PTC® Live Global

Bringing Large Models Down to Size

Steven LaPha Jr.
NASA KSC – ESC
Steven.G.LaPha@NASA.gov

Summary

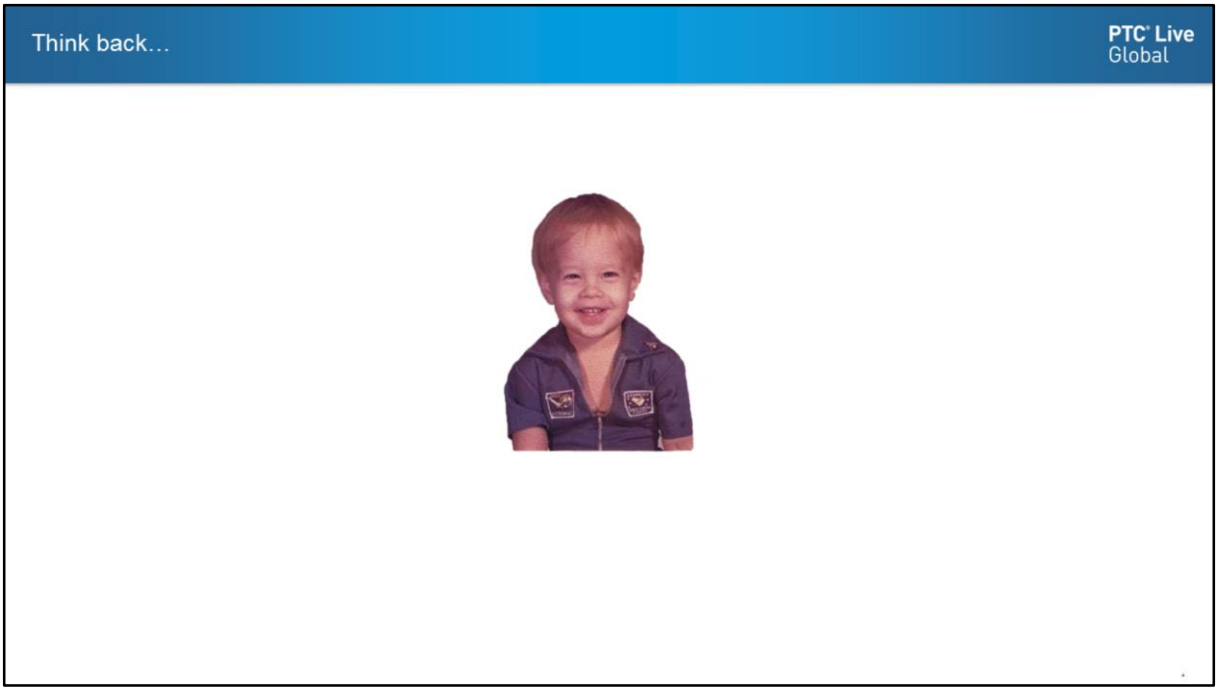
PTC® Live Global

- Introduction
- Computer Performance Constraints
- Working with Existing Large Models
  - Simplified Representations
    - Levels of Detail
    - Envelopes
    - Rules
  - Drawing Representations
  - Creo View
  - Config.pro Settings
- Preventing Large Models
  - Assembly Cuts
  - Patterns
  - Additional Concepts
- Important Rules for Working with Large Assemblies

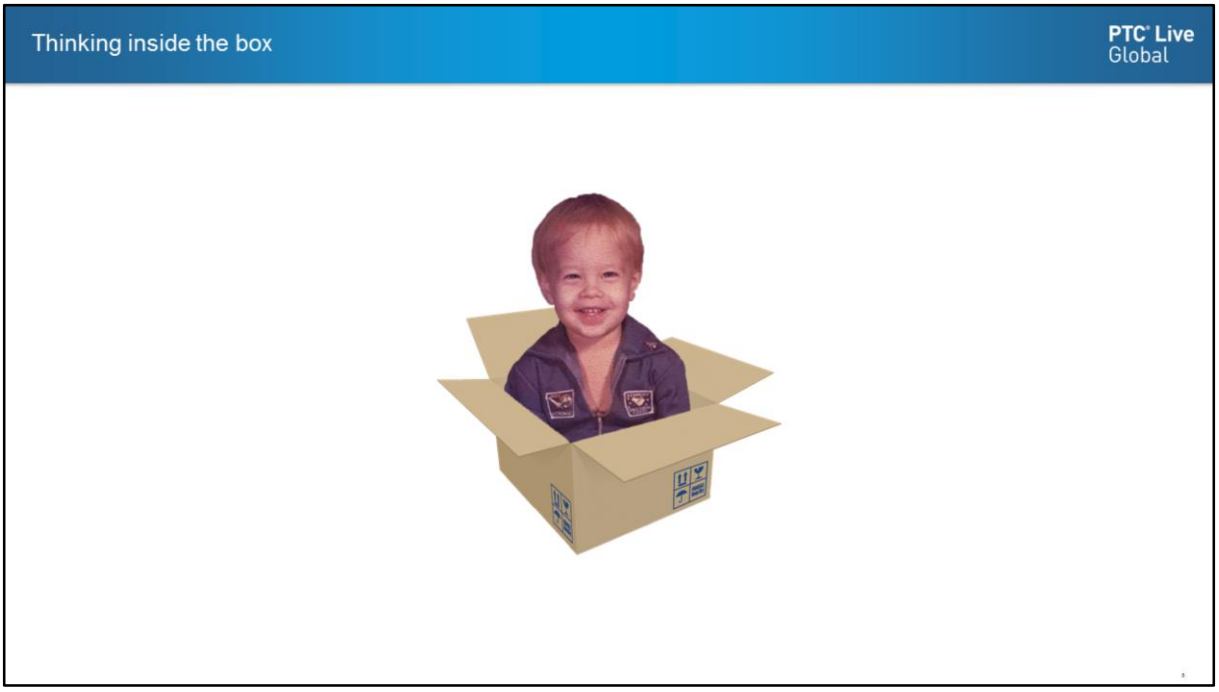
ESC Principal Engineering Technology Development Group

PTC® Live Global

The Engineering Services Contract (ESC) at Kennedy Space Center (KSC) provides services to NASA in respect to flight and ground systems design and development. To aid this effort, the ESC Principal Engineering Technology Development Group investigates and provides the necessary tools, aid, and best practice methodologies required for efficient, optimized design and process development. The team is responsible for configuring and implementing software, along with training, documentation, and administering standards. The team—comprising of 5 members—supports over 200 engineers and design specialists with the use of Windchill, Creo Parametric, NX, AutoCAD, and a variety of other design and analysis tools.



Think back to when you were a little kid. After your parents got you that really big expensive toy, what's the first thing you would do?

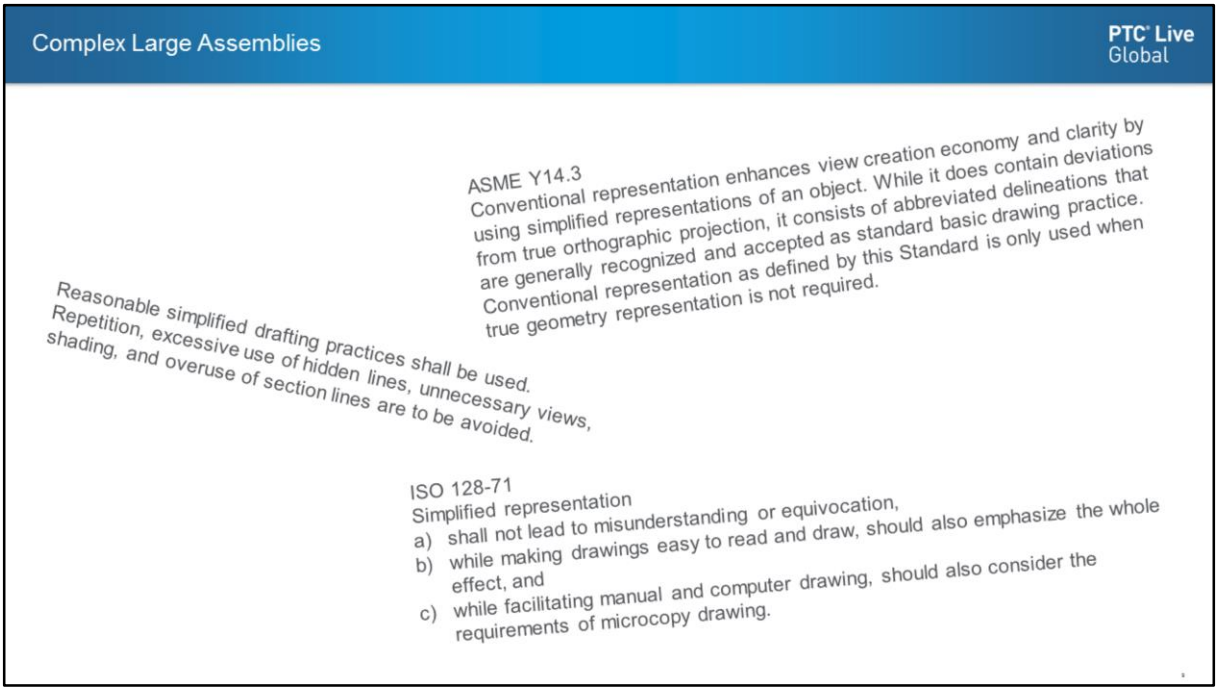


Play with the cardboard box.
You parents probably said something like “Why are you playing with the box when we got you the toy of the year?"
But to you.. the box wasn't a box,

maybe it was a castle

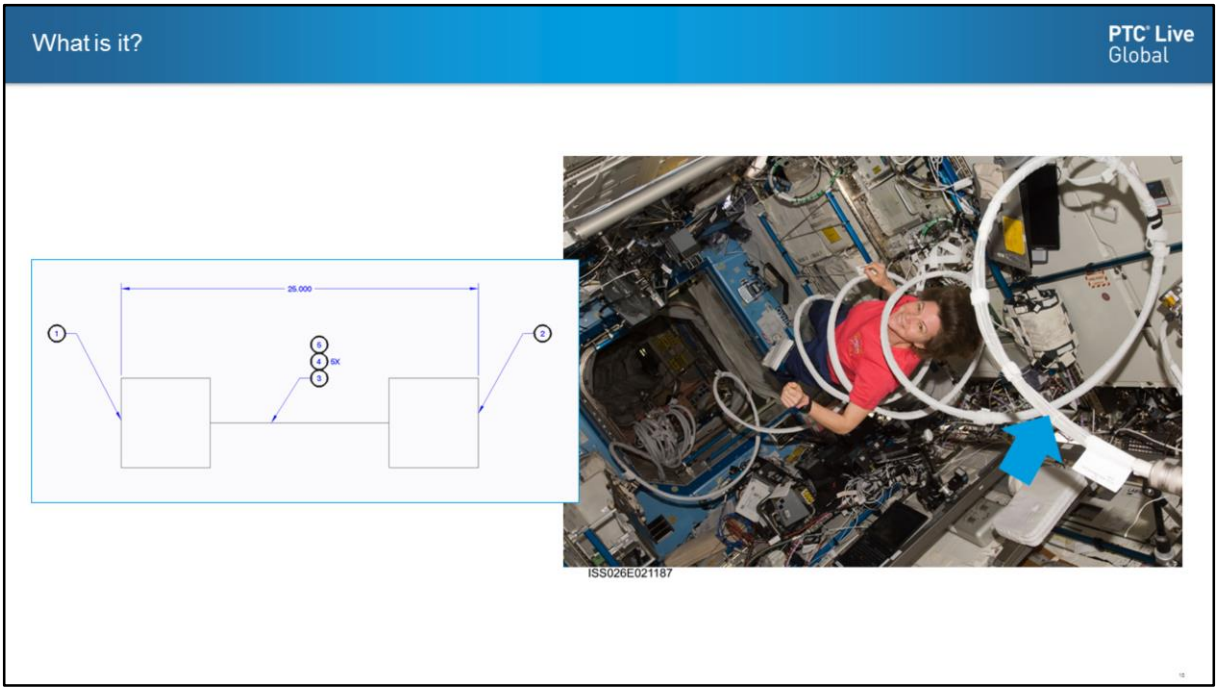
maybe it was a piece of construction equipment

Or maybe it was even a Space Shuttle
You didn't need to see real wings to know the flaps on the side were wings.
All the things one would expect were rarely there unless drawn on with crayons.



Now you're all thinking…"What does this have to do with large complex models"?
Well, at the very root of engineering **it's not about how good the engineering looks**,
but about **how it helps you build the end product in the clearest way** possible.

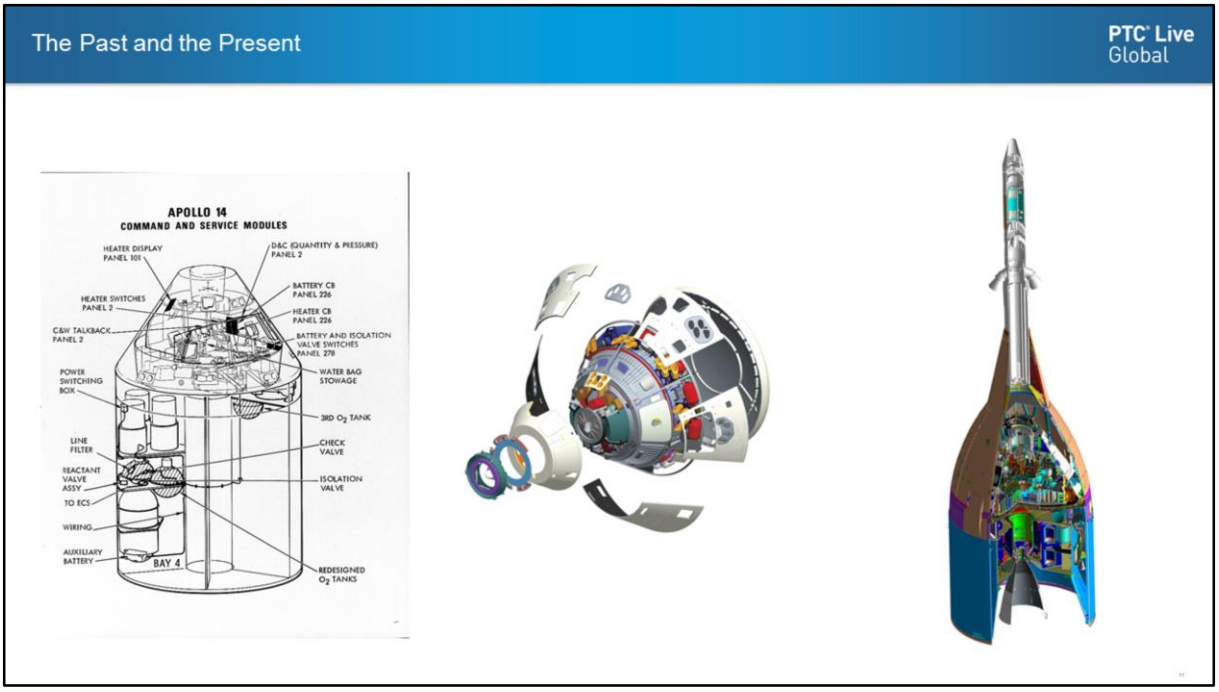
Have you ever gotten a set of **Ikea instructions** and it had a perfectly rendered image of the final product?
No. It has a very basic black and white diagram.
Engineering is about showing just enough information to get the point across.



When I first started working out at the space center, I would be met with some things that looked like this

can anyone guess what this is?

" A cable"



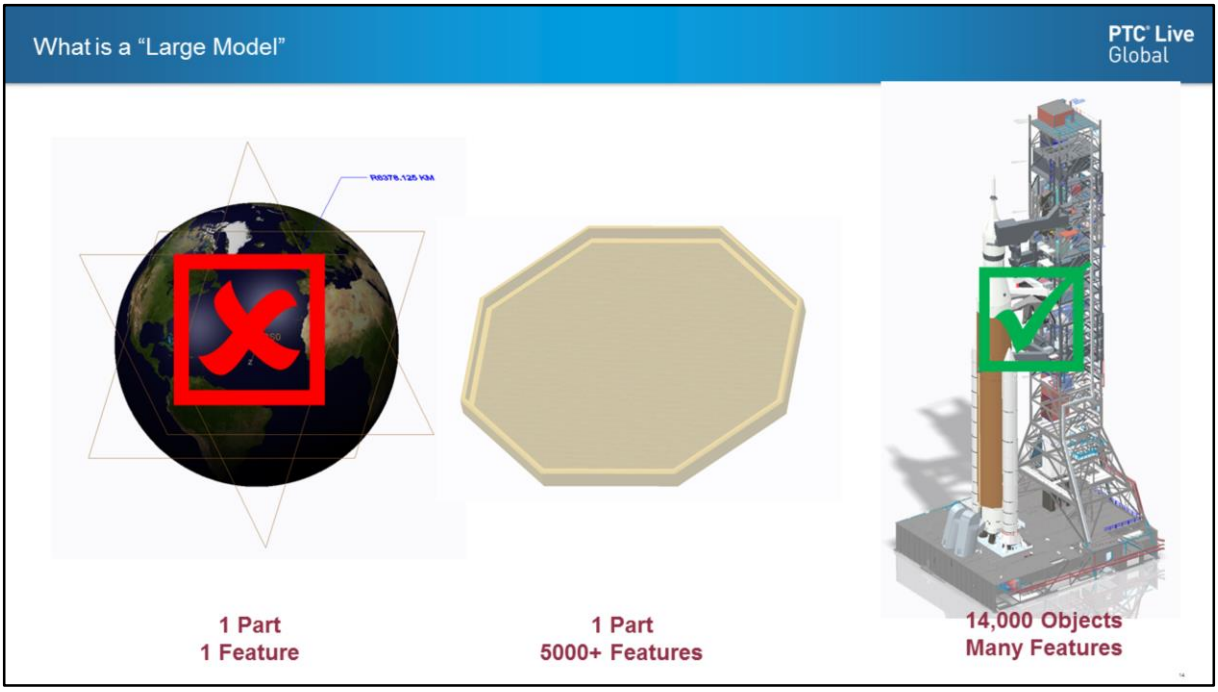
And here we see a **simple Apollo diagram**, and what similar diagrams look like today **now that we have advanced 3D models**.

We ventured into space and landed on the moon with simple drawings like those here on the left.
They didn't need all this complex hyper-detailed imagery.
So why do we need it today?

'POWERPOINTS',
Humans are very visual learners. Now that we can create a full detailed 3D mockup of the design before it's ever built, that's what everyone likes to see.

or as I like to call it "**Pretty pictures**".
Now I'm **not dismissing** the reason for these highly detailed models, there are plenty of use cases for these pictures, and models.
Frequently they give everyone **a sense of how it will really look built, which can help management, process development, and even funding.**

The question you have to ask yourself is,
do you need all this detail in the engineering
and **especially while you're working on the design?**



So when it comes to this presentation, what do I mean when I say Large Model?

Here we have a large model of the Earth, pretty large but simple.

What about a model with over 5000 features? It's small and complex, but not exactly what we'll be looking at here.

This assembly has over 14,000 objects and many are just shells. That's what this presentation will be on.

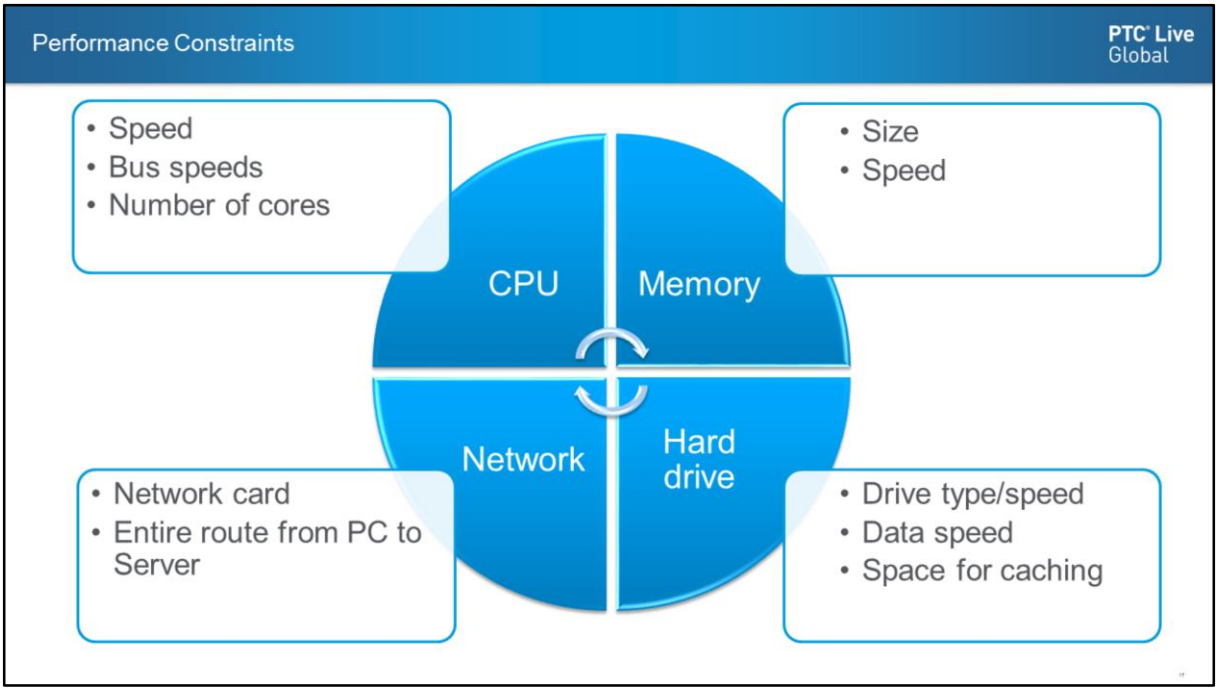
What is this presentation going to cover

PTC® Live Global

- Primary goal
  - Reduce CPU and memory usage to allow working with larger and more complex models efficiently
- This presentation is not about
  - Reducing the scale of models
  - Reducing the quantity of models
  - Reducing file size
- Briefly cover areas that have been covered before
  - PTC University Best Practices Large Assembly
  - Top-Down Design
- Deep dive on some areas

PTC® Live Global

Computer Performance Constraints

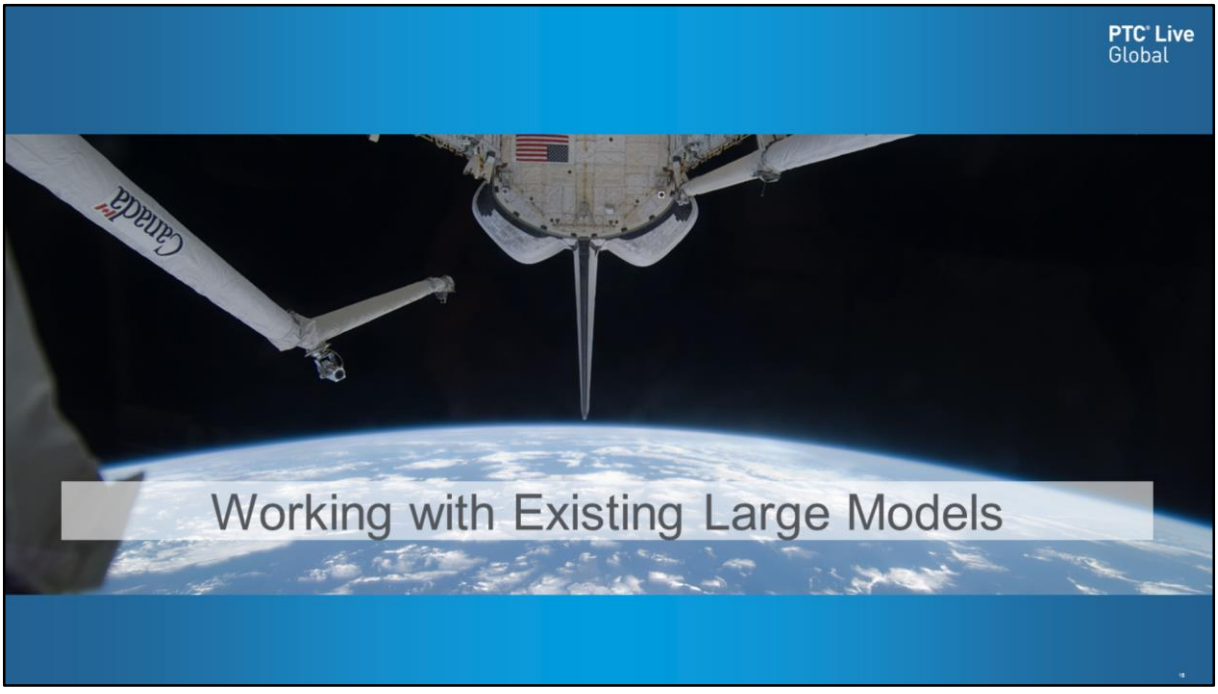


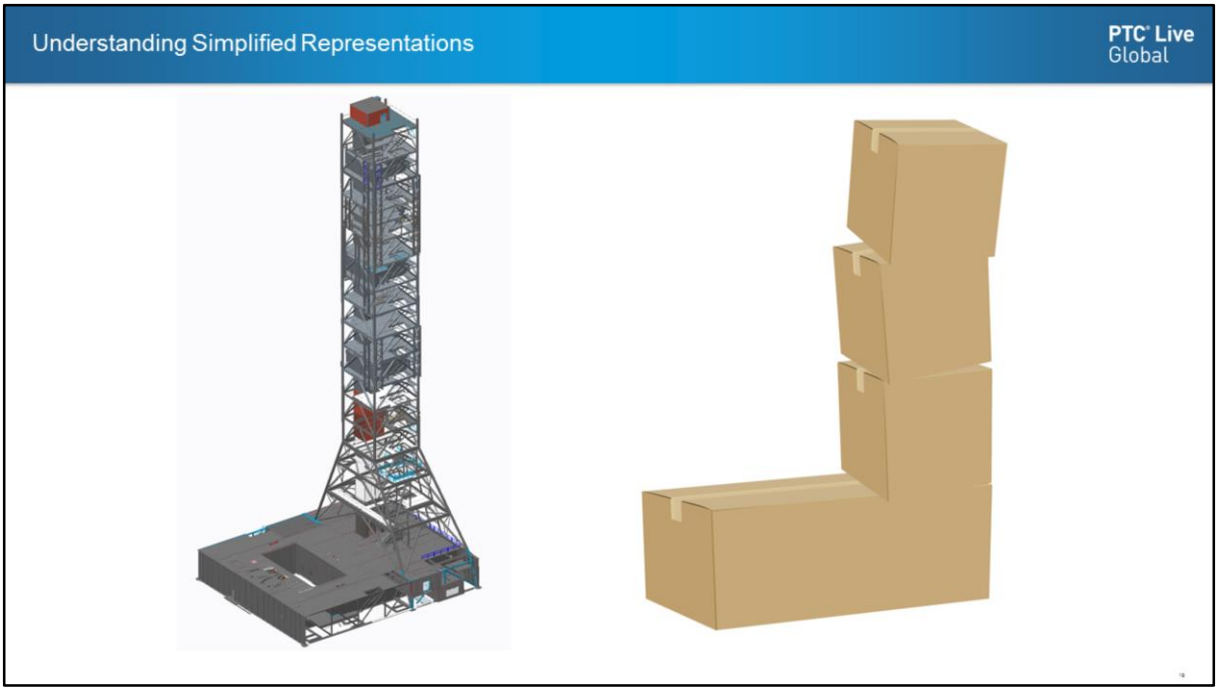
Creo Parametric is a **single core process** but the speed of those cores has a great deal to do with how fast Creo can run.
Additionally the **bus speeds** on the CPU and motherboard will **limit how fast the memory** can process and how wide of a bus you have available.

No one has ever turned down a memory increase when working with large models.
Speed is also something to consider.

One of the most **underrated upgrades is to a better hard drive**. Hard drives can range from 5400 to 7,200 and even 14k RPMS,
but today you can buy relatively expensive solid state drives which increase data storage and retrieval.
The **best case scenario would be a solid state drive** for Windows and Creo and another for your workspace or working directory storage, with slower cheaper drives for longer term storage.

Lastly if you're working with a PLM system you're going to want a good **network connection**. You can get by with a solid wifi connection but for uploads and downloads you want as much bandwidth as possible.


PTC Live
Global
Canada
Working with Existing Large Models

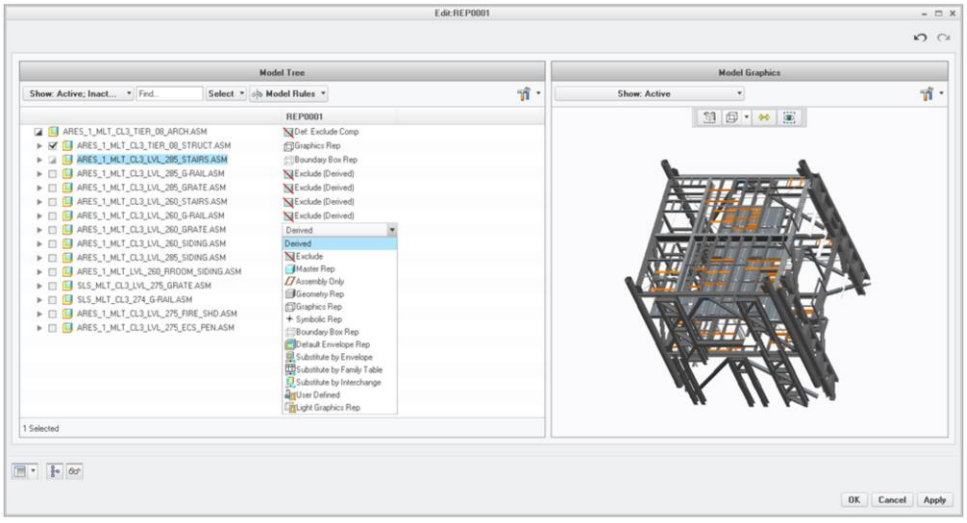


Going back to our box example,
Simplified reps are a way of taking a large complicated model and breaking them down into usable blocks showing only what you need.

Maybe you need the full detail, but when it comes to large assemblies usually you only need to work in one small area at a time.

Creating Simplified Representations

PTC® Live Global

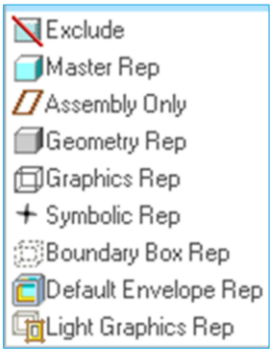


When creating a simplified representation this is the window you are presented with.

"Weight" of Simplified Representations

PTC® Live Global

• Exclude	Lightest	(~0%)
• Boundary Box Rep		
• Symbolic Rep		(~2%)
• Assembly Only		
• Light Graphics Rep		
• Default Envelope Rep		
• Graphics Rep		(25%)
• Geometry Rep		(50%)
• Master Rep	Heaviest	(100%)



% Values Ref: PTC Large Assembly Management in PTC Creo Parametric

Here is a list of simplified rep types available in approximate order of weight they add to your displayed model.
You have from exclude which shows nothing, up to Master Rep which shows everything.

Some of these, such as Envelope will vary based on how they are used.

Levels of Detail

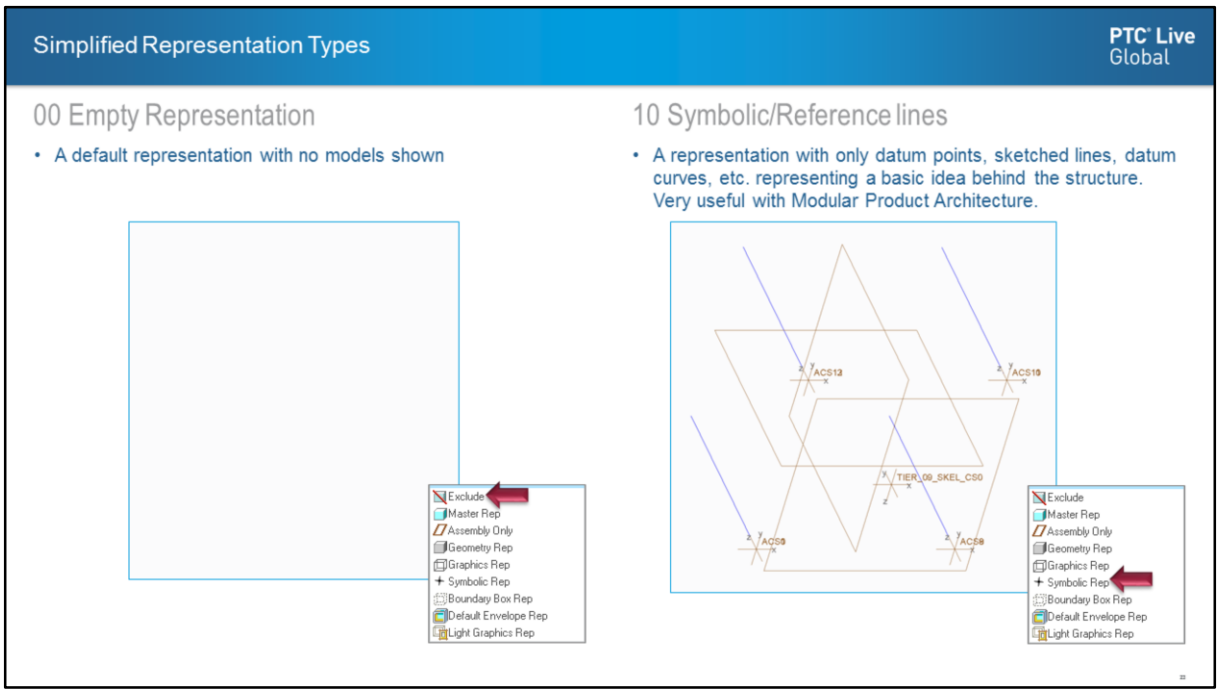
PTC Live Global

Simplified models can be broken down into various levels of detail with use of combined states, simplified reps, styles, etc.

Here are just a few ideas:

- 00 Empty representation
- 10 Symbolic / Reference lines
- 20 Envelope / Bounding box
- 30 Space claim / Keep out zone / Motion envelope
- 40 Bare bone/minimal design elements
- 50 Usable for reference in drawing
- 60 Simplified
- 70 No hardware\No small parts
- 80 Design for drawing details
- 90 Model Based Design – Annotated
- 99 Visualization/Rendering

A set of commonly used simplified reps should be used across each project.
This creates a level of understanding of what will be shown.
This set for example is just a list of a few possible levels which I've given a scale from 0 to 100 for how much detail.
This also allows for creation of intermediate reps as needed.
Not all of these can be accomplished with just simplified reps, many require using combined states to adjust layers and annotations.



If you're not familiar with empty rep you've probably never needed to open a large model in a short period of time.
This ability is one of the out of the box options when defining models making it one of the easiest to use.
Yes that white box is an actual screenshot of the very model I'm going to be showing throughout this.

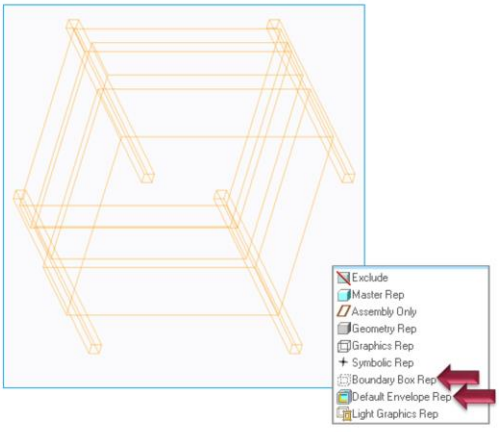
Symbolic or Reference lines can be created using the Symbolic Rep can be created in many ways.
You can use the out of the box symbolic rep on lower level components or you can have it show sketched lines or datum curves, even those used for things like AFX frames, piping, and cabling as shown here.

Simplified Representation Types

PTC® Live Global

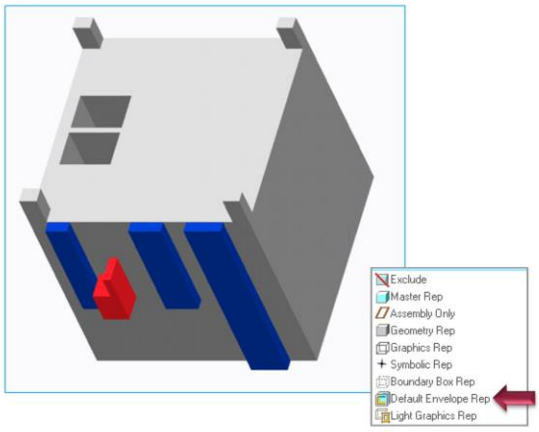
20 Envelope/Bounding box

- Simplified boxes to represent major elements of design. Default bounding box or envelopes can be used.



30 Space Claim keep out zone

- A more detailed bounding box, but here more elements can be added to show intent such as motion envelopes or areas to keep clear.

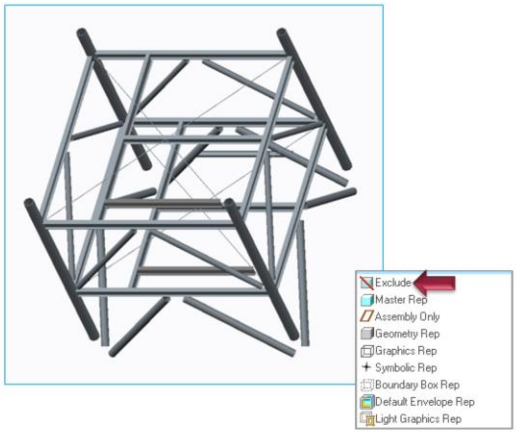


Simplified Representation Types

PTC® Live Global

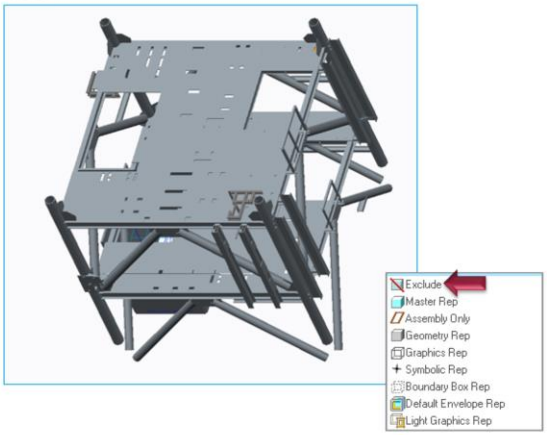
40 Bare bones/Minimal design elements

- Just the major structural elements. Use Rules and Exclude to choose components.



50 Usable for reference in drawing

- Show only what you want to see in the drawing. Anything from a box to a partial design. Envelopes can make a real difference here.

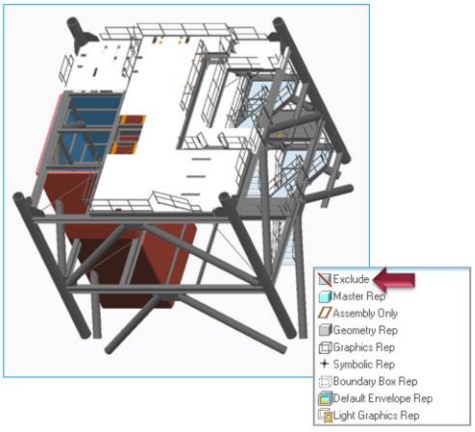


Simplified Representation Types

PTC® Live Global

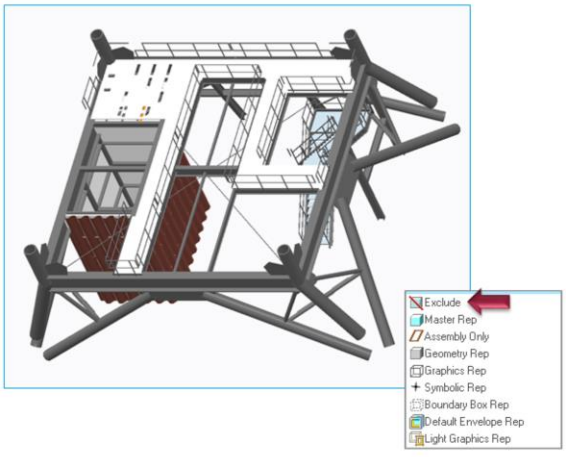
60 Simplified

- Similar to drawing reference but closer to Master Rep.



70 No Hardware

- Excluding hardware and small components. Rule based exclusion is especially powerful here.

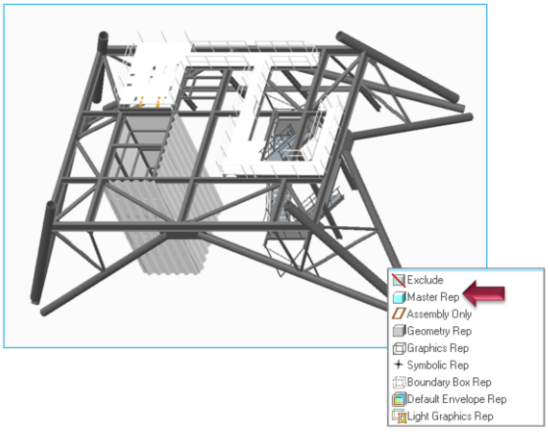


Simplified Representation Types

PTC® Live Global

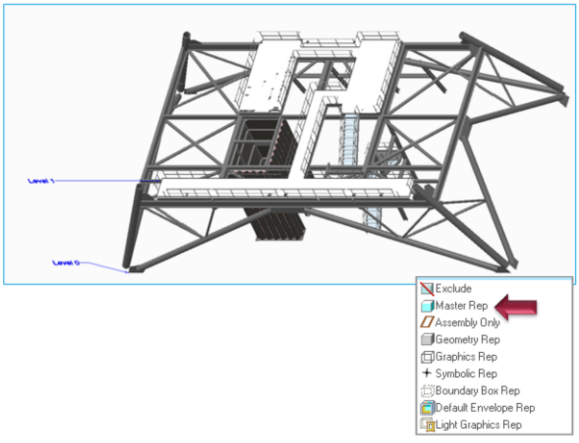
80 Design for drawing details

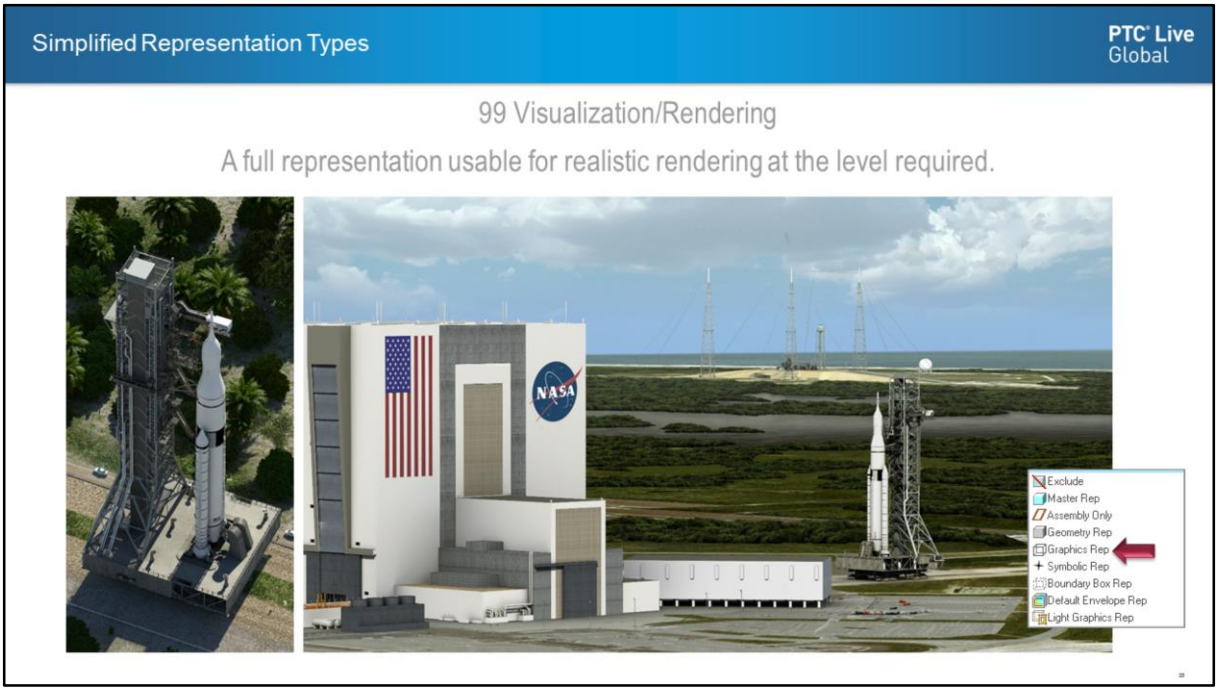
- Full design model without any extras



90 Model Based Design – Annotated

- Using MBD? Add your annotations to a combined state along with an appropriate rep.





I'd like to say this was rendered completely in Creo, but it's not. This is a rendering created by NASA's visualization group. However, many of the models used to develop this were created in Creo Parametric. For a large scale rendering such as this every small detailed part was probably not included and many models were stripped down to just what was needed, but then textures and other visual elements were added that wouldn't normally be in a parametric design model. That's why I put this at the highest fidelity. For smaller scale renderings and close up views many times you want to see the fine details with the added visualization elements.

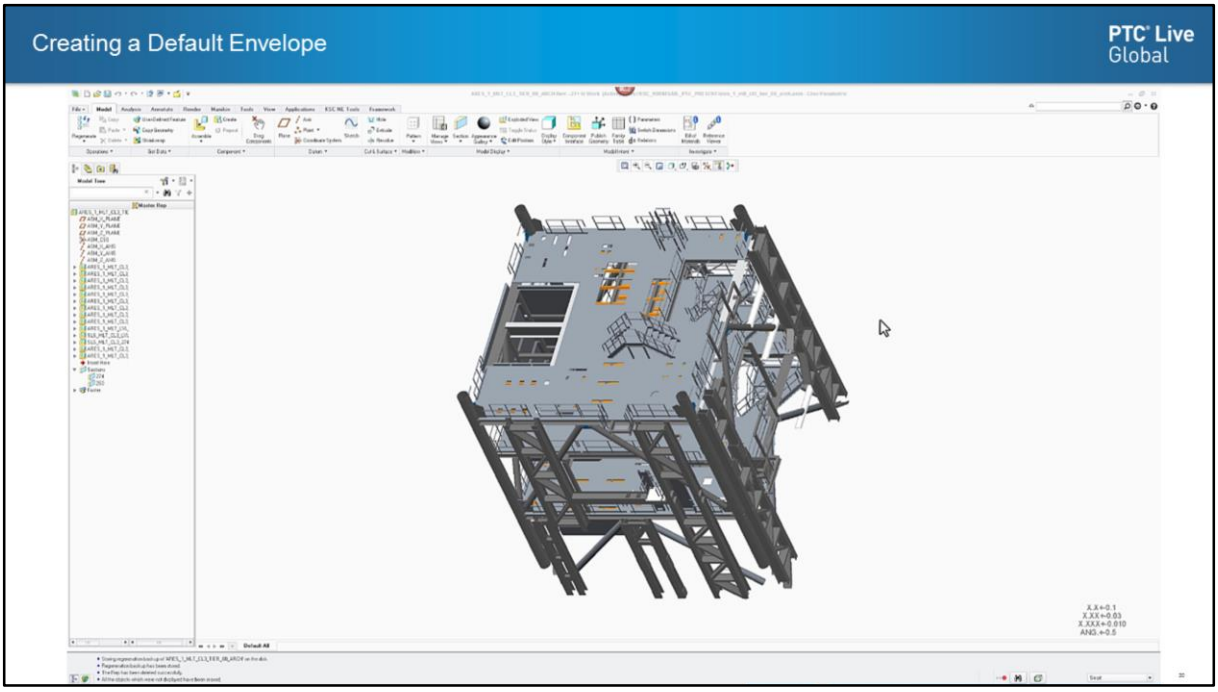
Creating Envelopes

PTC Live Global

- Envelopes create a separate model to represent multiple parts
- Can defines all or part of the assembly
- Types of Envelopes
  - Default - Shrinkwrap of part of an existing design
  - Manual geometry creation

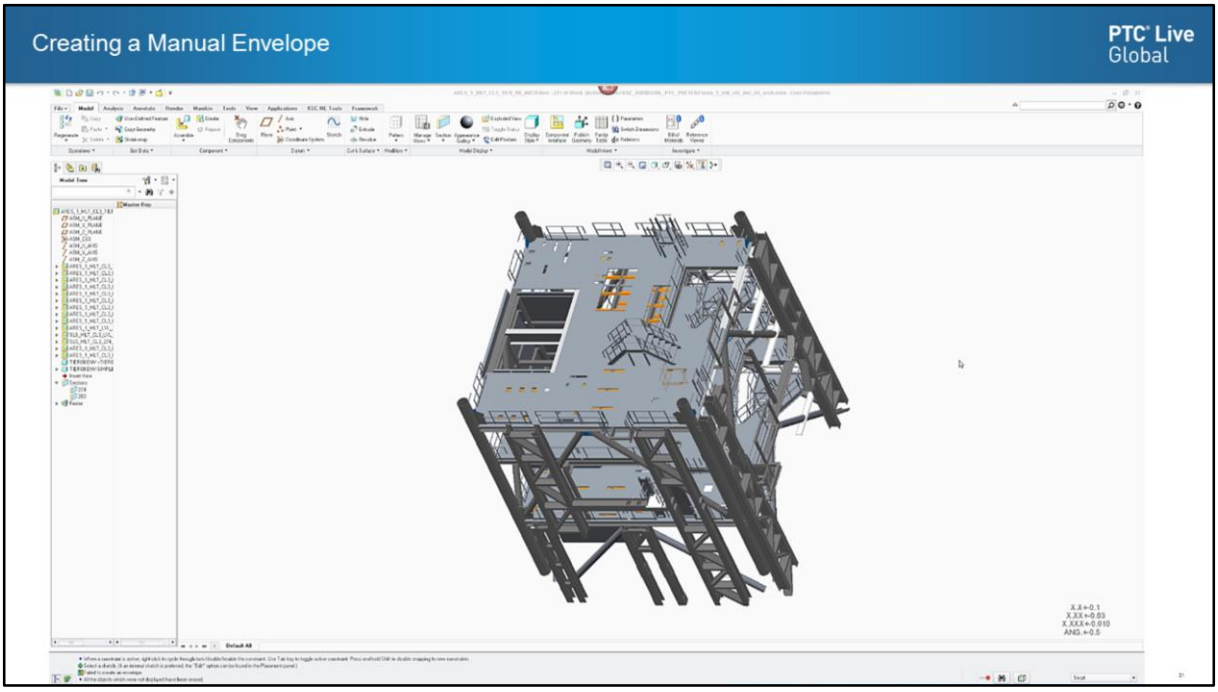
Creating a Default Envelope

PTC Live Global



Creating a Manual Envelope

PTC® Live Global

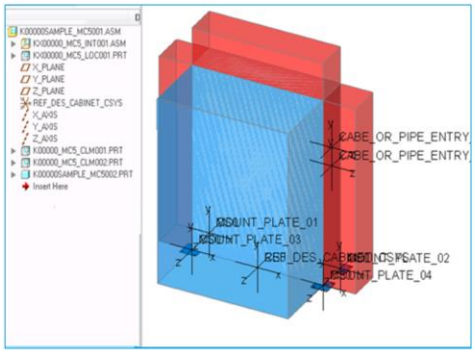


Envelope for Design

PTC Live Global

At the lowest level envelope, a simple box space claim you can define not only the object but its interactions in space.

- Object Zones - Envelope (white)
  - The rough volume space claim of the designed object
- Hard Keep-out Zones – Skeleton (Red)
  - Areas needed for connecting directly to items.
  - These zones are intended not to be infringed on by other keep out zones.
  - Mechanical structure, Fluids runs, Electrical Runs, Clearances
- Soft Keep-out Zones – Skeleton (Blue)
  - An area to be kept clear for personnel access and door swings.
  - These zones are intended to be kept clear but may be infringed on by other end item soft keep-outs.

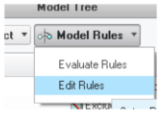


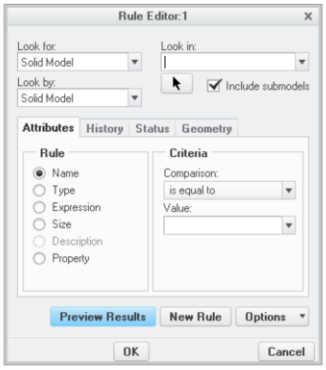
Here we have an envelope method developed by one of our engineers, Ryan Bingham.

Setting up Rules

PTC® Live Global

- Evaluate a set of searches to define representation state
- Sample Rules for Large Assemblies
  - Weight
  - Size
  - Type
  - Custom Parameters

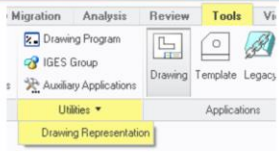


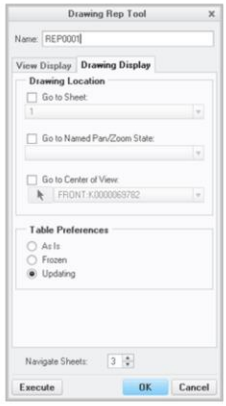


Drawing Representations

PTC® Live Global

- Hide individual views, models, and sheets
- Improves Navigation
- Use multiple large models in a drawing without overhead





Drawing Representations are a series of actions to hide and show different portions of a drawing. They can also perform various navigation functions as well.

Config.Pro Settings

PTC® Live Global

- open_simplified_rep_by_default yes
- Show_axes/coord_sys/planes/points no
- Highlight_geometry no
- Prehighlight no
- Fasthlr yes
- max_animation_time
- min_animation_steps

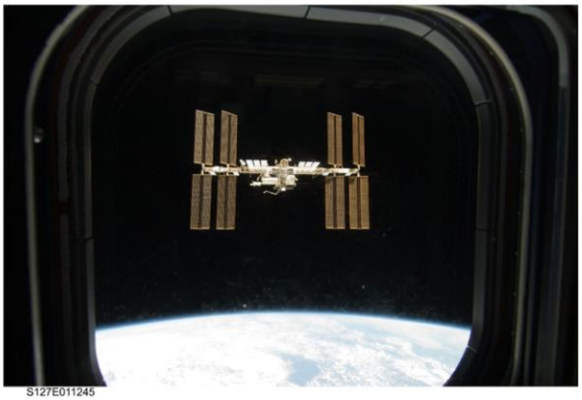
- **CS103645 – Rotation and Zoom Performance**
  - Spin_with_notes no
  - Spin_with_silhouettes no
  - Spin_with_part_entities no
  - Display shade
  - Default_ramp_size 0
  - Lods_enabled no
  - Edge_display_quality normal
  - Shade_quality 3
  - Shade_with no
  - Blended transparency no
  - Show_shaded_edges no

- **CS57084 – Drawing Performance**
  - auto_regen_views no
  - enable_auto_regen no
  - disp_trimetric_dwg_mode_view yes*
  - force_wireframe_in_drawings no*
  - hlr_for_quilts no*
  - retain_display_memory no
  - save_display no*
  - tangent_edge_display other than no
  - thermo_position_hint window_overlap*

Creo View

PTC® Live Global

- Open models with minimal processing power
- Measure
- Cross-Section
- Markup
- Interference Detection
- Search
- Compare
- Move models around for mock ups



S127E011245

- Currently Creo View Adapters do not currently support Default Envelopes, Part Substitutions, Envelopes.

Though this is another presentation I wanted to mention it. CreoView can not only save you time but also save you valuable Creo licenses when you just want to investigate a model.


PTC Live
Global
Preventing Large Models

Assembly Cuts

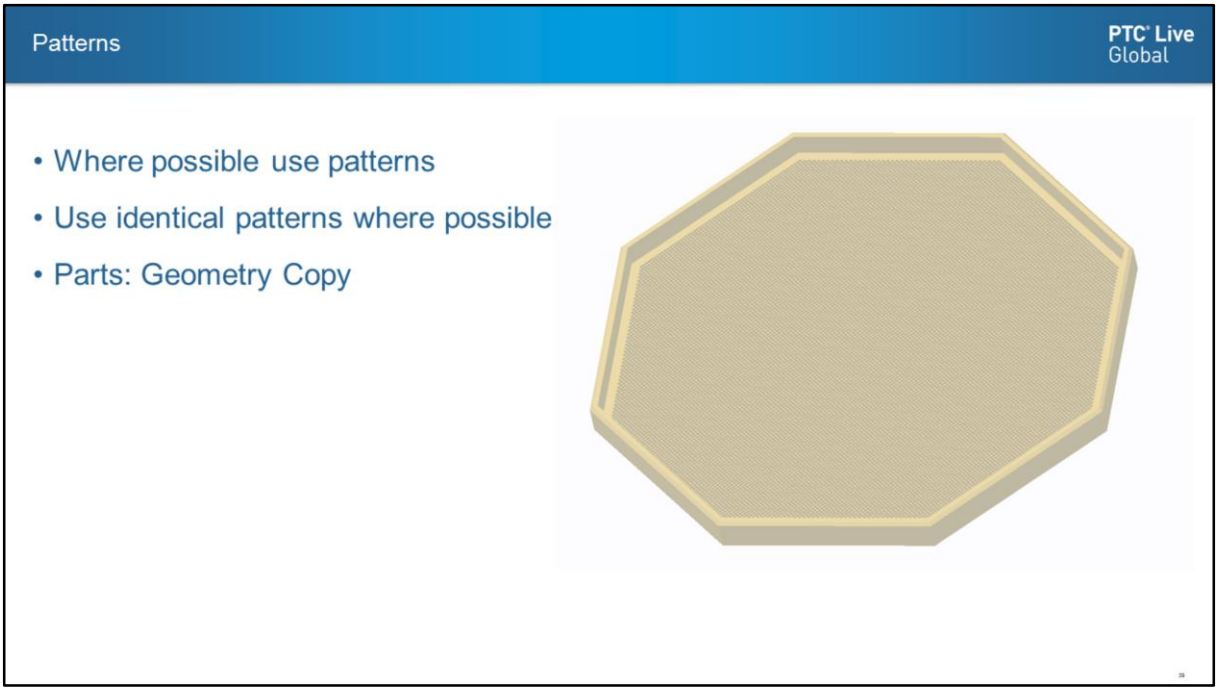
PTC® Live Global

- Assembly cuts are the fastest way to make a simple assembly complex
- Approximate impact:

Number of Unique Cuts	X	Number of Unique Intersected Models	=	Number of Unique Models in Memory

- Mitigate Assembly cuts by using feature level cuts
- Switch to manual model selection

With Creo's parametric functionality each model is based on all the features that came before it. Creo allows you to quickly pull up any component exactly as it's shown. It does this at a performance hit.

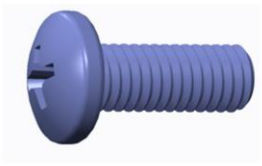


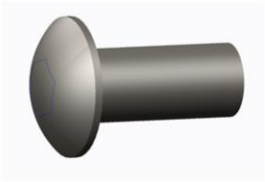
Patterns do help with performance, especially in the area of assembly cuts.
However, make sure to use identical where possible.
In parts, using geometry copy will help reduce the load in the future.

Features

PTC® Live Global

- Evaluate if you need the feature, or just a representation/cosmetic of the feature





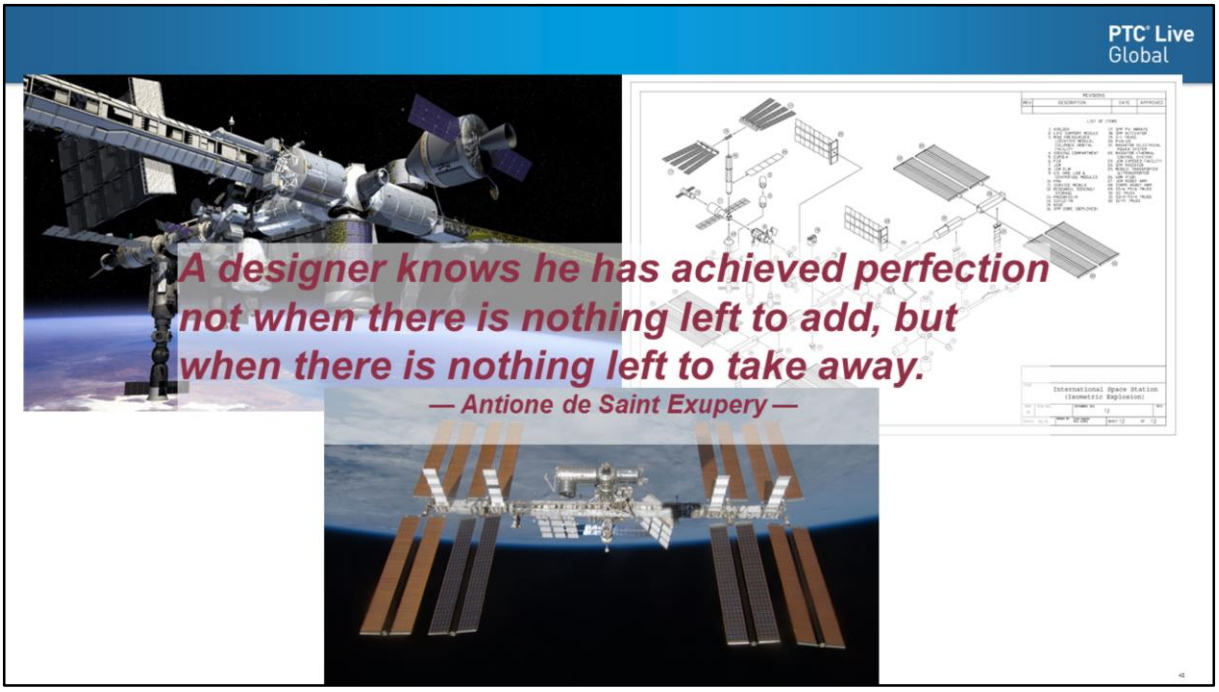
- Evaluate how it will look on a drawing at scale.

Important Rules for Working with Large Assemblies

PTC Live Global

- Start early
- Think for the future
- Don't reinvent the wheel
- Think Simple
- Set up your "default" rep
- Be careful on drawings
- Make sure your setup is ready

Start Early - start with lower level assemblies during creation
Think for the future – Engineering is not all about you, it's about everyone
Don't reinvent the wheel - Use previous User Defined reps within higher assembly reps
Think simple - Only show what you need to show – You don't need every detail all the time
Set up your "default" rep -
Be careful on drawings - When using BOM balloons on drawings, be careful of which rep you show – Exclude will remove items from the parts list and bom balloons will not cross reps.
Lightweight Graphics Rep works only if visualization available – otherwise defaults to bounding box
Make sure your setup is ready - Lightweight Graphics Rep works only if visualization available – otherwise defaults to bounding box



All in all, what I want to leave you with is know when you need this.
And when you should be using this.
So you can succeed at building something like this.

http://www.nasa.gov/mission_pages/station/multimedia/scalemodel/index.html

PTC® Live Global

- Your feedback is valuable
- Don't miss out on the chance to provide your feedback
- Gain a chance to win an instant prize!
- Complete your session evaluation now

PTC® Live Global

Questions

Steven LaPha Jr.

Steven.G.LaPha@NASA.gov

Find out more about NASA's Space Launch System
www.NASA.gov/exploration/systems/SLS


PTC® Live Global
PTC PRODUCT & SERVICE ADVANTAGE®