Streamlining CAM Workflows

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About the speaker

Rob Lockwood

15+ years as some kind of machinist -
currently with Facebook’s AR/VR Labs 3D print and CNC lab (5 years!)

Engineers are professionals who invent, design, analyze, build, and test machines, systems, structures and materials to fulfill objectives and requirements while considering the limitations imposed by practicality, regulation, safety, and cost.

As a Prototyping Engineer, I apply these principles to the process of prototyping.

Stored Manufacturing Assembly

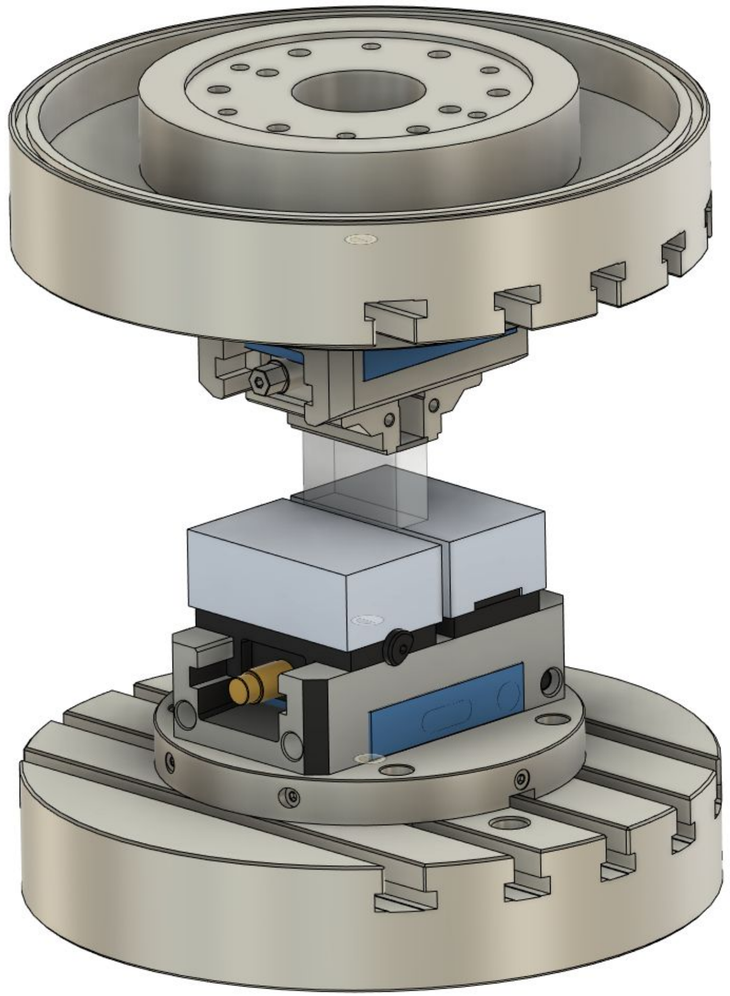
Stored Manufacturing assemblies are standard Fusion design files that are pre-configured and re-used as a starting point in the CAM process.

The stored assembly is duplicated for each new part, and the part to be programmed is inserted into the Stored Assembly for programming

.

These can contain..

- ✅ CAM Operations
- ✅ CAM Tools
- ✅ CAM Setups
- ✅ Geometry
- ✅ NC Programs
- ✅ Parameters
- ✅ Joints
- ✅ Named Views
- ✅ Selection Sets
- ✅ Parametric Links (containers)



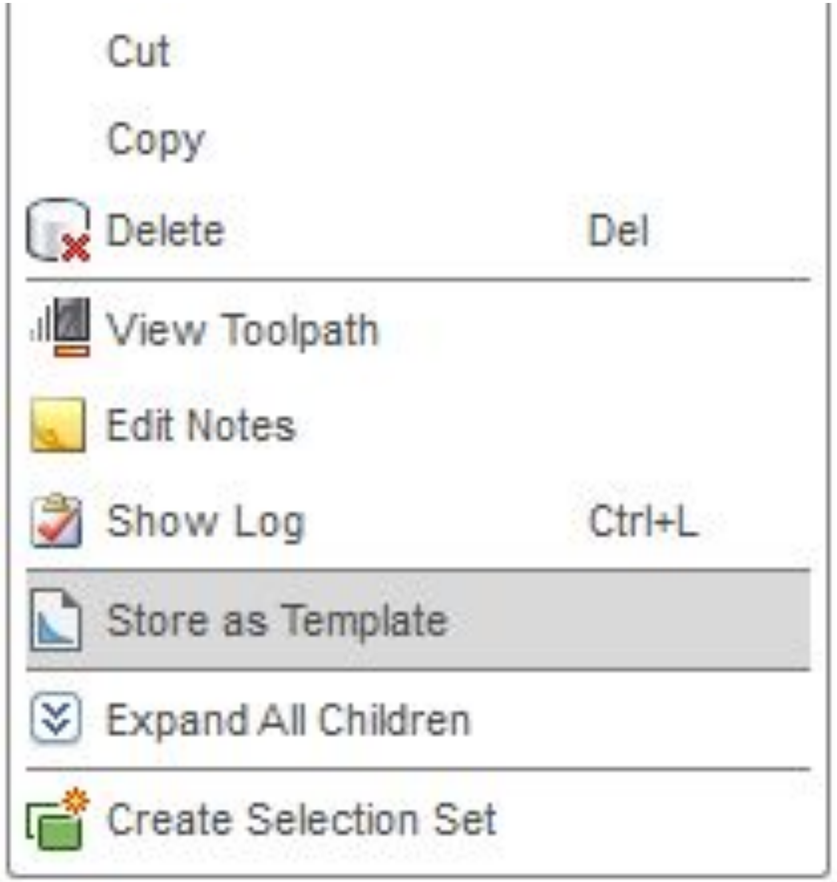
CAM Templates

“CAM Templates” allow users to store and share customized CAM operations to be recalled for later use.

These are found in the CAM workspace and are limited to..

- ☑ CAM Operations
- ☑ CAM Tools

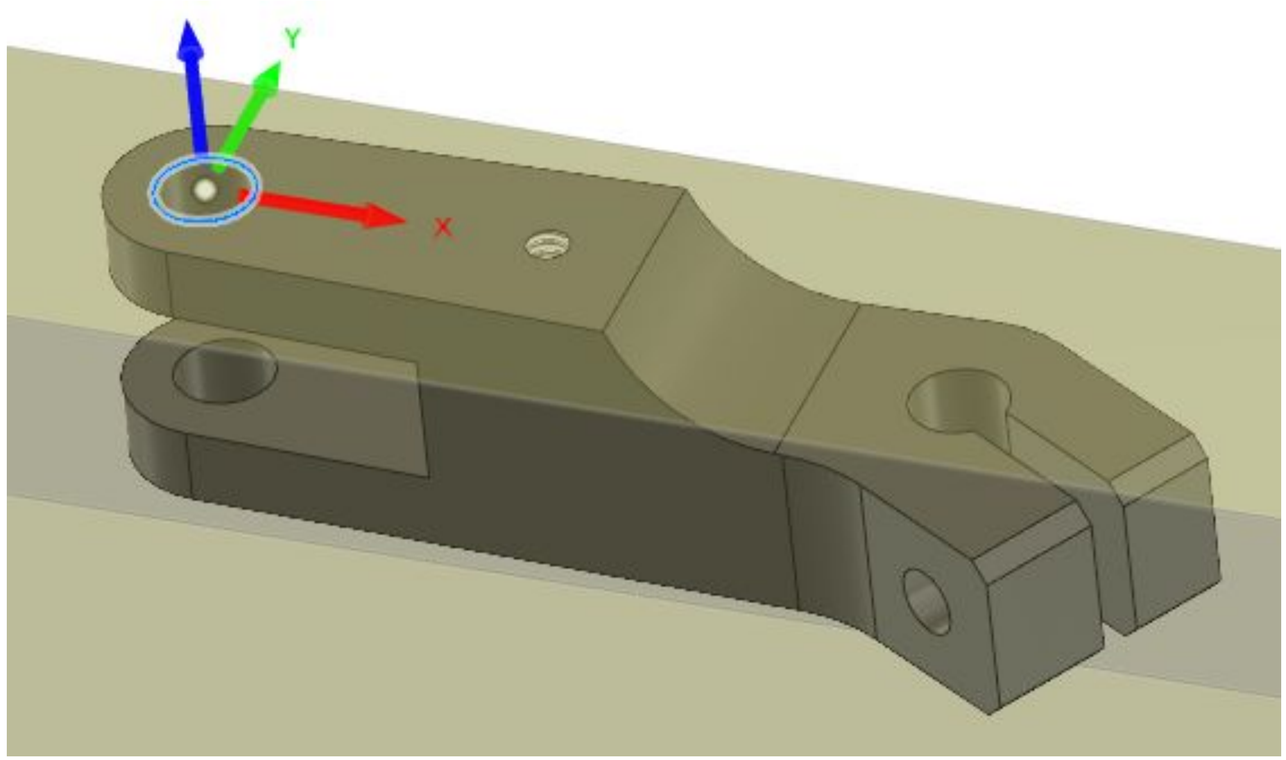
And really aren’t what we’re talking about today!



WCS on Part

+ Output code was easy to decipher and often matched to blueprint features.

- WCS was part dependent and needed to be set with every part, typically by finding a reference location and shifting the datum.

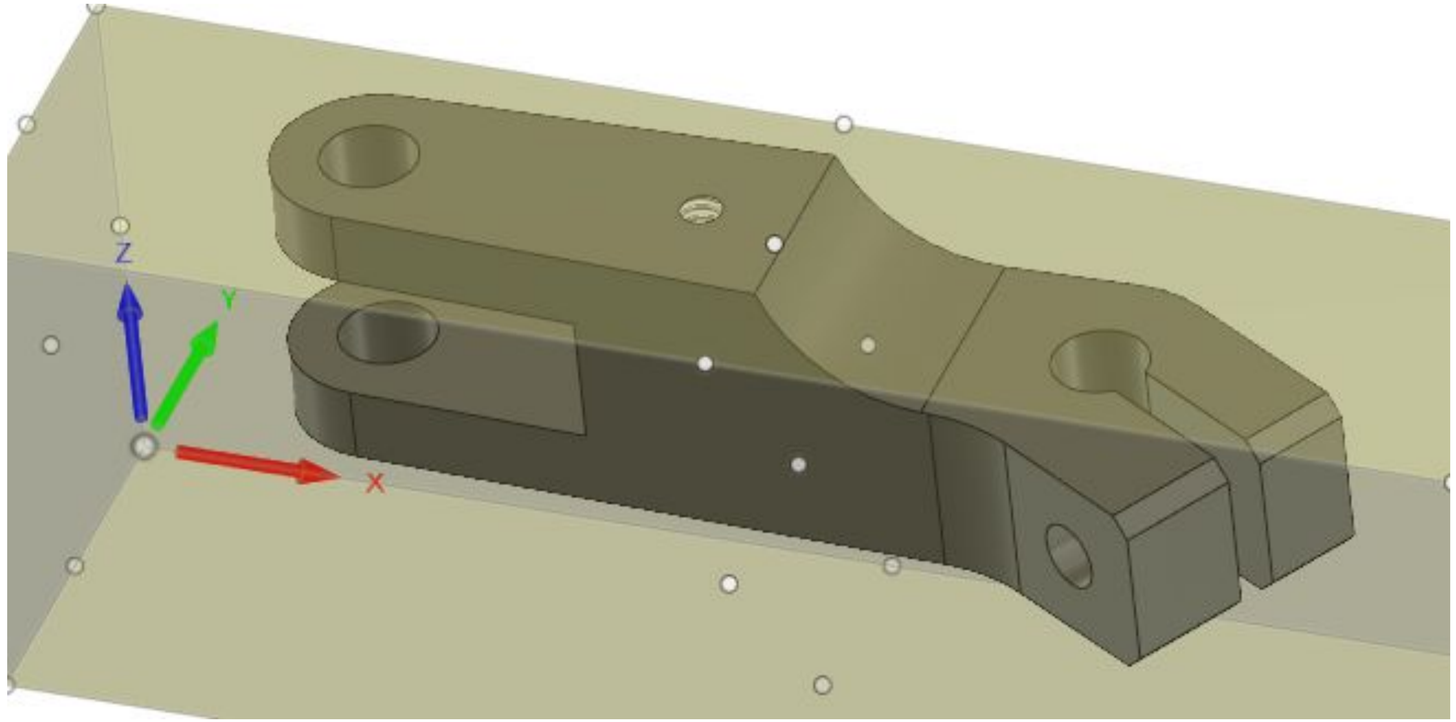


WCS on Stock/Vise Jaws

+ WCS is aligned with vise datums, making it more stable.

- WCS needs reset if vise is moved, jaws are changed, etc.

- Programming is harder to interpret directly.

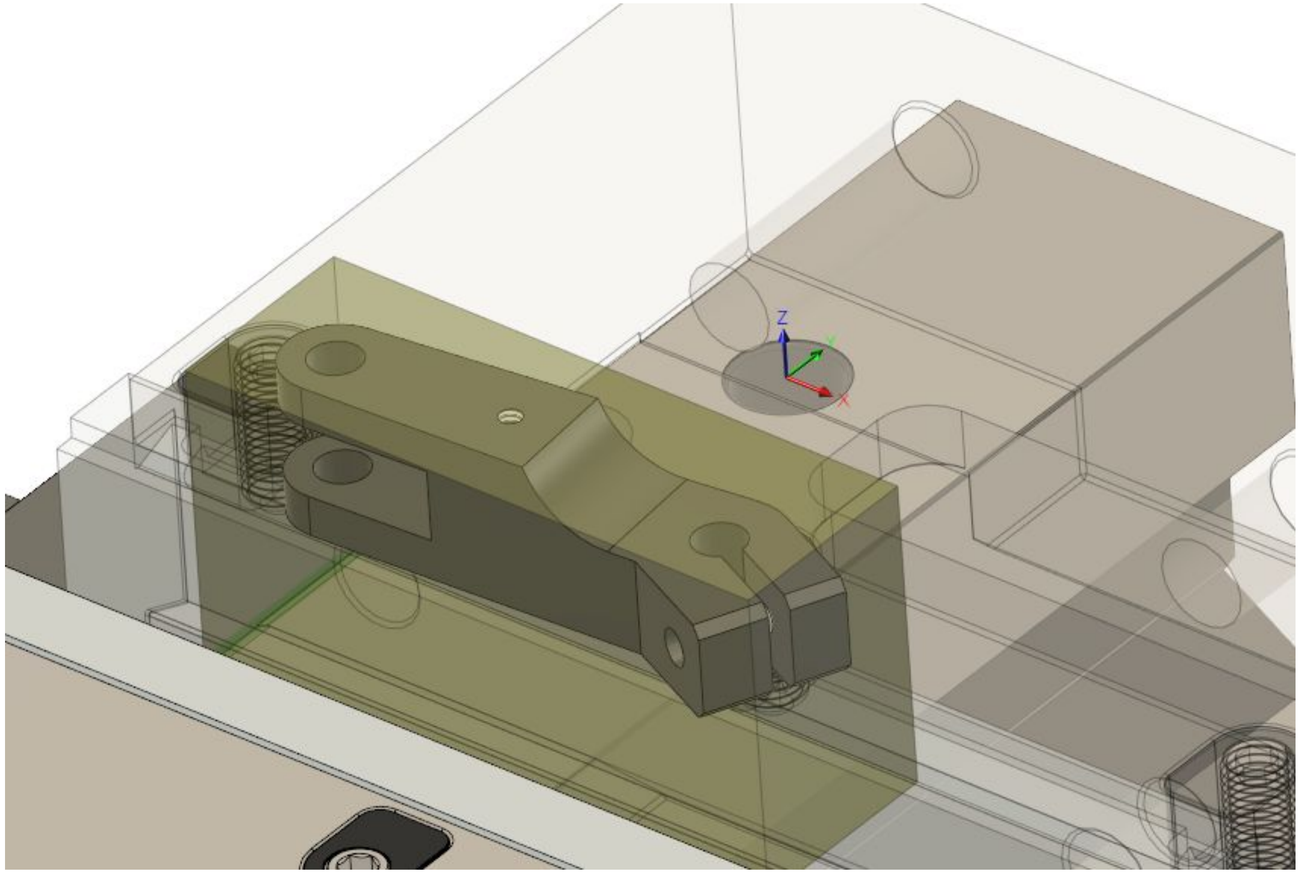


WCS on Vise

+ WCS is aligned with specific vise features that mostly stays static across setups

+ Vise jaws and configurations can be varied infinitely, relationships are accounted for in CAD.

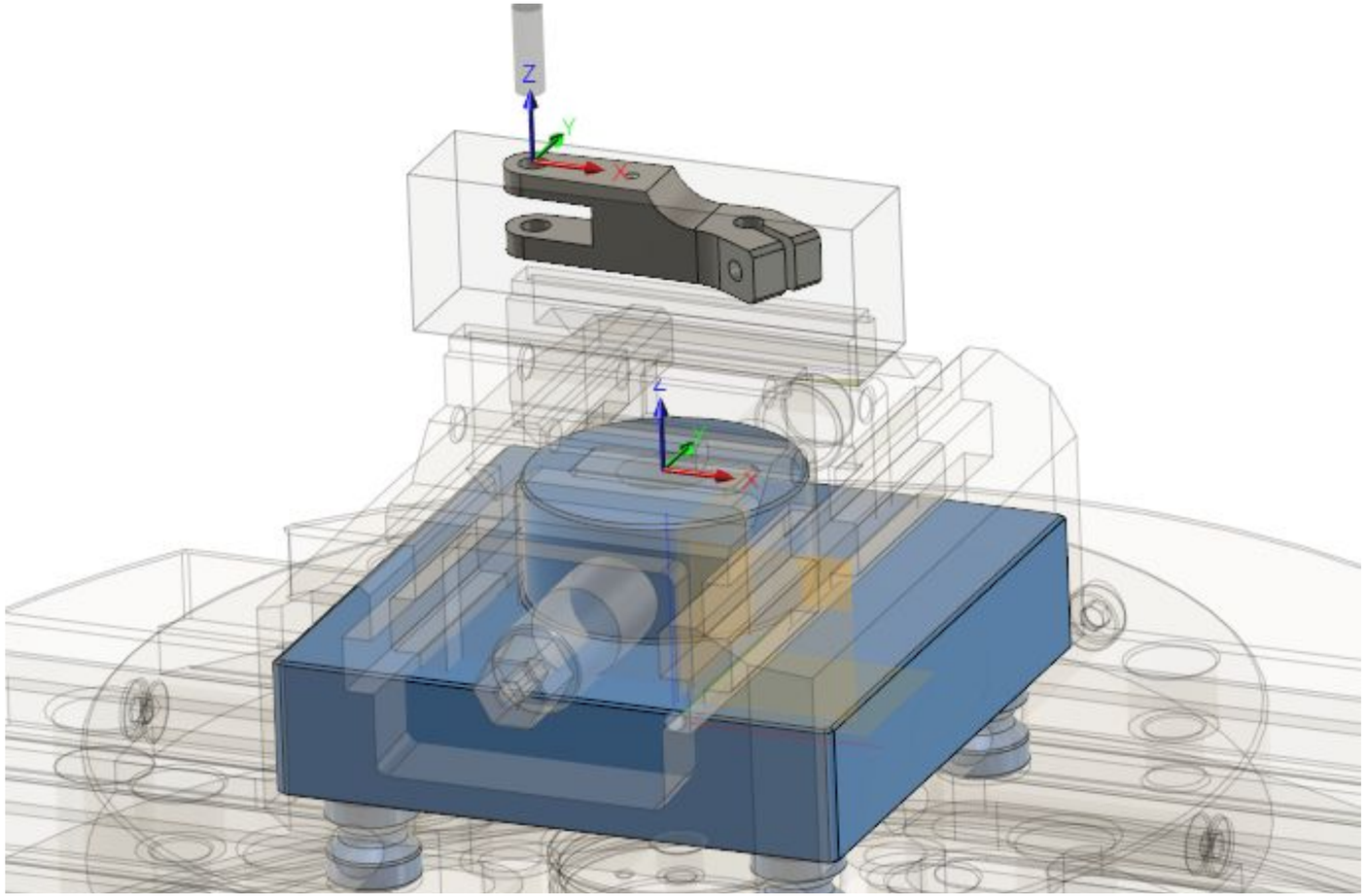
- WCS still needs reset if vise is moved, or if a different vise is used



WCS on Zeropoint

+ WCS is essentially permanent for each table or pallet

+ With all geometry fully modeled in CAD, specific features can be probed in CAM, the work coordinate can be shifted, and output code again matches blueprint features.

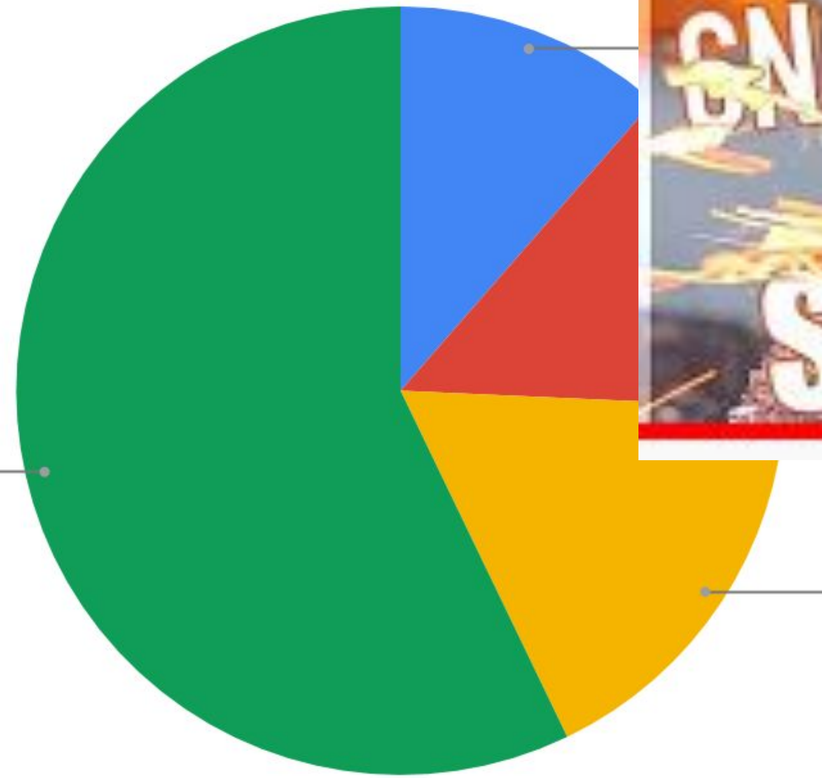


WCS Refinement

Time spent se

Watching to make sure
40.0%

Time Spent setting WCS



Fixing it
57.1%

Watching it crash
17.1%

Validation
33.3%

What happens if we apply the same concepts to our CAM workflow?

Lathes..

What happens if we apply the same concepts to your entire CAD/CAM workflow?

Move faster

Create richer datasets in faster. The “Container” method can be used to quickly make multiple logical geometry definitions. By making NC programs, Setups, etc ahead of time, you’ll save time by eliminating obvious repetitive motion.

Standardized Processes

CAD and CAM are only part of making this work properly. The workflow at the machine should also be standardized, with Fixturing, Tool libraries, and general processes also predefined where possible.

Reduce mistakes!

The fewer decisions you need to make with each CAM setup, the less likely something gets missed and leads to a costly mistake. Workflow based templates also make it easy to add specific helper geometry for toolpath containment, keeping your paths clear of fixtures.

Team standardization

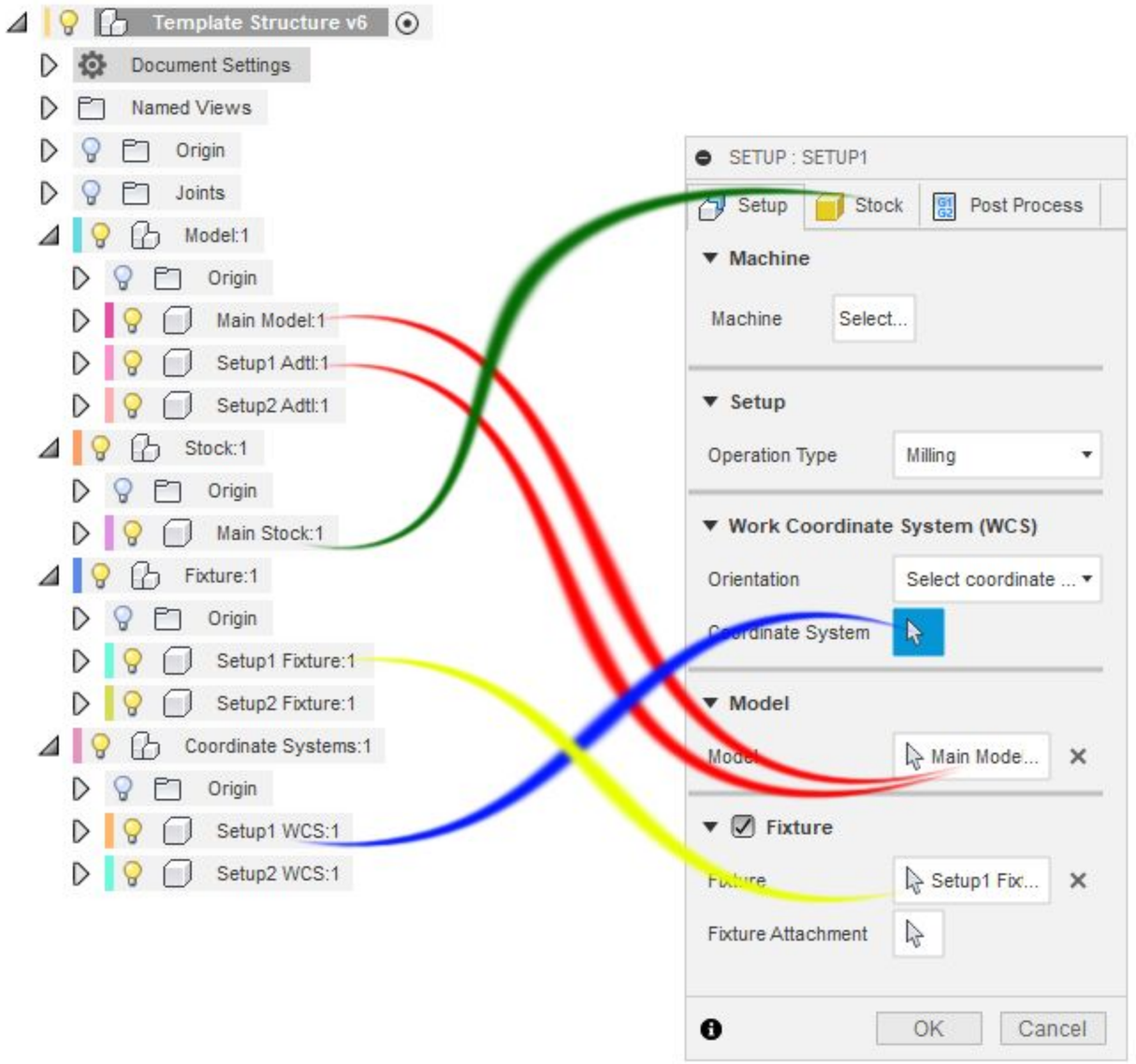
The persistence of these templates makes them incredibly easy to continuously improve. In addition, it’s a great vehicle for standardizing workflows, settings, and structure across teams.The standardized file structure makes it easy to decipher what is happening within each assembly.

Template structure: Containers

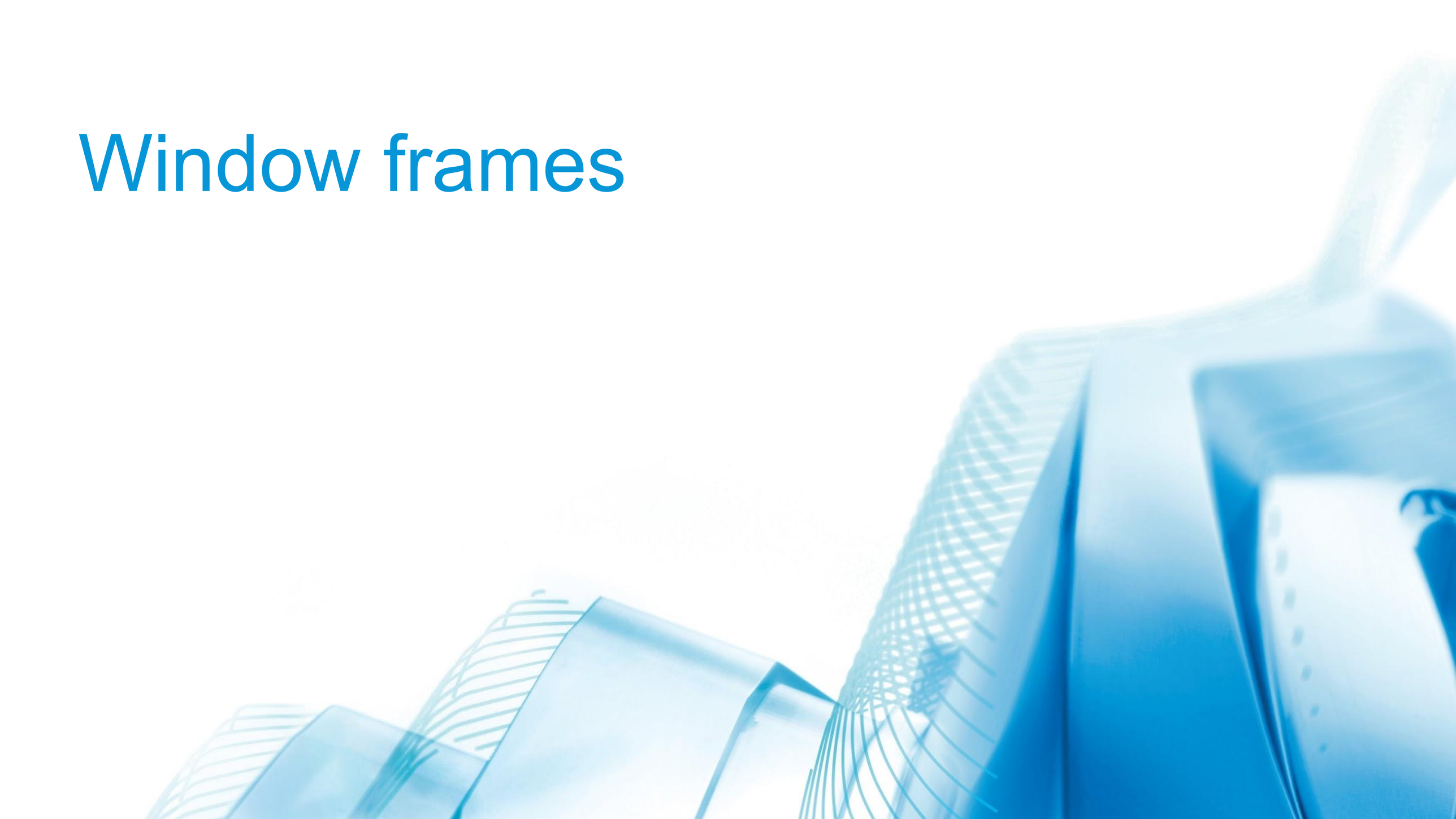
Assembly structure closely mimics the selections made during the CAM setup process. Components are used as geometry buckets that feed selections into CAM setups and operations.

For this two operation CAM template, the top level Model component contains three sub components, Model Geometry, Setup1, and Setup2.

- The ‘Main Model’ and ‘Setup 1’ components are selected as Model geometry in Setup 1.
- Stock, Fixture, and WCS all link similarly.
- The additional geometry components used for patches, keep away surfaces, etc.



Window frames



How to get parts into this workflow while maintaining parametric links?

Derive 

- If working from a top down fusion design, you will want to use Derive.
- You can Derive directly into the Stored Assembly, but Derived components must live in the top level of the assembly (no containers!) This method will maintain parametric links, and will enable in-context edits to the model within the CAM assembly.
- Alternately, you can Derive the component into a new Design file, and then X-ref into the Stored Assembly.
- This can be beneficial as it isolates the model changes from the CAM assembly

X-Reference 

- If design data is being imported into fusion from another design package, X-reference’s are a great option.
- X-reference will maintain a parametric link to the source geometry, but will not allow any in-context edits to be made. These must be made in the source geometry file.
- Utilizing the AnyCAD upload method will enable you to import new versions at a later date without losing parametric links in your CAM assembly.

Soft Jaws

Toolpath Selections

- Adaptive Clearing & Pocket Clearing
  - Roughing and Rest roughing
- Steep and Shallow
  - Extremely applicable to this workflow!
  - Suitable for both steep and shallow regions (duh)
- Parallel, Scallop, Radial, Spiral
  - Suitable for shallow regions
  - Radial, Spiral require basic geometry selections, but these can often be built into the assembly.
- Facing & Horizontal
  - Flat areas
- Pencil
  - Rest Finishing
- Contour & Ramp
  - Suitable for steep regions
- Drilling
  - Diameter range allows for opening of holes and basic automation of tapped holes.
- Turning - Rough, Finish, Face, Parting.
  - Turning is amazingly applicable to this workflow!
- Probing
  - Very useful for probing stock size and location to make sure the proper program is being executed!
- Everything else
  - The remaining toolpaths require more selections, but are still very useful when assembly geometry can be used or parametrically driven!

Questions?

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