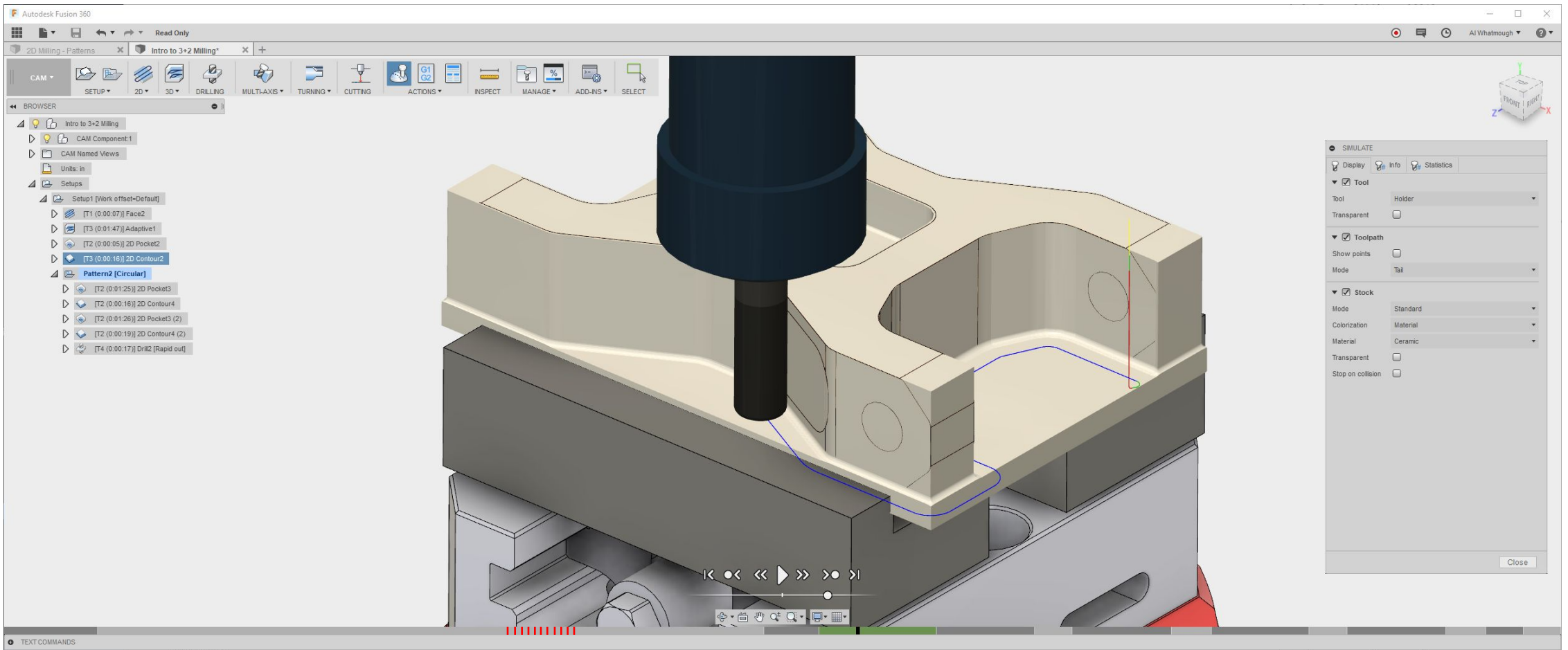
Fillets

Smoothing

Feed Optimization

OK Cancel





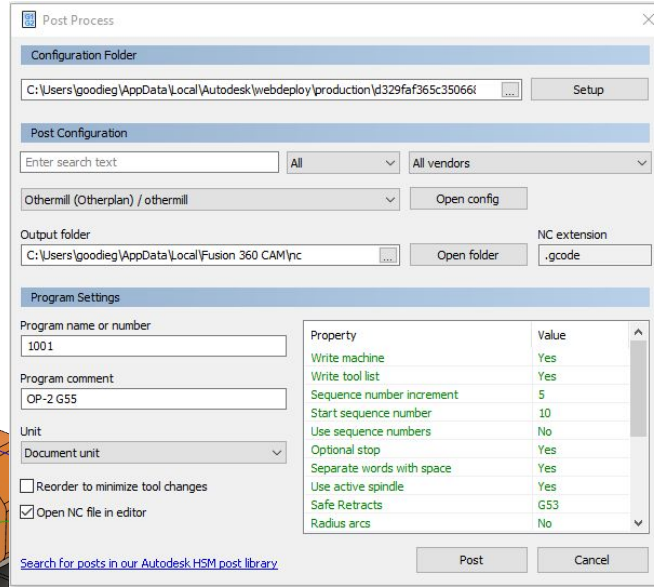
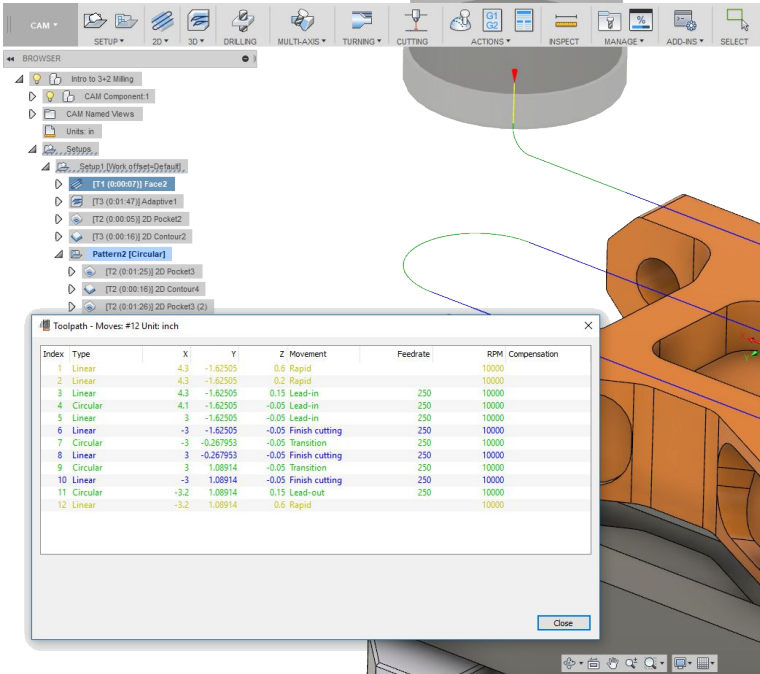
Create/Open
CAD Data

Define Job
Setup

Define
Operation

Simulate
Toolpath

NC Code



```

1 %
2 O01001 (2ND OP)
3 (Using high feed G1 F650. instead of G0.)
4 (Machine)
5 ( vendor: Haas Automation)
6 ( model: HAAS UMC-750)
7 (T2 D=0.25 CR=0. - flat end mill)
8 N10 G90 G94 G17
9 N15 G20
10 N20 G53 G0 Z0.
11
12 (2D Pocket3)
13 N30 T2 M6
14 N35 S5000 M3
15 N40 G54
16 N45 G53 X-29. Y-8.
17 N50 G0 B75. C118.301
18 N55 G254
19 N60 M8
20 N70 G0 X0.9208 Y-1.6474
21 N75 G43 Z3.6748 H2
22 N80 G0 Z1.1113
23 N85 G1 Z1.0363 F39.37
24 N90 G3 X0.9218 Y-1.6467 Z1.0287 I-0.0623 J0.1011 F13.123
25 N95 X0.9247 Y-1.6449 Z1.0218 I-0.0633 J0.1005
26 N100 X0.929 Y-1.6418 Z1.0163 I-0.0661 J0.0986
27 N105 X0.9343 Y-1.6377 Z1.0127 I-0.0705 J0.0956
28 N110 X0.9399 Y-1.6327 Z1.0113 I-0.0758 J0.0914
29 N115 X0.9321 Y-1.6395 Z0.9856 I-0.0814 J0.0865
30 N120 X0.9237 Y-1.6455 Z0.9599 I-0.0735 J0.0932
31 N125 X0.9148 Y-1.6508 Z0.9342 I-0.0651 J0.0993
32 N130 X0.9055 Y-1.6553 Z0.9085 I-0.0562 J0.1046
33 N135 X0.8958 Y-1.659 Z0.8828 I-0.0469 J0.1091
34 N140 X0.8858 Y-1.6618 Z0.8571 I-0.0372 J0.1128
35 N145 X0.8756 Y-1.6638 Z0.8314 I-0.0272 J0.1156
36 N150 X0.8653 Y-1.6648 Z0.8057 I-0.0171 J0.1175
37 N155 X0.855 Y-1.6649 Z0.78 I-0.0068 J0.1186
38 N160 X0.8446 Y-1.6642 Z0.7543 I0.0036 J0.1187
39 N165 X0.8344 Y-1.6625 Z0.7286 I0.0139 J0.1179
40 N170 X0.8244 Y-1.66 Z0.703 I0.0242 J0.1163
41 N175 X0.8146 Y-1.6565 Z0.6773 I0.0342 J0.1137
42 N180 X0.8051 Y-1.6523 Z0.6516 I0.044 J0.1103
43 N185 X0.7961 Y-1.6472 Z0.6259 I0.0534 J0.1061
44 N190 X0.7875 Y-1.6414 Z0.6002 I0.0625 J0.101
45 N195 X0.7795 Y-1.6349 Z0.5745 I0.071 J0.0952
46 N200 X0.7721 Y-1.6276 Z0.5488 I0.0791 J0.0886
47 N205 X0.7653 Y-1.6198 Z0.5231 I0.0865 J0.0814
48 N210 X0.7593 Y-1.6114 Z0.4974 I0.0932 J0.0735
49 N215 X0.8586 Y-1.4275 Z0.4803 I0.0993 J0.0651

```



The background features a series of overlapping, semi-transparent blue and white geometric shapes, possibly representing a stack of papers or a modern architectural design. These shapes are reflected on a glossy, light blue surface below them. A white, trapezoidal shape is overlaid on the left side of the image, containing the text.

Introduction to Tooling

Types of Tools

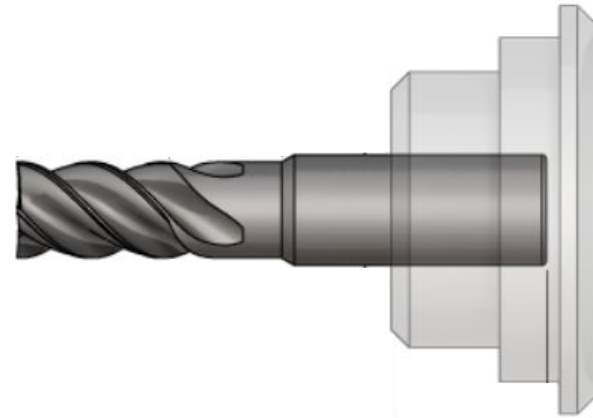
Types of tool

Flat End Mill

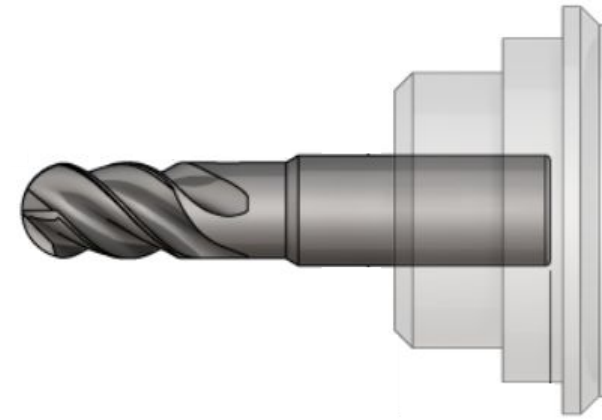
- Used primarily for roughing strategies – can also be used for finishing strategies
- Some non-flat end mills have tip radius', tapers and more
- Can cut in all directions

Ball Nose Mill

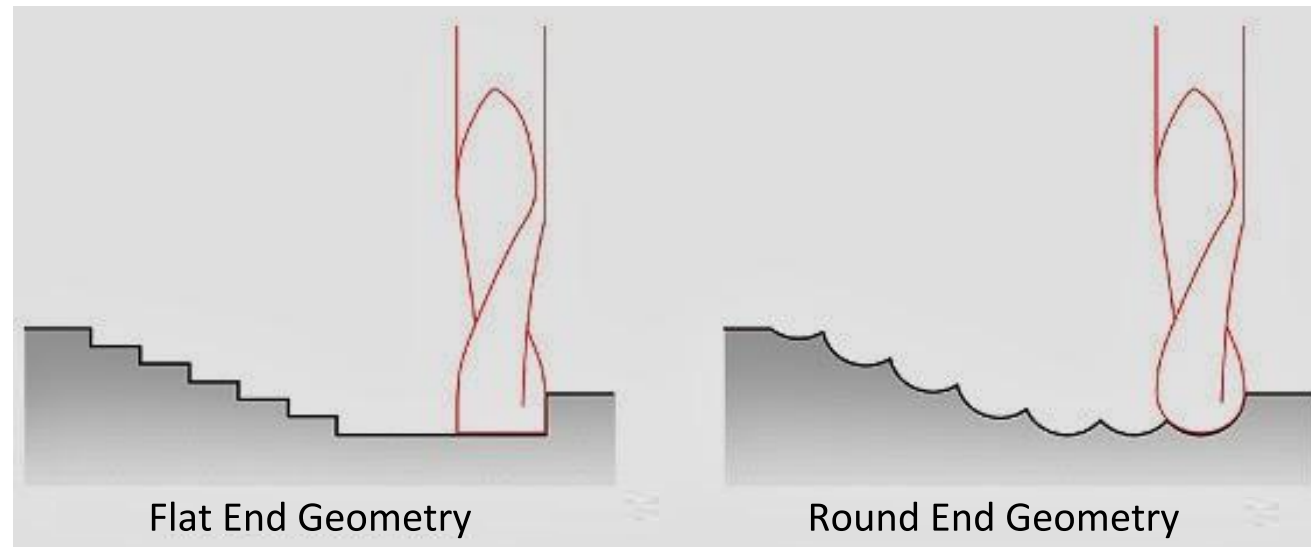
- Used primarily for finishing strategies - typically used on complex surfaces
- Too large a stepover can cause cusps on the part surface



Flat End Mill



Ball Nose End Mill

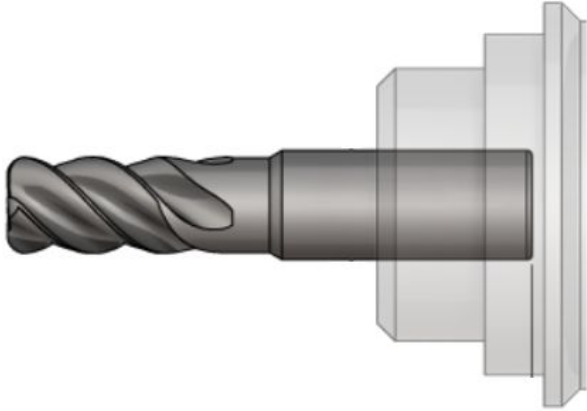


Flat End Geometry

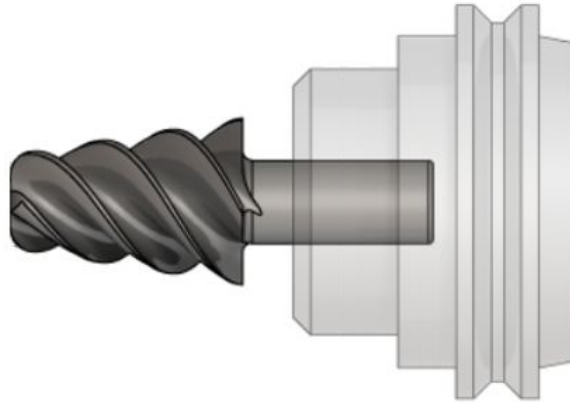
Round End Geometry

Types of tool

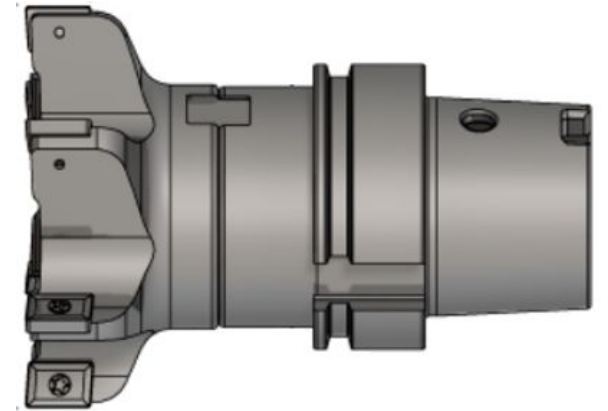
Bull Nosed End Mill



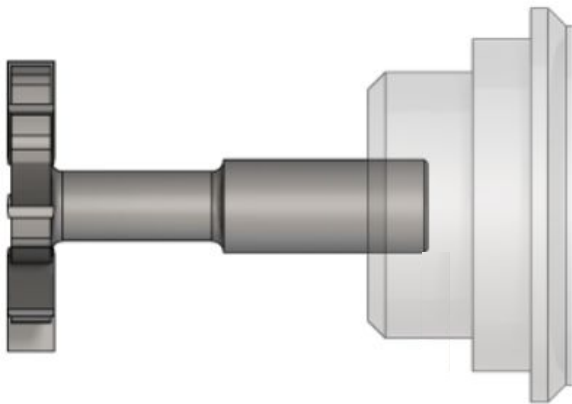
Tapered End Mill



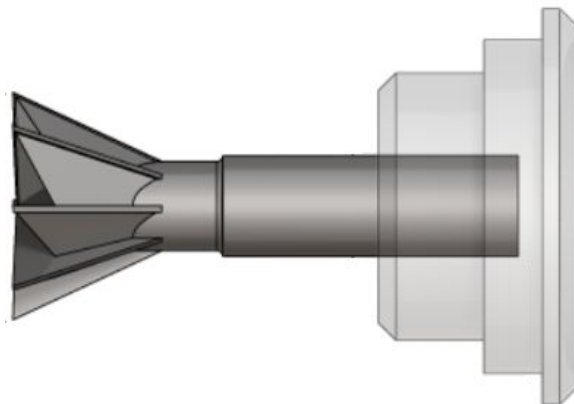
Face Mill



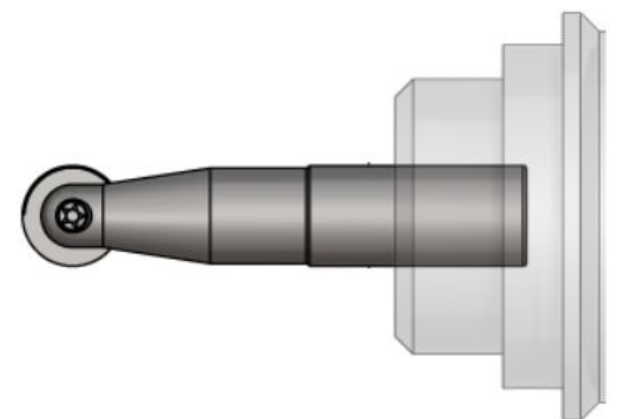
Slot Mill



Dove Tail Mill

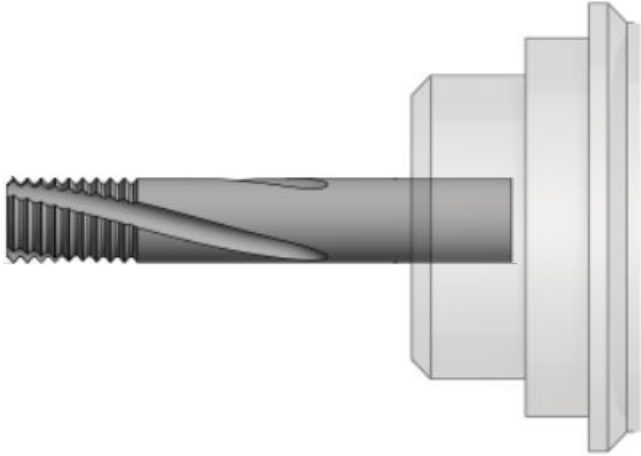


Lollipop Cutter

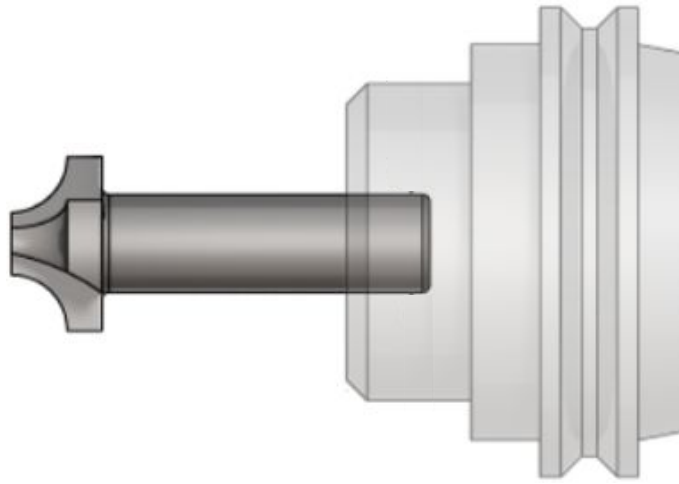


Types of tool

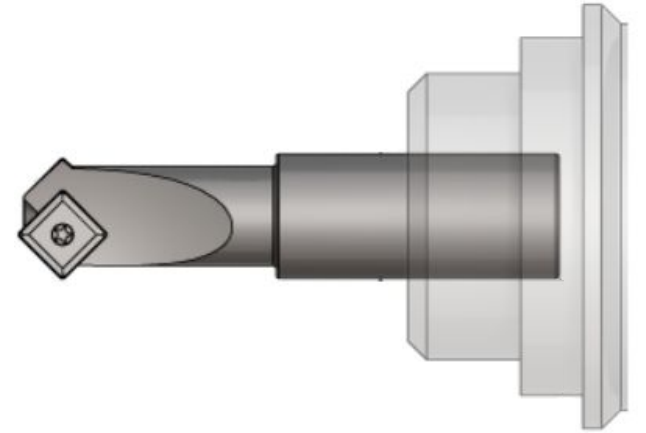
Thread Mill



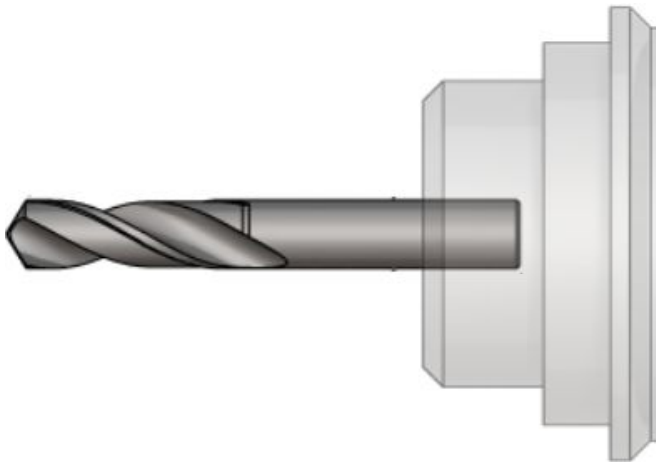
Radiused End Mill



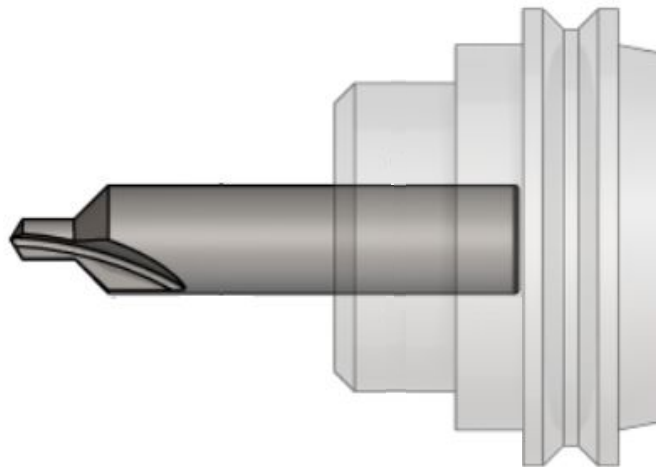
Chamfered End Mill



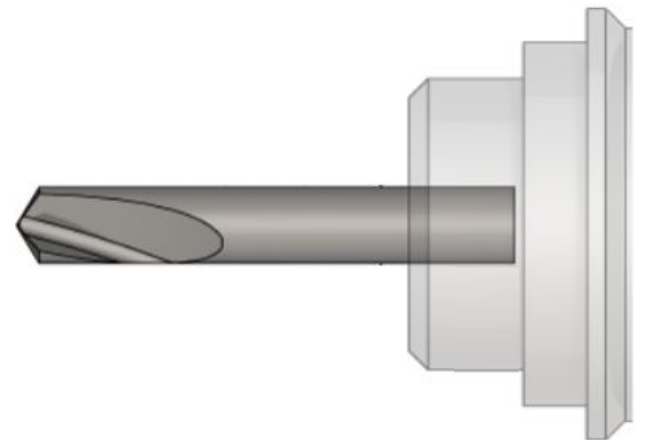
Drill



Center Drill



Spot Drill



The background features a complex, layered geometric design in shades of light blue and white. It consists of numerous overlapping, semi-transparent planes and surfaces that create a sense of depth and movement. A prominent white diagonal shape, resembling a large, stylized 'Z' or a series of overlapping planes, cuts across the center of the image. The overall aesthetic is clean, modern, and architectural.

Design Considerations

CAD Considerations

There are a few factors to consider when designing a part / editing a part:

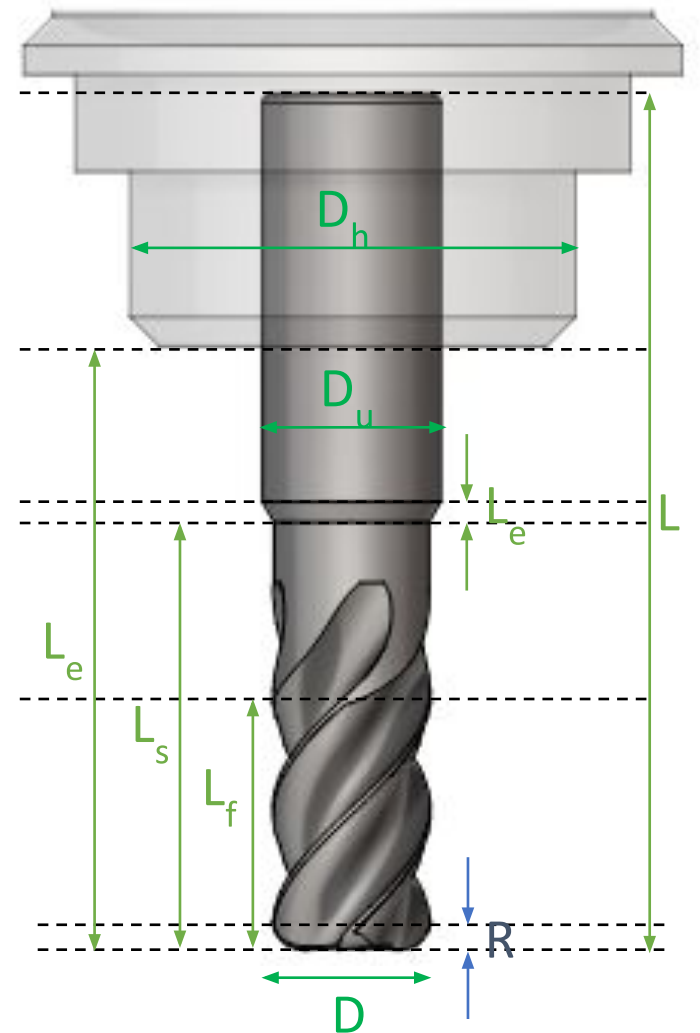
- Ensure a tool can access all areas of the part
 - Sharp corners cannot be cut using circular tools
 - The flute length must be more than the depth of cut
 - The tool must be able to enter the material safely
 - The holder must not collide with the part
- Ensure your part is the correct size/material for the specific machine
- Ensure the part can be machined by the type of machine you are using
 - Look at the type of geometry you select and whether it can be held



Tool Considerations in Design

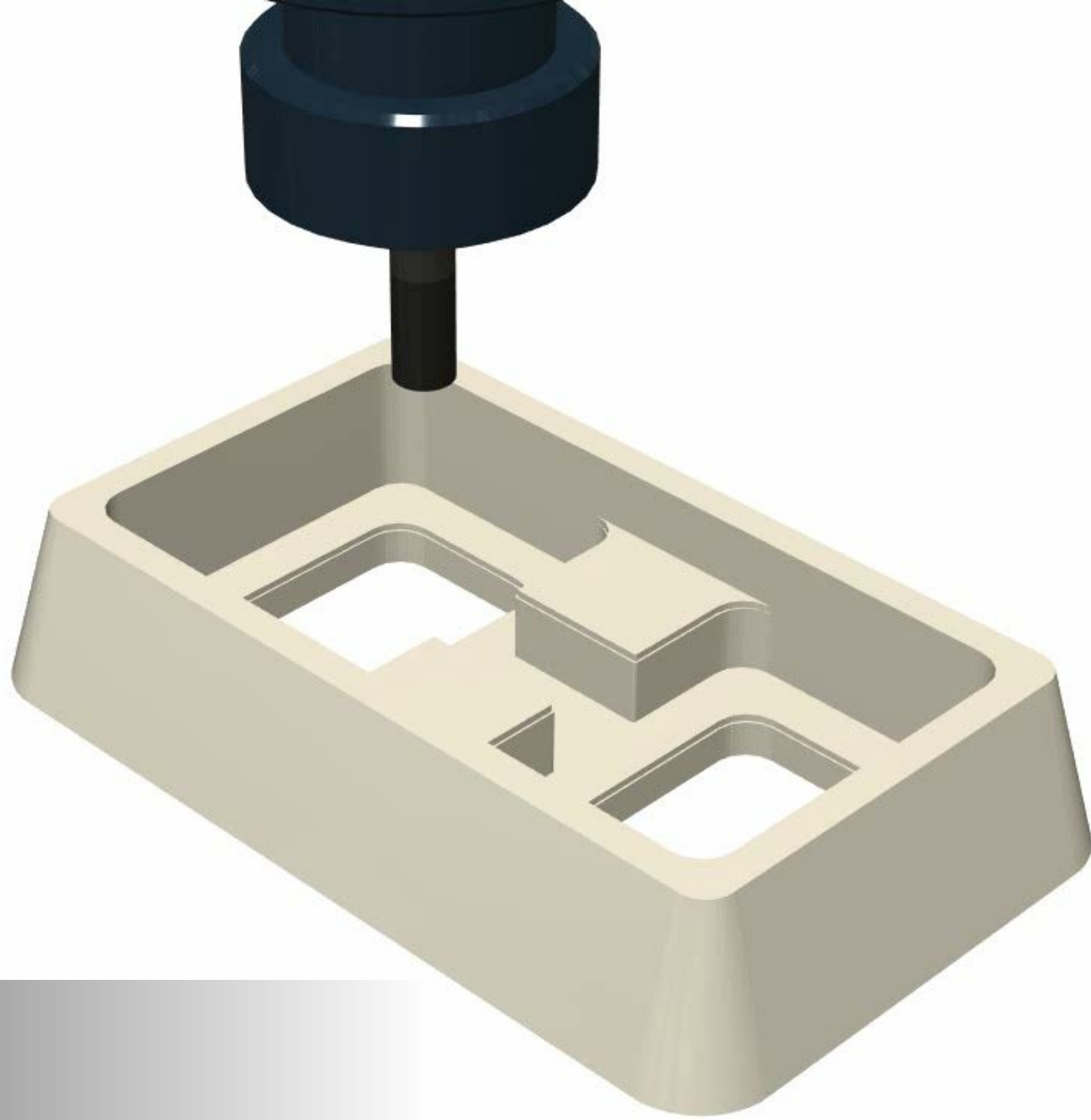
There are a few measurements of a tool that you must take into account:

- **Overall Length (L)** – Total length of the tool
- **Flute Length (L_f)** – Length of the cutting part of the tool
- **Shoulder Length (L_s)** – Length below the shaft change
- **Exposed Length (L_e)** – Length below the holder
- **Tool Diameter (D)** – Diameter of the flute of the tool
- **Shaft Diameter (D_u)** – Upper diameter of the tool which is held in the holder
- **Holder Diameter (D_h)** – Diameter of the tool holder
- **Tip Radius (R)** – Radius of the tool (if applicable)

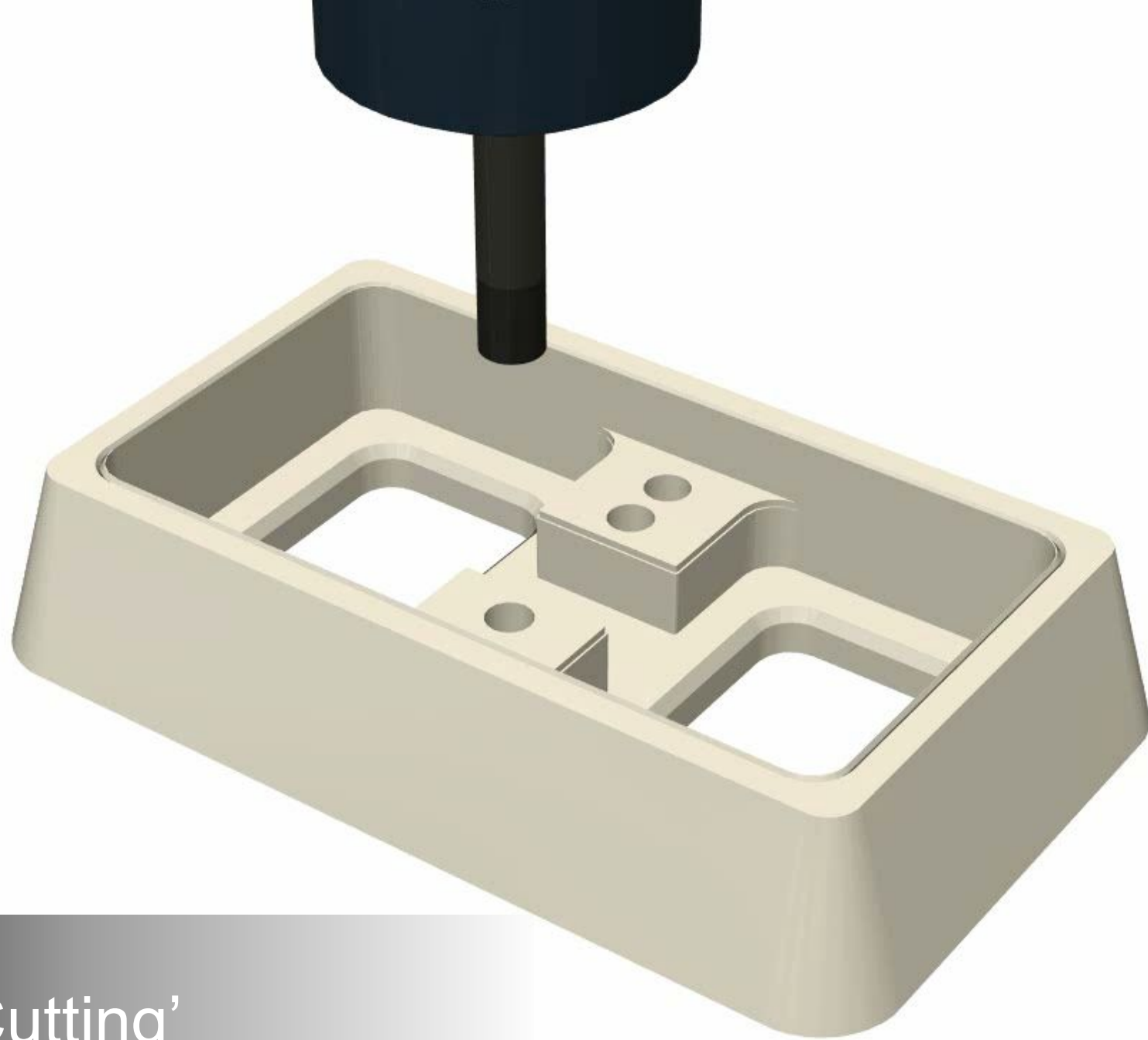


Examples of Poor Design for Manufacturing Considerations

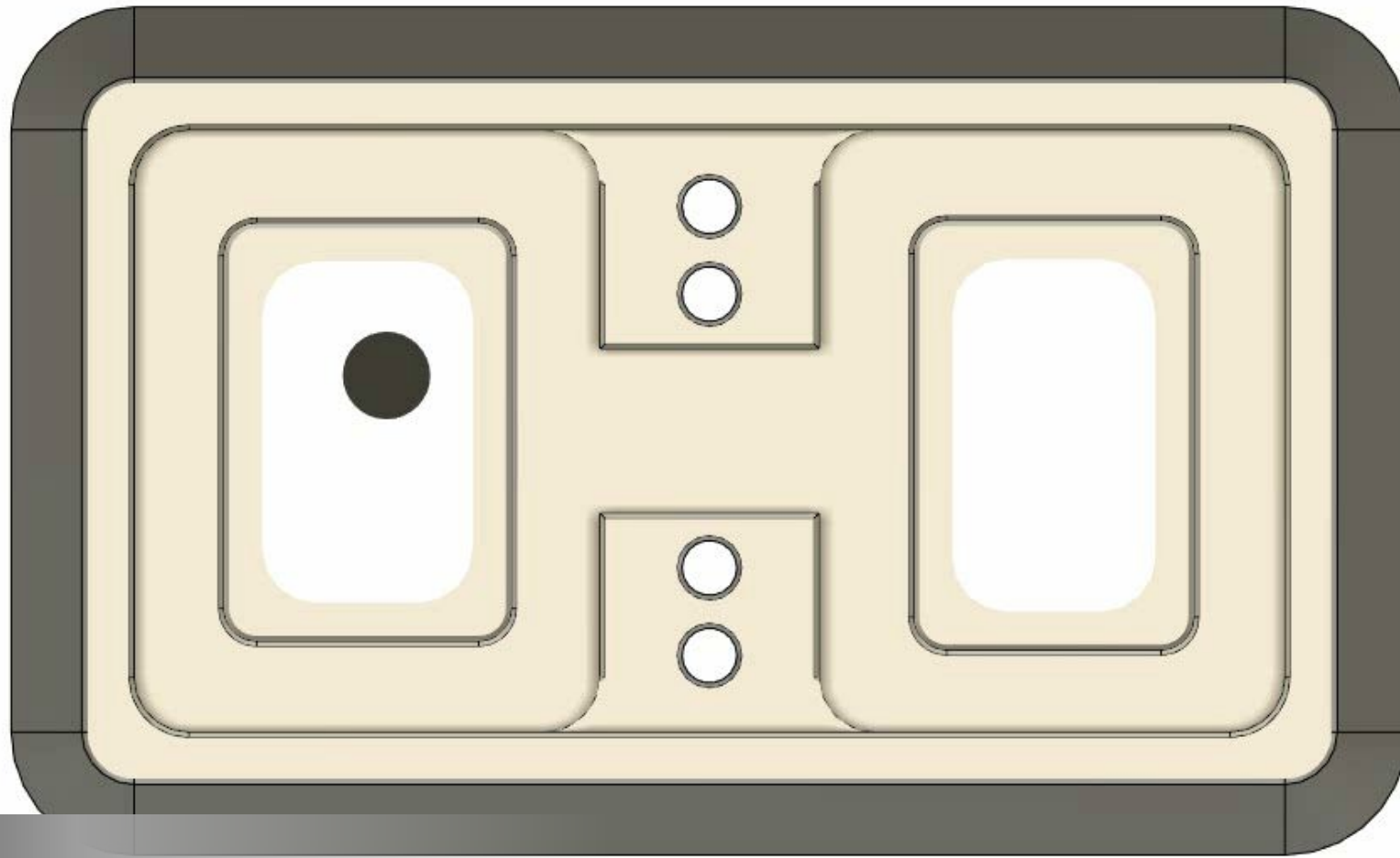




Holder Gouges



Non-flute 'Cutting'

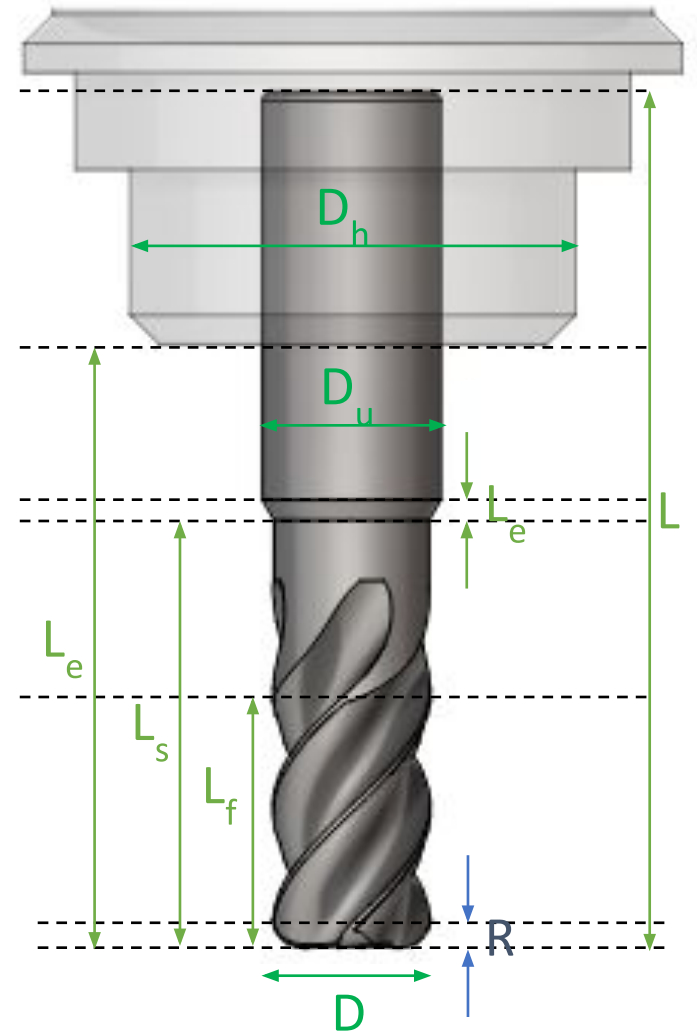


Too Large Tools

Tool Consideration Summary

Ensure that:

- L is large enough to adequately hold the tool you order and provide enough L_e so as not to cause a collision between the holder and the stock
- L_f is less than the total depth of cut that you make
- If D_u is larger than D , then ensure the resultant shaft (L_e) does not collide with edges of the stock
- D is less than the size of any internal fillets
- D_h has enough room to manoeuvre in if machining a deep pocket/side
- R is the same size as the fillet you require at the bottom of a pocket



CAD IN FUSION

360 DEMO

Bantam Tools Desktop CNC Milling Machine

- Setup parts quickly with Automatic Stock Location
- Quickly produce prototypes / parts
- Machine Aluminium
- 28K RPM Spindle
- 180° Window visibility
- Drag in SVG files and use the built-in auto-CAM
 - Quickly adds engravings to your parts or mills simple 2D objects
- Use the built-in previewer to get real-time machining information

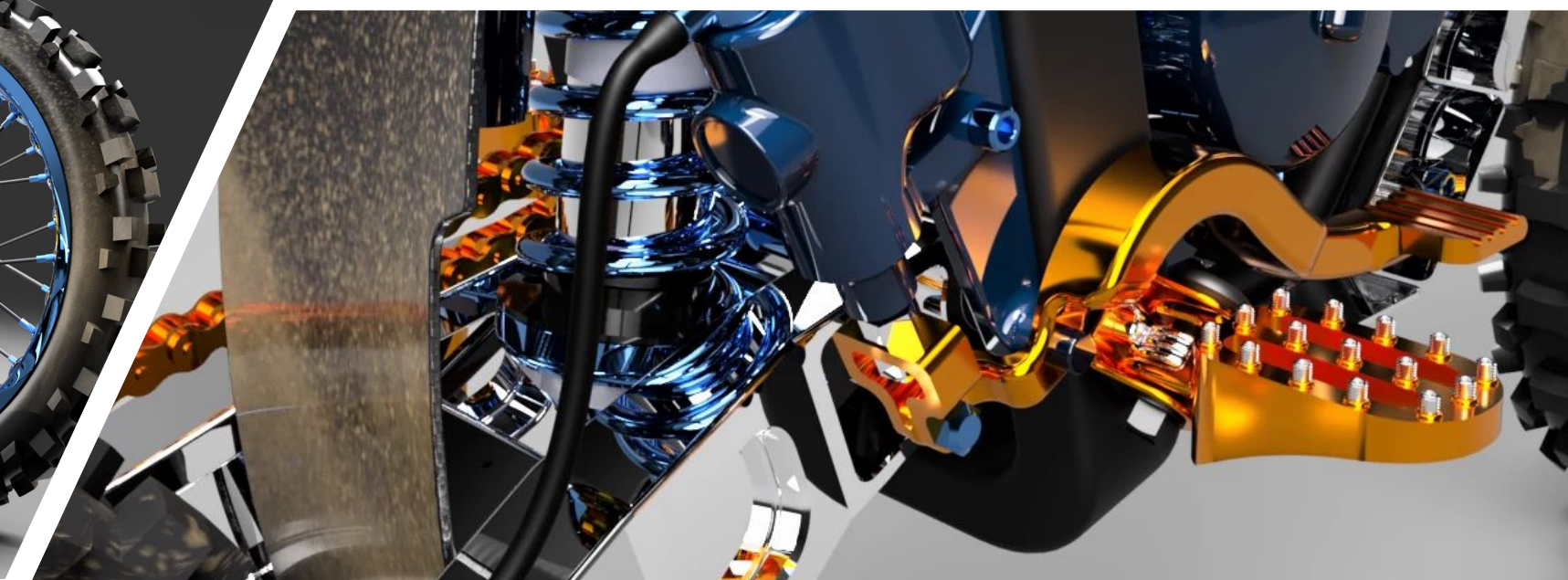
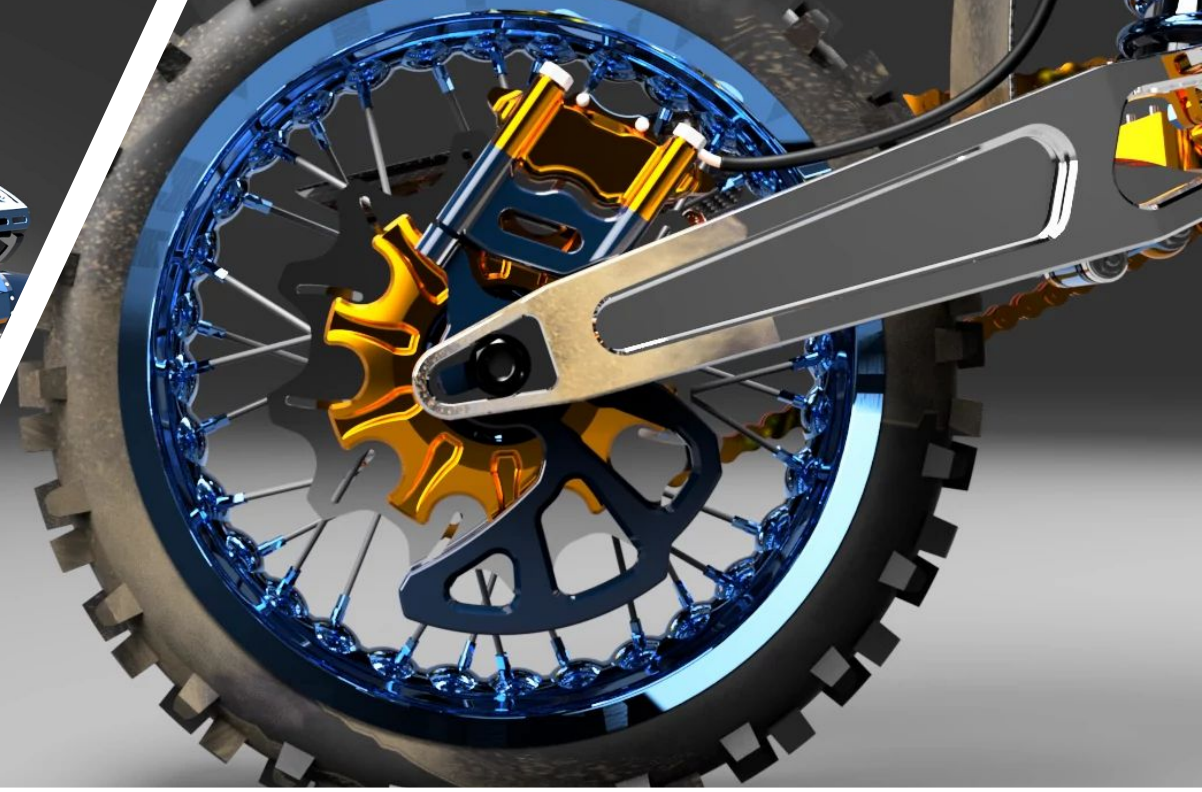


An abstract 3D rendering featuring a series of blue, curved, geometric shapes that resemble a stylized landscape or architectural elements. The shapes are arranged in a row, with some appearing to be stacked or layered. The scene is set on a highly reflective, glossy surface that mirrors the objects above. A semi-transparent white rectangular area is overlaid on the left side of the image, containing the word "Rendering". The overall color palette is dominated by various shades of blue, from light sky blue to deep, vibrant cyan.

Rendering









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