MBD - Best Practice
Summary and Storyboard

Jan Stothfang

Content

- **Drawingless Design Best Practice Summary**
  - Context, Definition & Scope
- **Drawingless Design Best Practice Storyboard**
  - Process Storyboard Overview
  - Process Storyboard Steps/Activities
- **Summary**

What is MBD? – The Journey

- **Common terminology for logical progression from fully drawing-based to fully model-based**

Drawing Centric

2D Master Drawing - 3D model not verified or configuration controlled

Model Centric

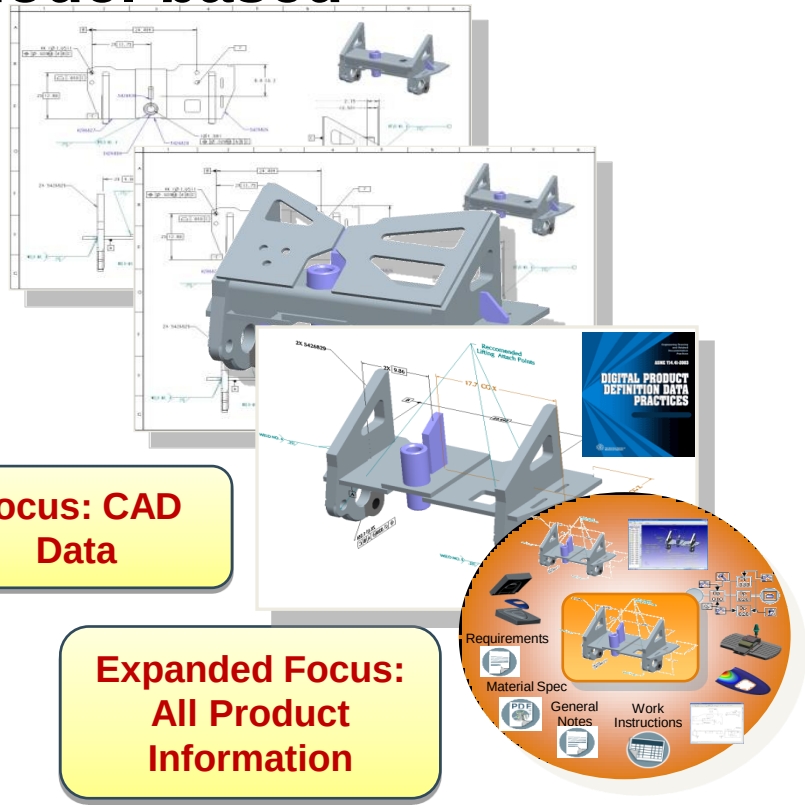
2D Master Drawing w/ associative 3D model (Model is verified and configuration controlled)

Model Based Definition

3D Master CAD Model with 3D annotations (2D drawings by exception)

Model Based Enterprise

3D Master CAD Model with 3D annotations (Fully leveraged by the Enterprise)



Focus: CAD Data

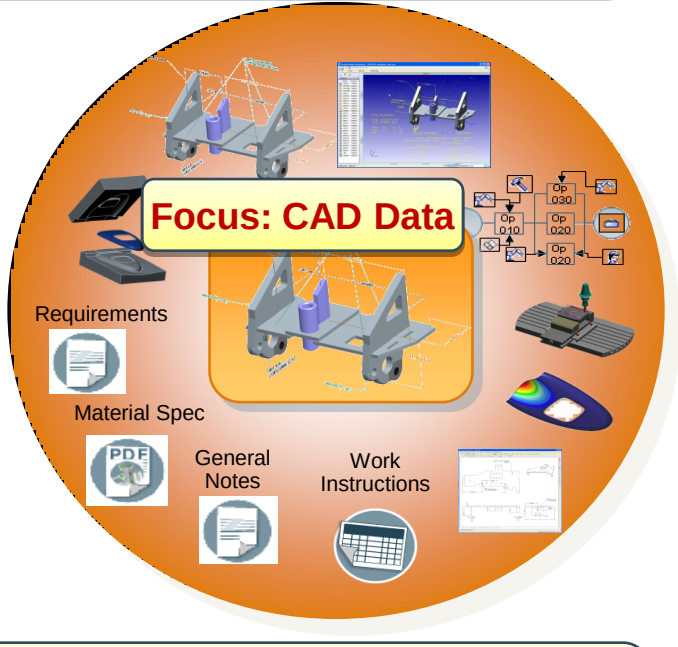
Expanded Focus: All Product Information

What is MBD - Definition

Business Process (supported by technology) to enable more efficient product development

Single Master Digital Dataset **that provides complete product definition**

- Flows seamlessly through the Product Development process
- Managed in Enterprise PLM
- Consumers access relevant information through the PLM, CAD, Visualization and Publication

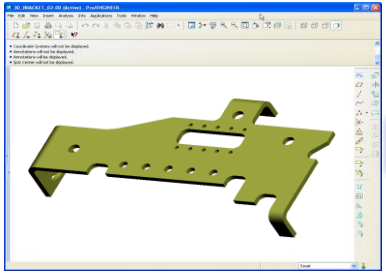


Fully Annotated 3D digital model becomes a Master portal for accessing critical geometric and mfg process information

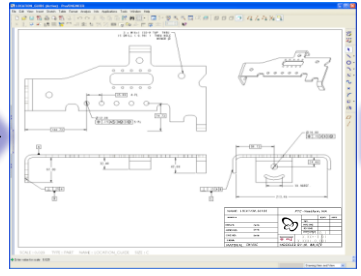
“Drawing Centric” Process

Create 3D Model → Create Drawing → Send Drawing to Downstream Consumers → Downstream Consumers Remaster Drwg for Mfg, Inspection…

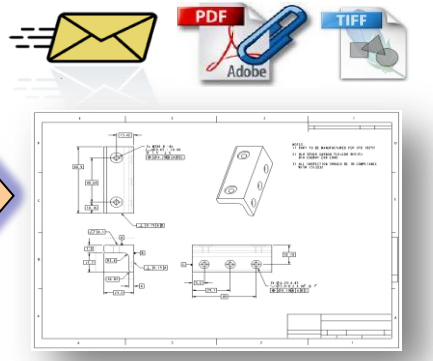
CAD Model



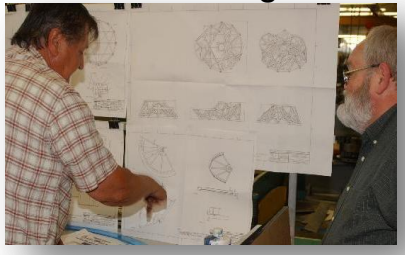
CAD Drawing



Paper Output



Remastered Drawings



Challenges/Pain Points

- Complex revision control, difficult collaboration
- Drawings get out of synch w. model
- Costly errors of manufacturing from outdated drawings
- In process changes don’t get communicated into model
- Duplication of effort - Manual recreation of product definition

Root causes

- Drawing is the master document
- Drawings are often in paper format
- Frequent re-mastering of data
- Model & drawing are 2 separate documents

Drawingless Design Best Practice *Summary*

- **Goal:**
  - Document and deliver 3D designs for downstream consumption by eliminating or drastically reducing 2D drawings
- **Capabilities:**
  - Document PMI and Key Characteristics via 3D Annotations
  - Organize PMI content in form appropriate for downstream consumers
  - Deliver documented design via lightweight format or reduced 2D format (optional)
- **Benefits:**
  - Data reuse vs. re-creation reduces lead time & cost
  - Reduces errors and time to market by reusing the single master data set
  - Reduce scrap through increased accuracy by replacing the 2D drawing with an annotated model

Drawingless Design Best Practice *Scope*

- **In Scope:**
  - Machined Parts, Plastic parts, Inseparable Assemblies

- **TBD Process Specific Best Practices for:**
  - Installations & Assemblies – Work instructions
    - Assembly models, Manufacturing tooling - jigs and fixtures
  - Forgings & Stampings, Sheetmetal or Blankets
  - Cables & Wire Harness
    - Cable and harness manufacturing, installation & hook-up (ref des attachments locations)
  - Piping & Waveguide
  - Composite Panels and Sandwich structures
    - Face sheets, core, inserts etc
  - Weldments

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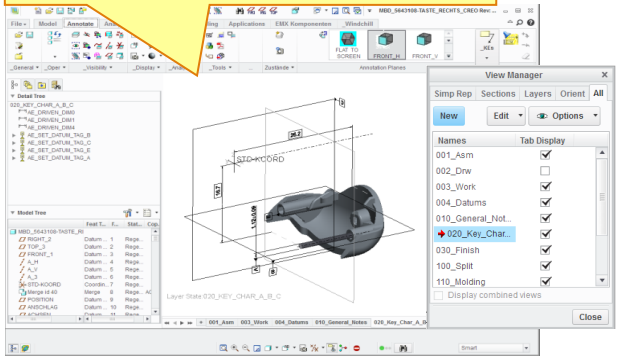
Process Storyboard Steps / Activities Overview

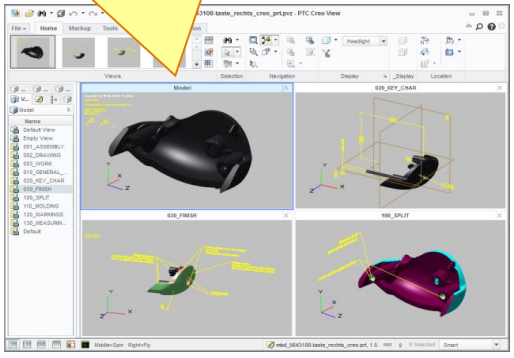
Design Engineer

- Start Best Practice
- 1.0 Create & Organize Annotated 3D Model
- 2.0 Deploy Annotated Content via Visualization
- 3.0 Create 2D Deliverables (optional)
- 4.0 Create Digital Product Definition Package
- End Best Practice

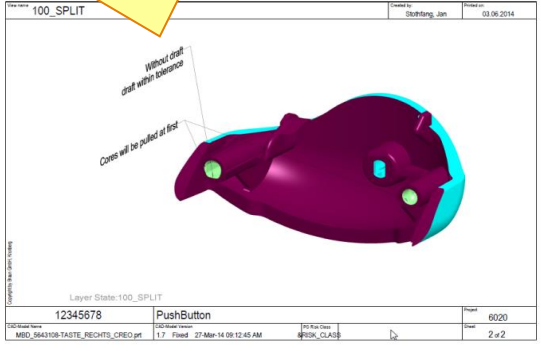
1.0 ***Create & Organize Annotation content in Creo/Parametric 3D model***



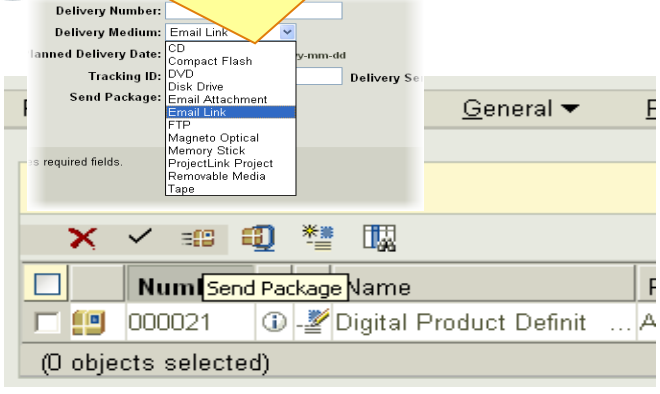
2.0 ***Publish to and Access PMI and Combined States in a 3D viewer***



3.0 ***Create 2D deliverables (optional)***



4.0 ***Assemble & make Digital product Definition Package available to consumers***



1.0 Create & Organize Annotated 3D Model

Design Engineer

Start Best Practice

1.0 Create & Organize Annotated 3D Model

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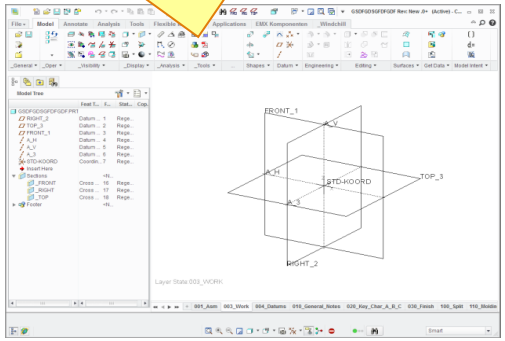
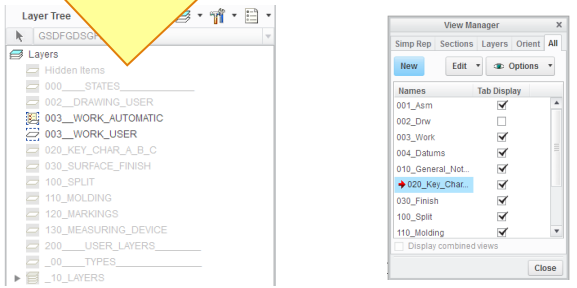
End Best Practice

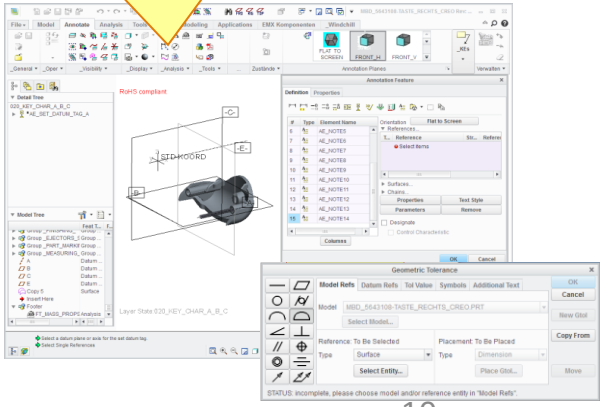
Use Start Parts/Assemblies



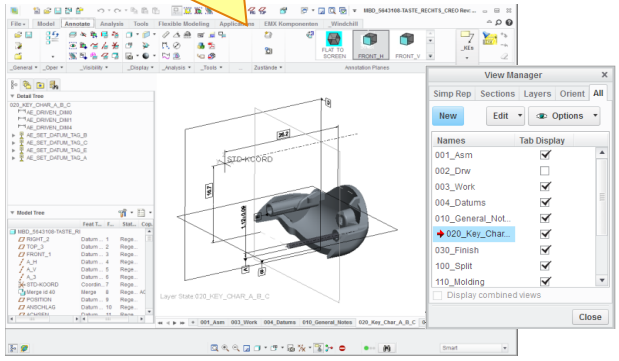
Create new PMI organizational structure (Views, Styles, Layers, X-Secs, Simp Reps, Combined States)



Create Annotations (Driving Dims, GTOLs, Notes, X-Secs, Symbols…)



Organize Annotation content in appropriate Combined States



2.0 Deploy Annotated Content via Visualization

Design Engineer

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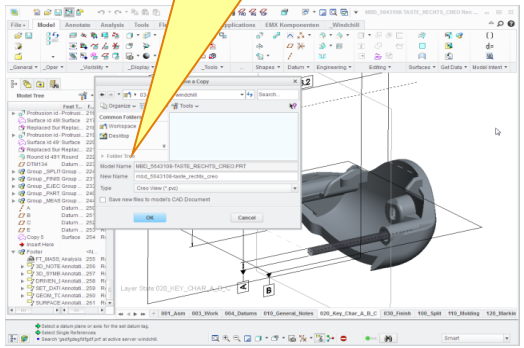
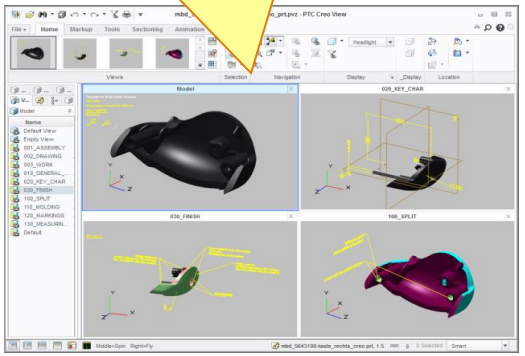
1 Manual process

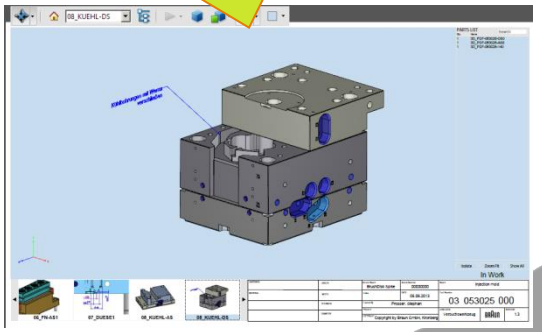
'Save as' directly from Creo/ Parametric



Access PMI, layers and Combined States in Creo/View



Access PMI and Combined states in 3D PDF



Any other 3D viewing format

2.0 Deploy Annotated Content via Visualization

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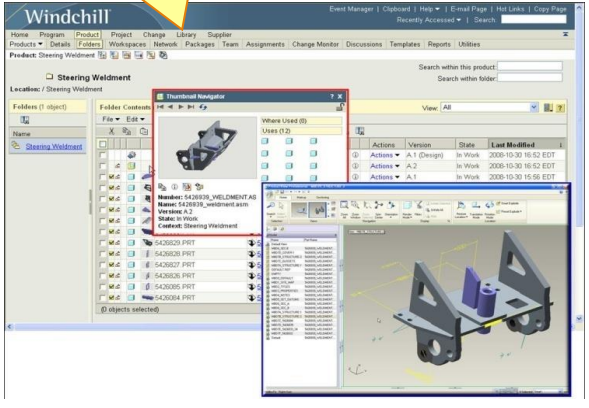
End Best Practice

2 Automatic process (Windchill worker)

Check-in into Windchill for automatic publishing



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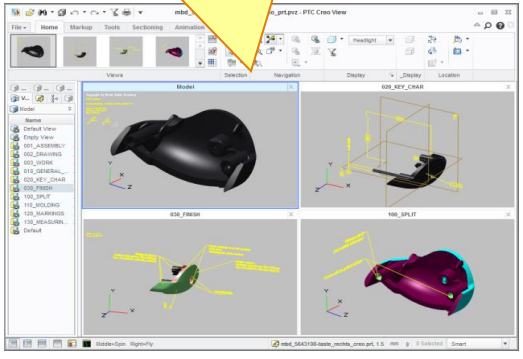

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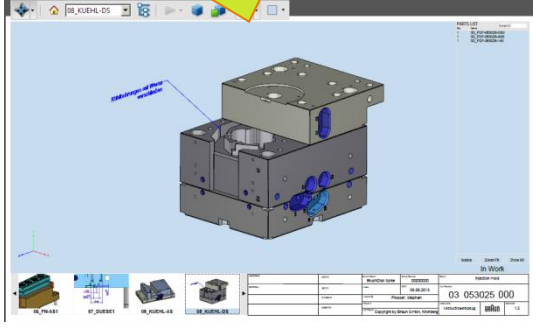

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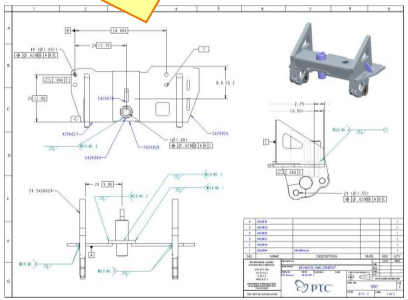
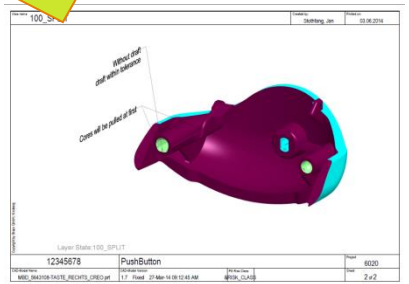
1 Manual process

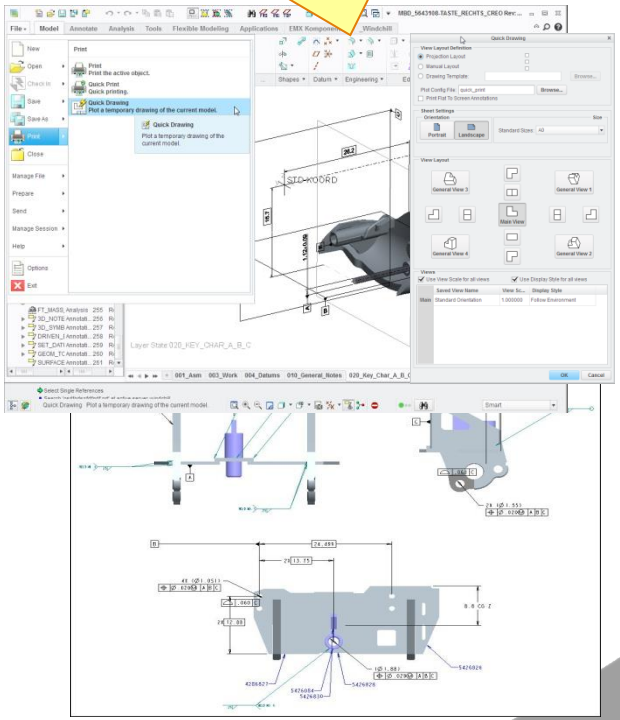
Create reduced dimension drawings based on combined states



Export to 2D PDF



Create quick drawings for instant collaboration



3.0 Create 2D deliverables (optional)

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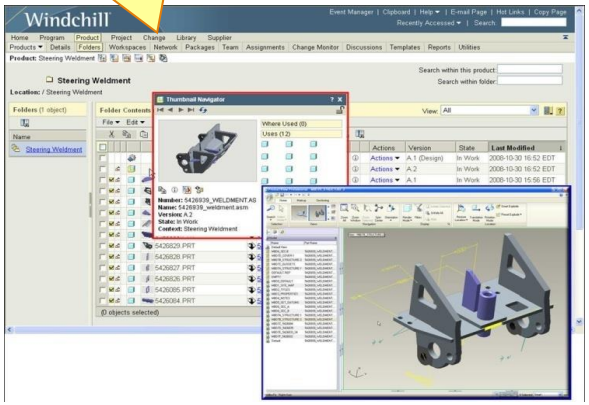

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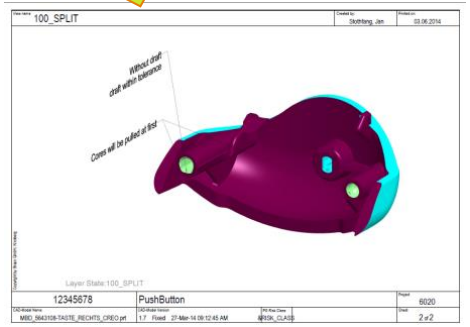

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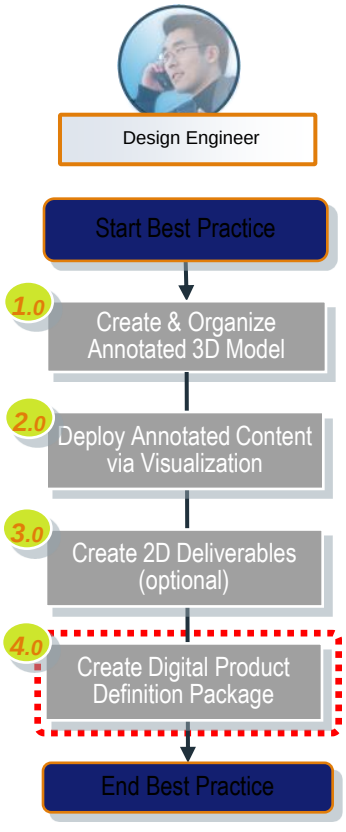
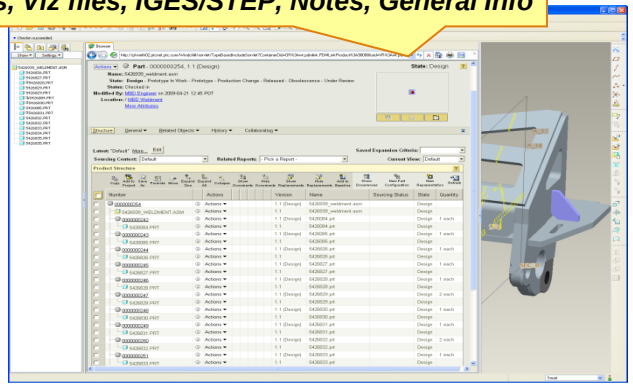
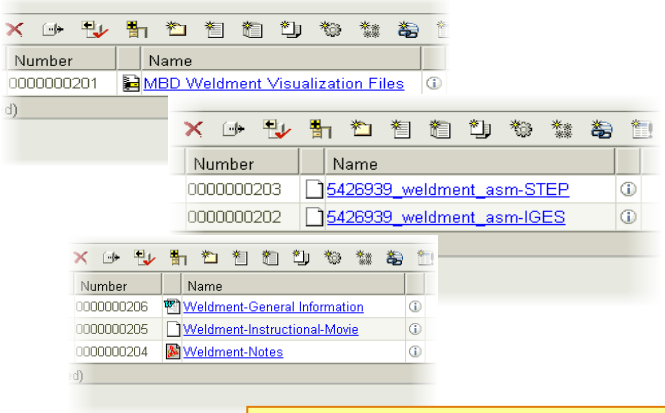
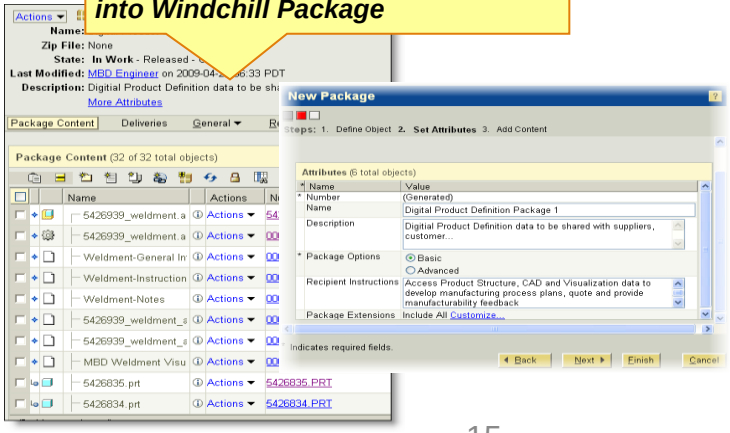


Collect all relevant product data – BOM, CAD Files, Viz files, IGES/STEP, Notes, General Info

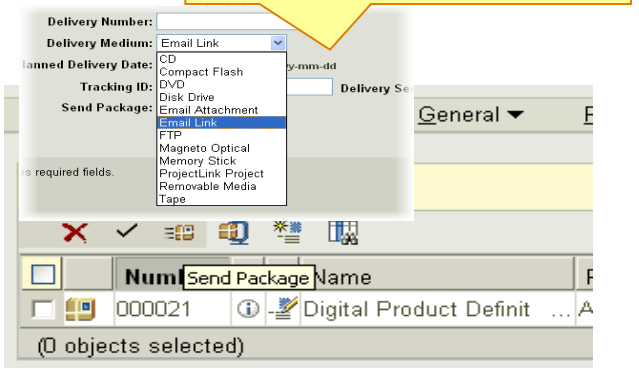




Assemble Digital Product Definition into Windchill Package



Make Digital product Definition Package available to consumers



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Process Storyboard Steps / Activities Overview

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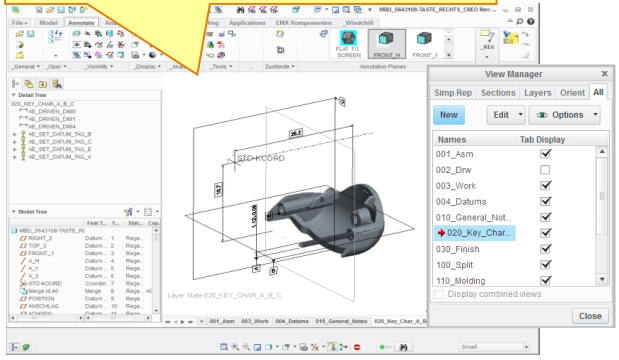

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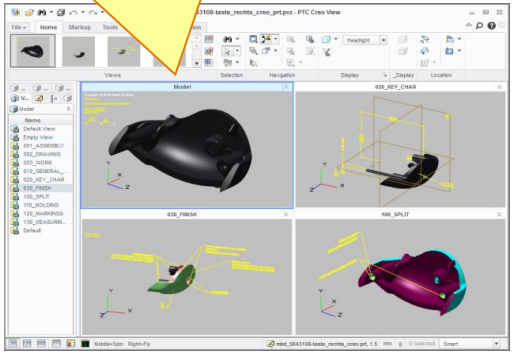

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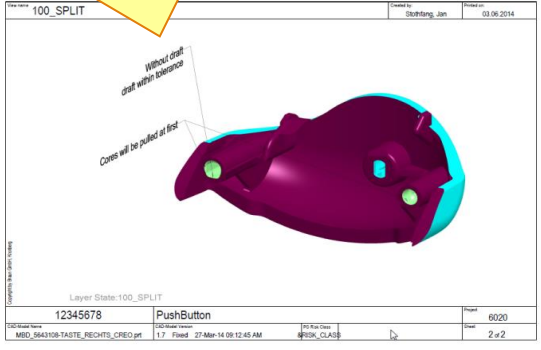

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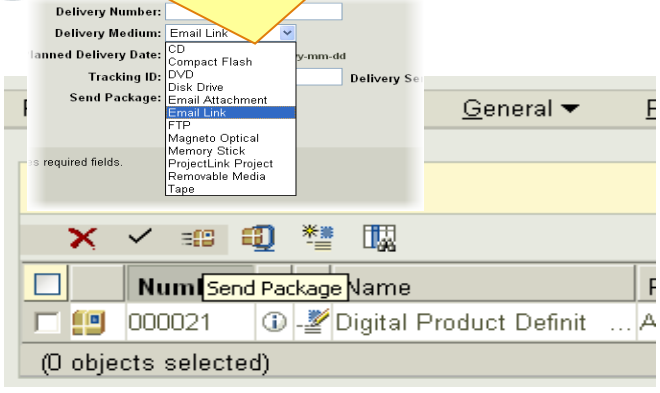

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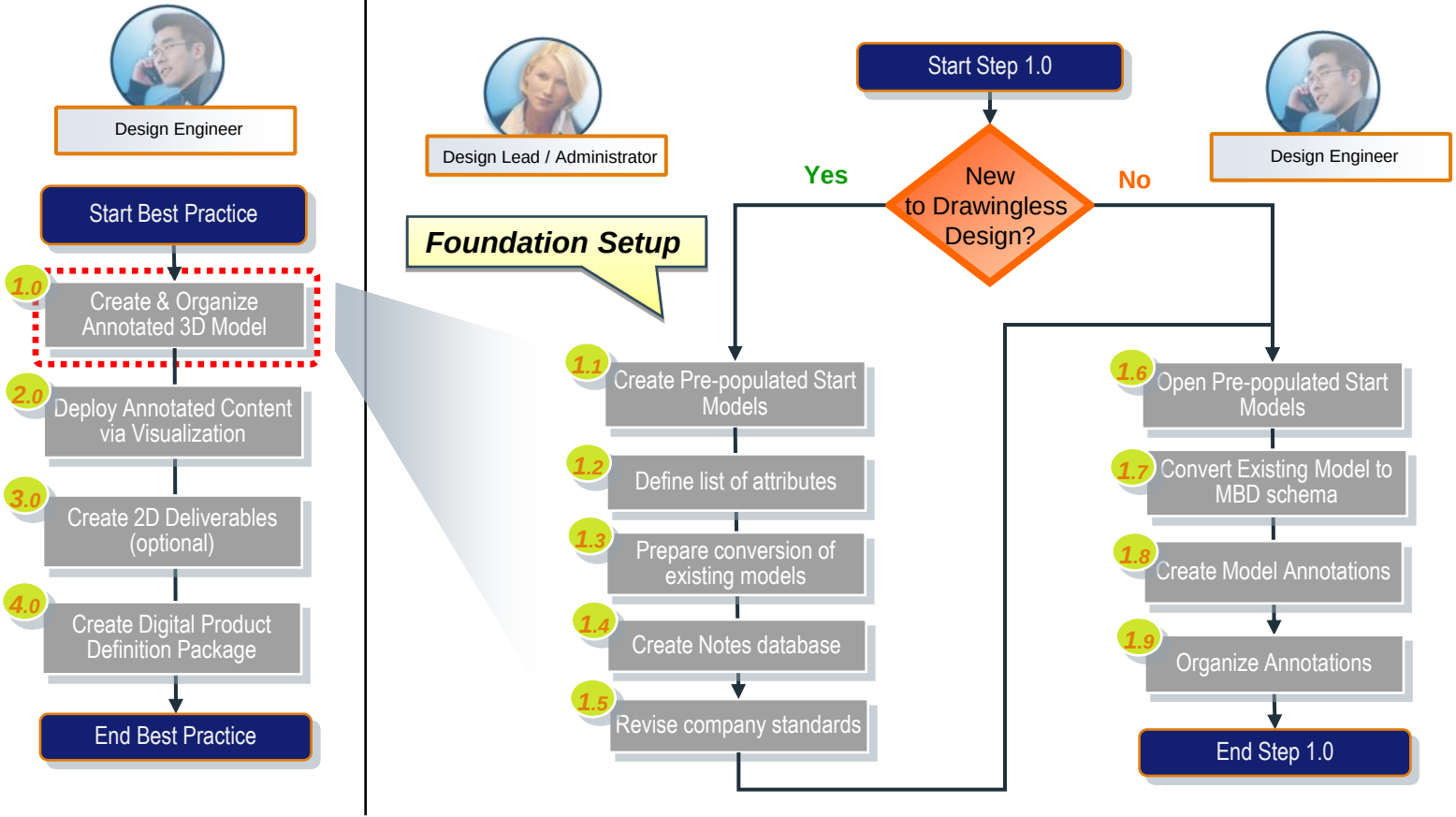

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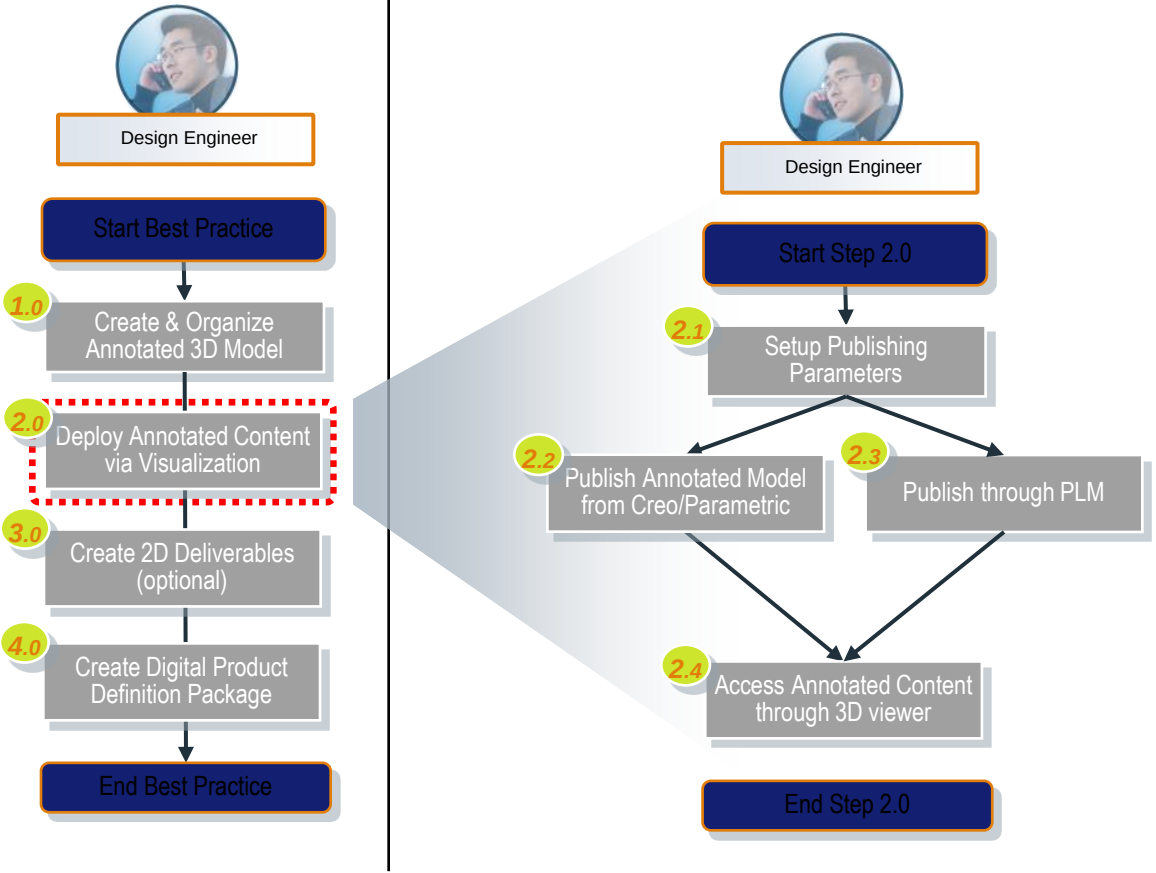

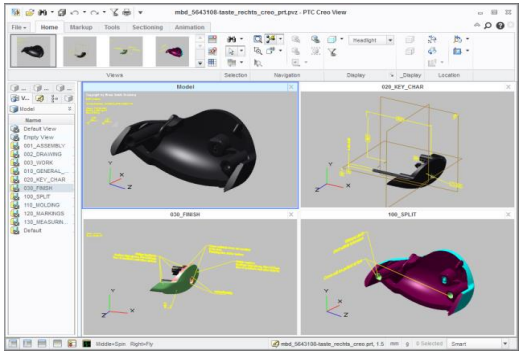

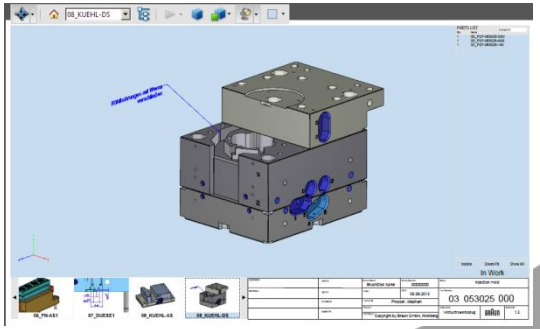

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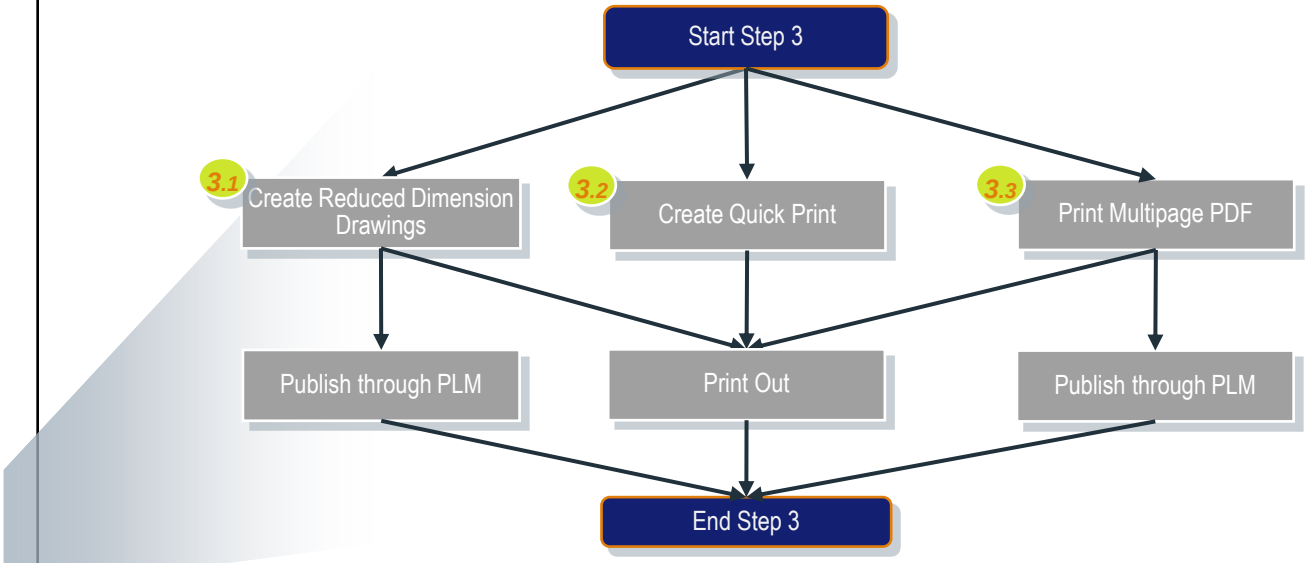
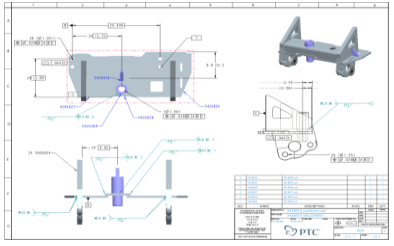
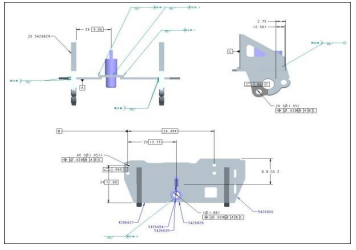
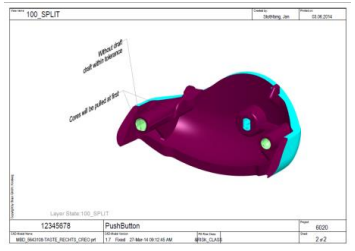
End Best Practice

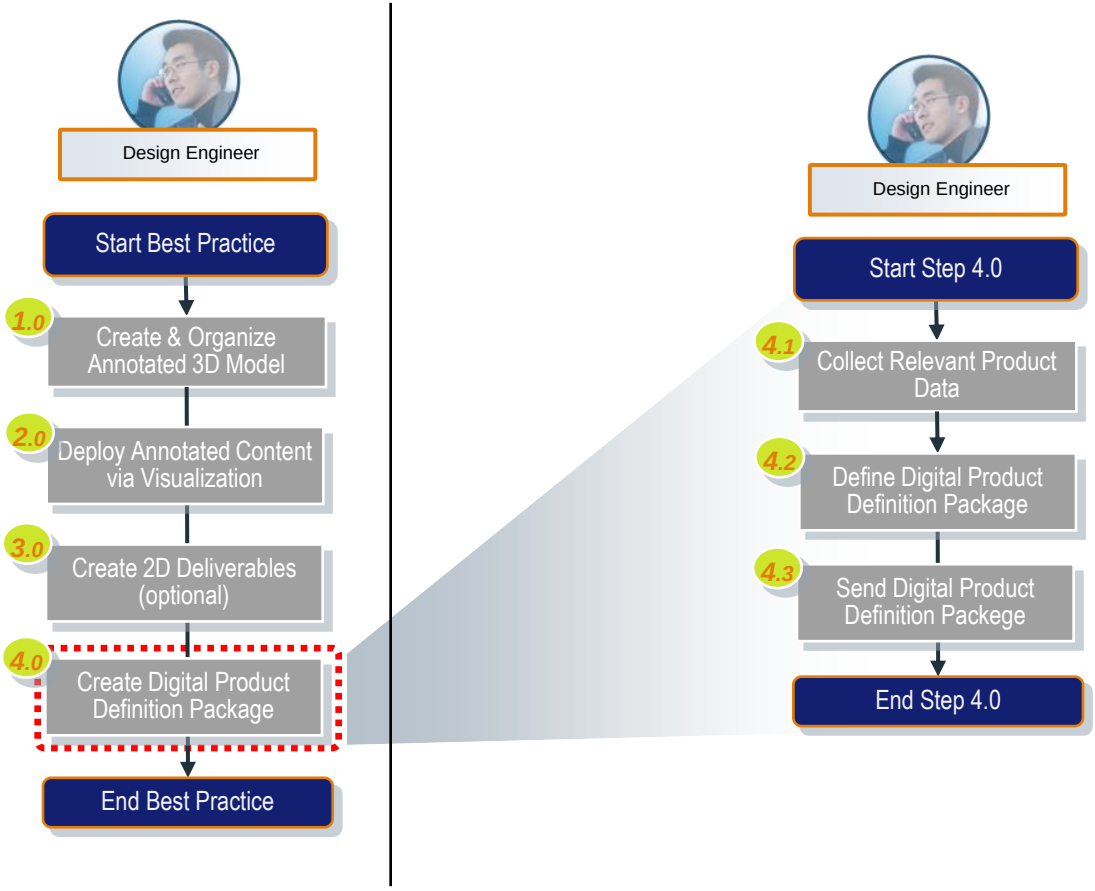


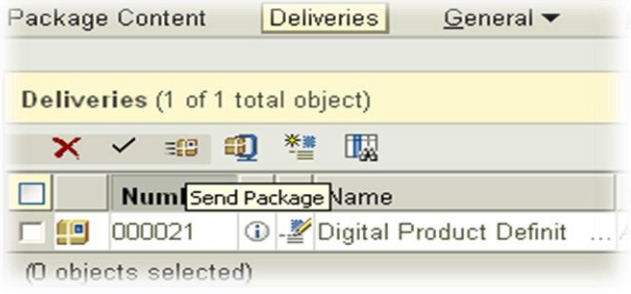






4.0 Create Digital Product Definition Package





MBD: Summary of Benefits

- **Higher quality products, lower costs**
  - Fewer errors, less rework
  - Reduce product non-conformance
  - Reduce need for aftermarket support
- **Accelerate the product development process**
  - Eliminate checking of drawing vs. model conflicts
  - Reduce time spent communicating with downstream consumers
  - Reduce time spent interpreting drawings on the shop floor
  - Compress designer effort compared to drawing creation
  - Significantly reduce change activity
- **Automate and improve data sharing between groups**
  - Capture knowledge gained in design, manufacturing, assembly, inspection, testing
  - Reuse validated process information

- **End**

Process Storyboard Steps / Activities Overview

Design Engineer

Start Best Practice

1.0 Create & Organize Annotated 3D Model

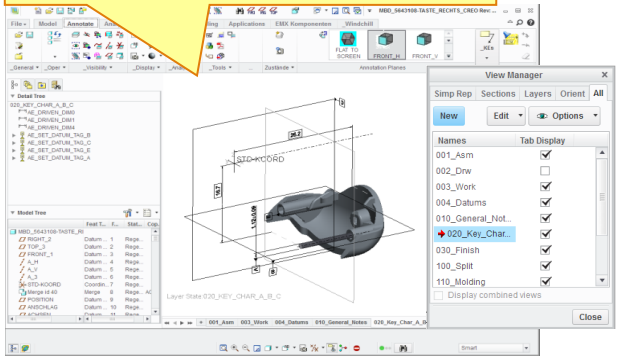
2.0 Deploy Annotated Content via Visualization

3.0 Create 2D Deliverables (optional)

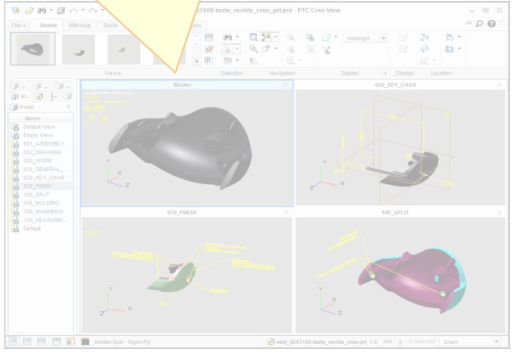
4.0 Create Digital Product Definition Package

End Best Practice

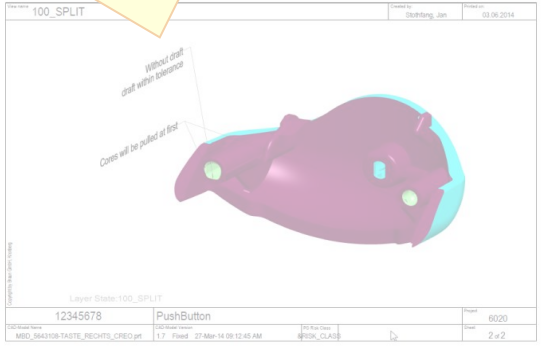
1.0 ***Create & Organize Annotation content in Creo/Parametric 3D model***



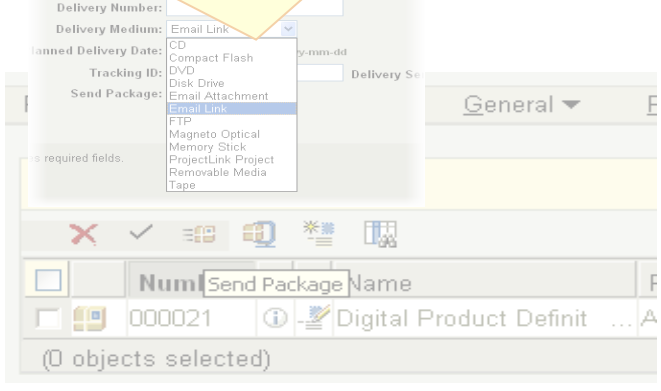
2.0 ***Publish to and Access PMI and Combined States in a 3D viewer***



3.0 ***Create 2D deliverables (optional)***



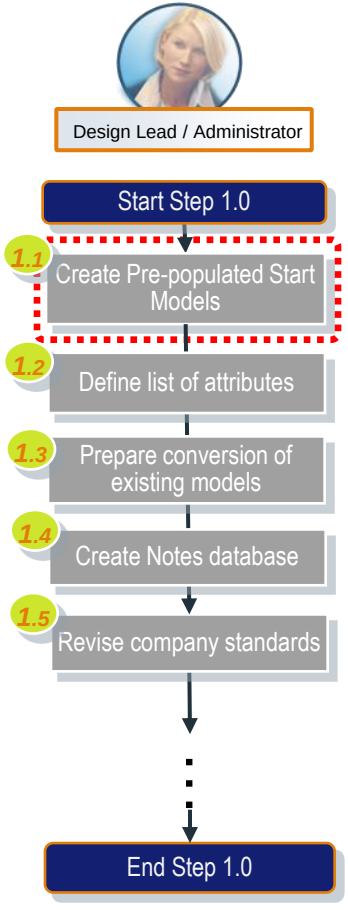
4.0 ***Assemble & make Digital product Definition Package available to consumers***



1.0 Create & Organize Annotated 3D Model

1.1 Create Pre-populated Start models

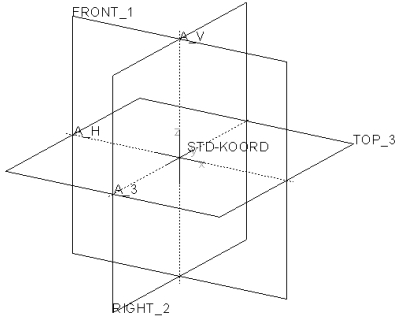
→ Tips & Tricks | → 1.0 Story Board



Suggested content and settings

- View Orientations
- X-sections
- Simp Reps
- Styles
- Layers
- Layer states
- Combined states
- Parameters
- Features (Datums, Csys, ...)
- Annotation features
- Annotations (Notes, Symbols, ...)

- Accuracy
- Units
- Setup file (.dtl)
- Tolerance class
- Tolerance tables

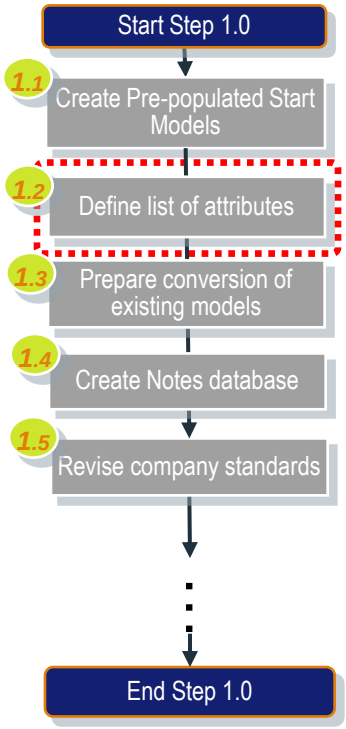


1.0 Create & Organize Annotated 3D Model

1.2. Define list of attributes

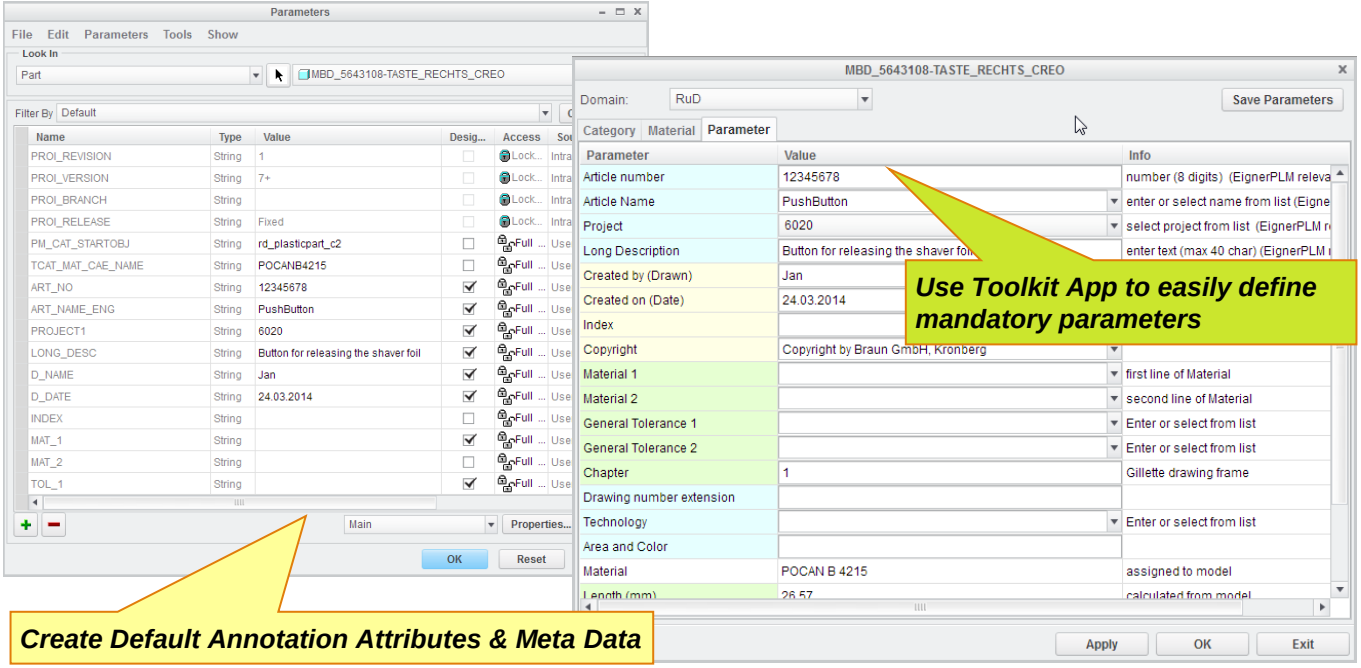
→ Tips & Tricks | → 1.0 Story Board

Design Lead / Administrator



1 PTC default

2 Customization

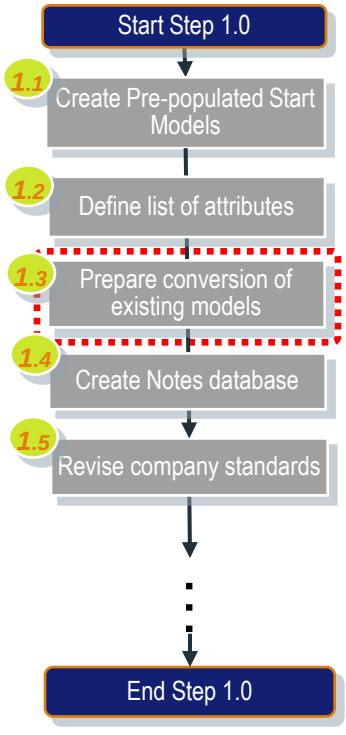


1.0 Create & Organize Annotated 3D Model

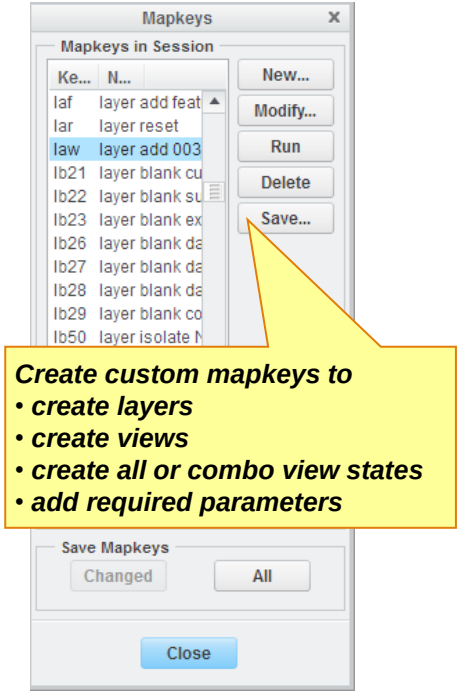
1.3 Prepare conversion of existing models

→ Tips & Tricks | → 1.0 Story Board

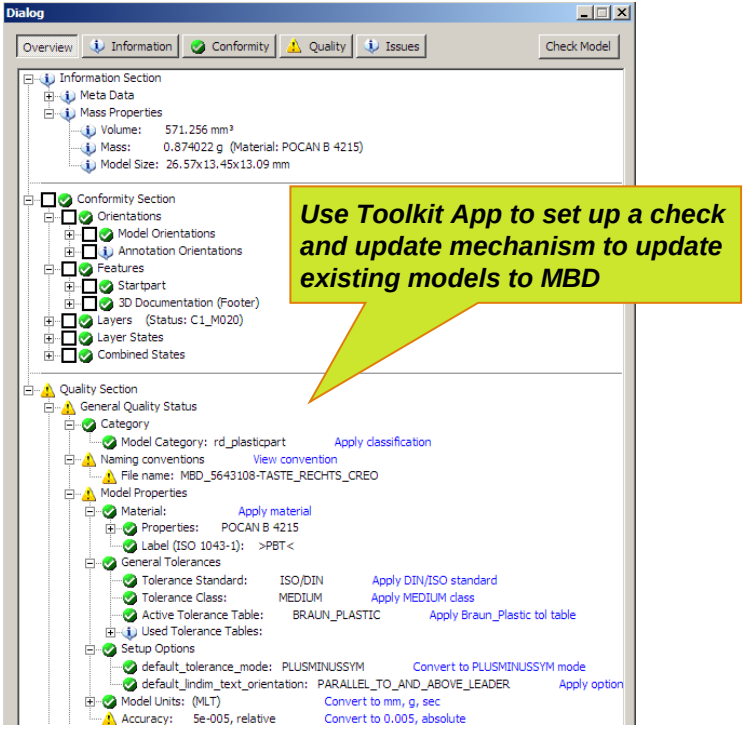
Design Lead / Administrator



1 PTC default



2 Customization



1.0 Create & Organize Annotated 3D Model

1.4 Create Notes database

→ Tips & Tricks | → 1.0 Story Board

Design Lead / Administrator

Start Step 1.0

1.1 Create Pre-populated Start Models

1.2 Define list of attributes

1.3 Prepare conversion of existing models

1.4 Create Notes database

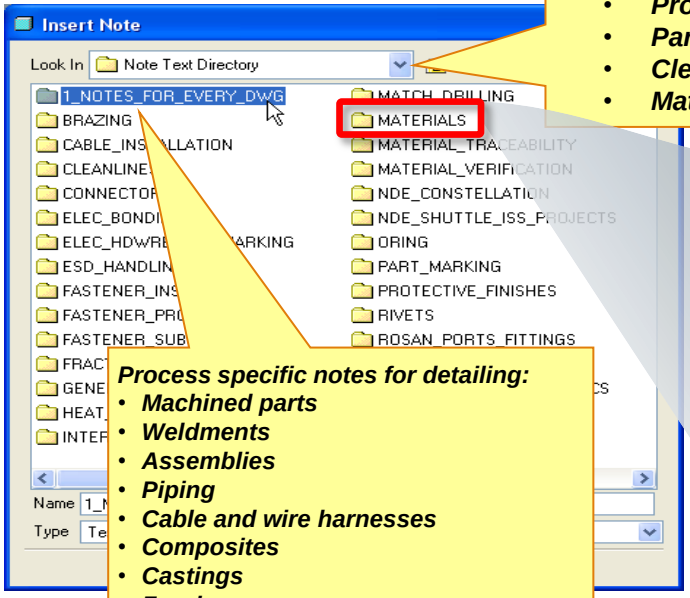
1.5 Revise company standards

End Step 1.0

1 PTC default

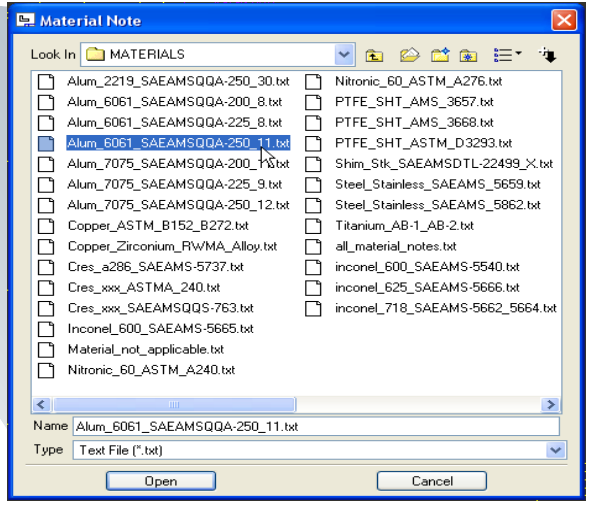
Create library of company standard notes
Can be automated to prompt user to select one of each type:

- ***Material Note***
- ***Protective Finishes Note***
- ***Part Marking Note***
- ***Cleanliness Note***
- ***Material Traceability Note***



Process specific notes for detailing:

- ***Machined parts***
- ***Weldments***
- ***Assemblies***
- ***Piping***
- ***Cable and wire harnesses***
- ***Composites***
- ***Castings***
- ***Forgings***
- ***Stampings***
- ***Blankets***
- ***Sheetmetal parts***



1.0 Create & Organize Annotated 3D Model

1.4 Create Notes database

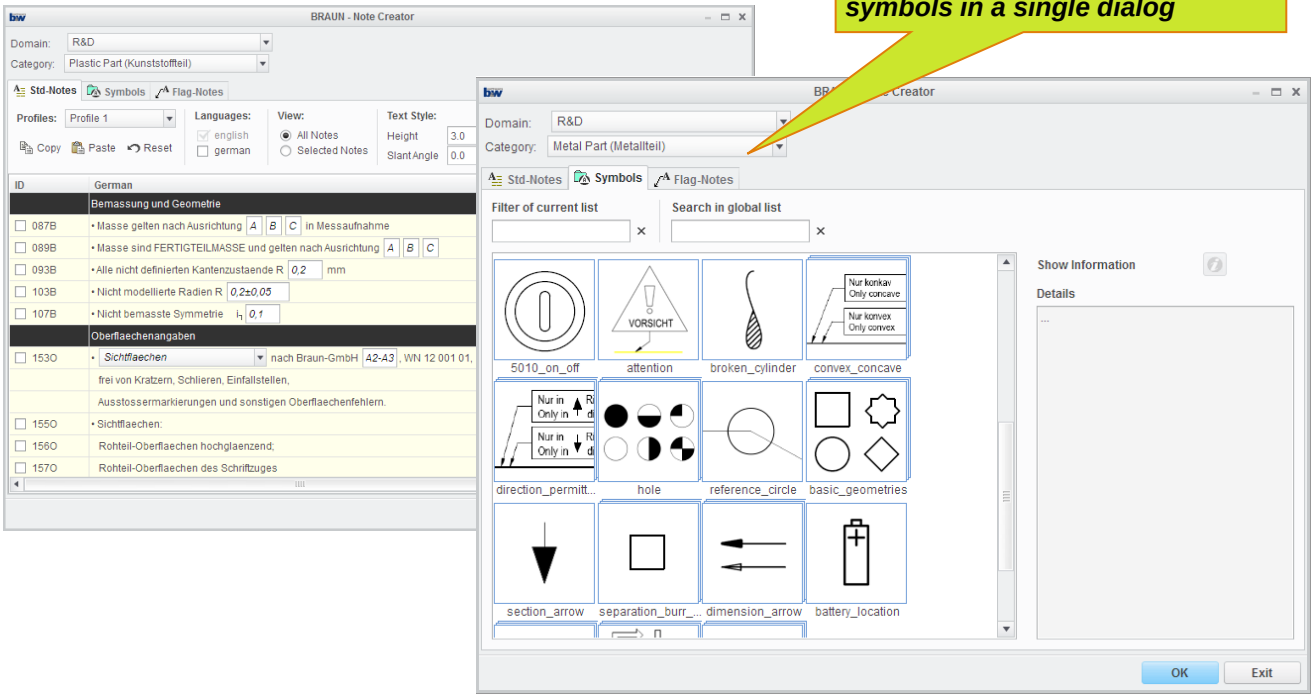
→ Tips & Tricks | → 1.0 Story Board

Design Lead / Administrator

- Start Step 1.0
- 1.1 Create Pre-populated Start Models
- 1.2 Define list of attributes
- 1.3 Prepare conversion of existing models
- 1.4 Create Notes database
- 1.5 Revise company standards
- End Step 1.0

2 Customization

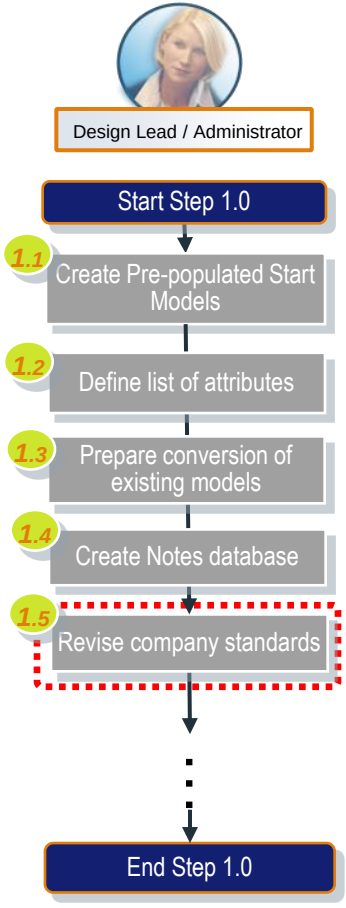
Use Toolkit App manage flat-to-screen notes, flag notes and symbols in a single dialog



1.0 Create & Organize Annotated 3D Model

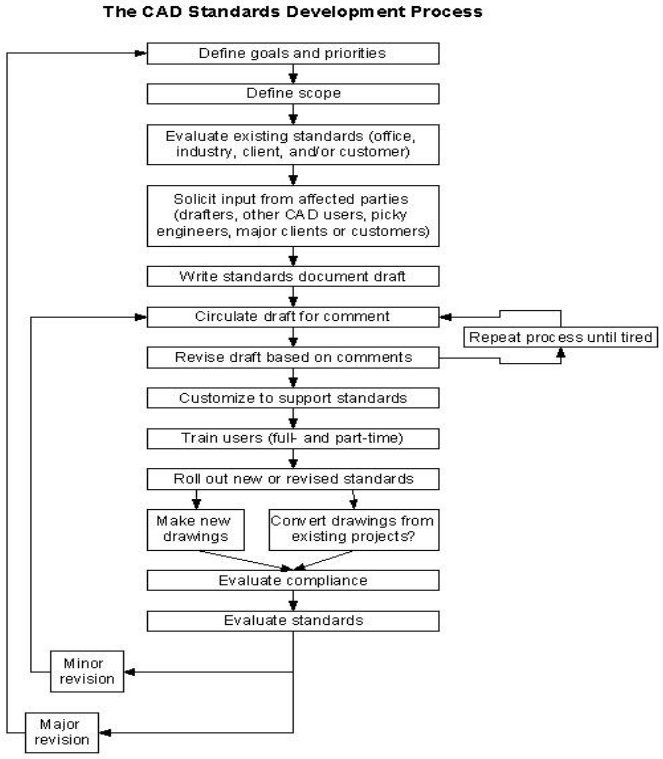
1.5 Revise Company Standards and Processes

→ 1.0 Story Board



Modify current CAD standards to include standards for drawingless design development process

- Model is leading object
- Print out strategy
  - Drawing Table for printouts



1.0 Create & Organize Annotated 3D Model

1.6 Open Pre-populated Start Models

→ 1.0 Story Board

Design Engineer

Start Step 1.0

1.6 Open Pre-populated Start Models

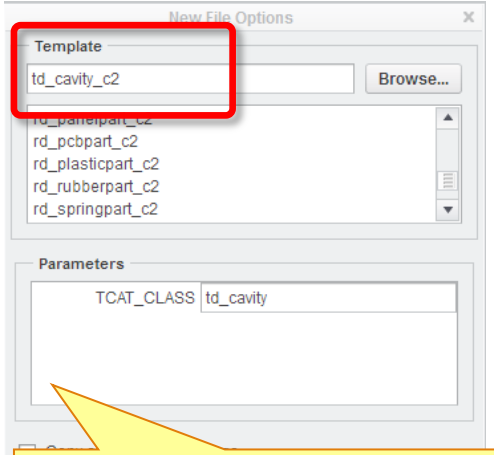
1.7 Convert Existing Model to MBD schema

1.8 Create Model Annotations

1.9 Organize Annotations

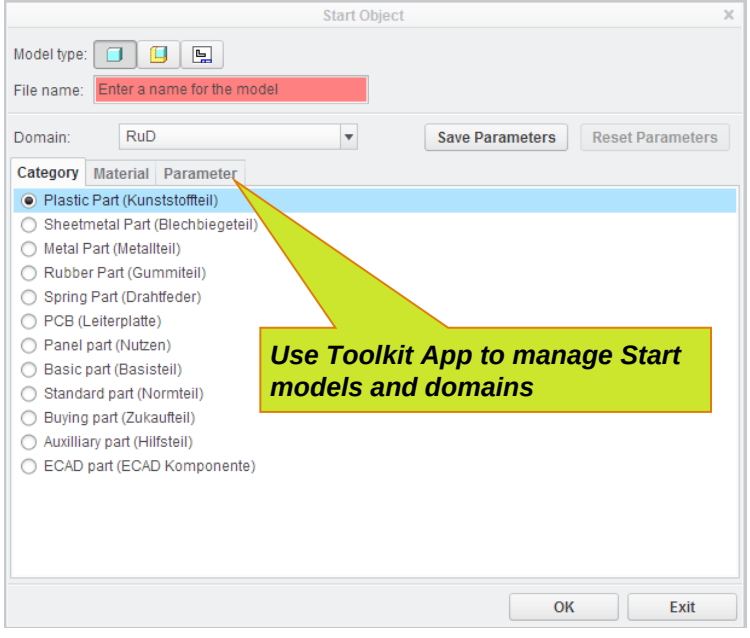
End Step 1.0

1 PTC default



Start part s and assemblies
Sheetmetal, wire harness, etc
Create mm and inch versions
- ***pre-defined Layers***
- ***pre-defined Views***
- ***pre-defined All states***

2 Customization



Use Toolkit App to manage Start models and domains

1.0 Create & Organize Annotated 3D Model

1.7 Convert Existing Model to MBD schema

→ 1.0 Story Board

Design Engineer

Start Step 1.0

1.6 Open Pre-populated Start Models

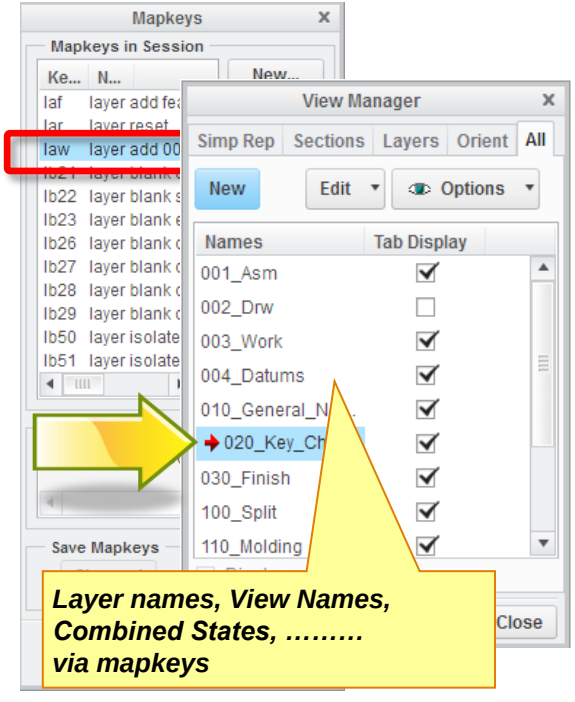
1.7 Convert Existing Model to MBD schema

1.8 Create Model Annotations

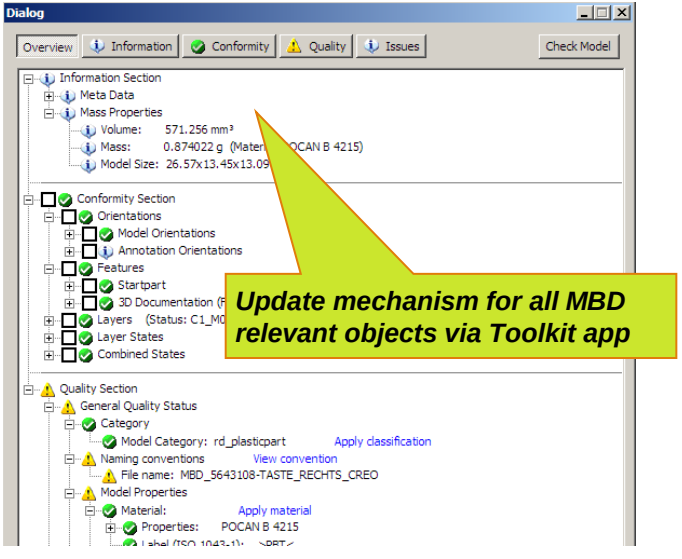
1.9 Organize Annotations

End Step 1.0

1 PTC default



2 Customization



1.0 Create & Organize Annotated 3D Model

1.8 Create Model Annotations

→ 1.0 Story Board

Design Engineer

Start Step 1.0

1.6 Open Pre-populated Start Models

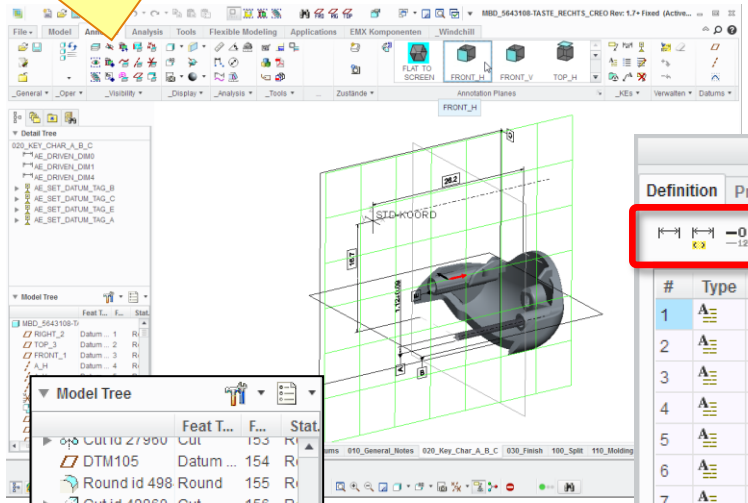
1.7 Convert Existing Model to MBD schema

1.8 Create Model Annotations

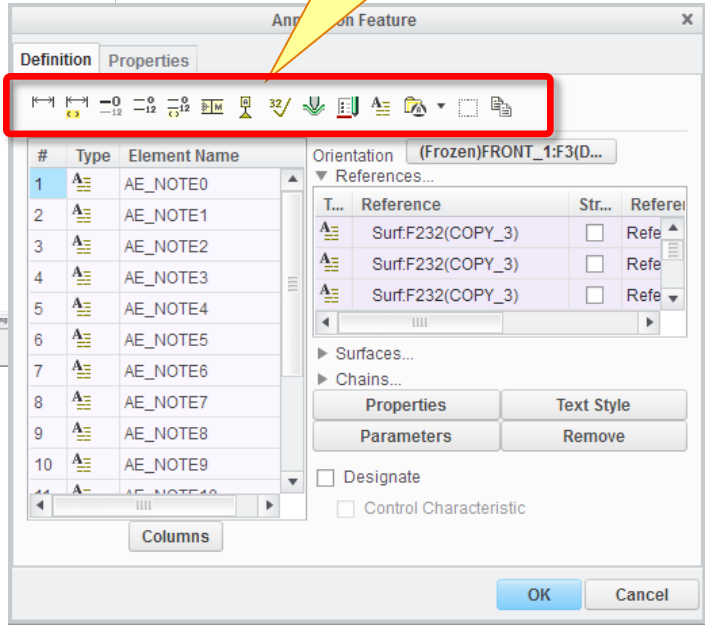
1.9 Organize Annotations

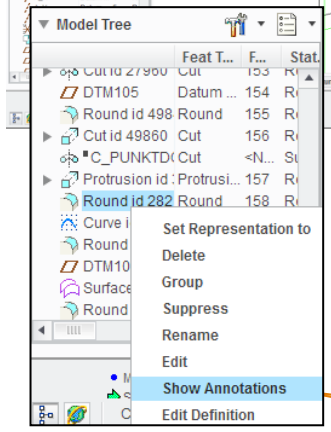
End Step 1.0

Define Annotation Orientation



Create Various Annotation Types





Create Driving Dimension

1.0 Create & Organize Annotated 3D Model

1.8 Create Model Annotations

→ 1.0 Story Board

Design Engineer

Start Step 1.0

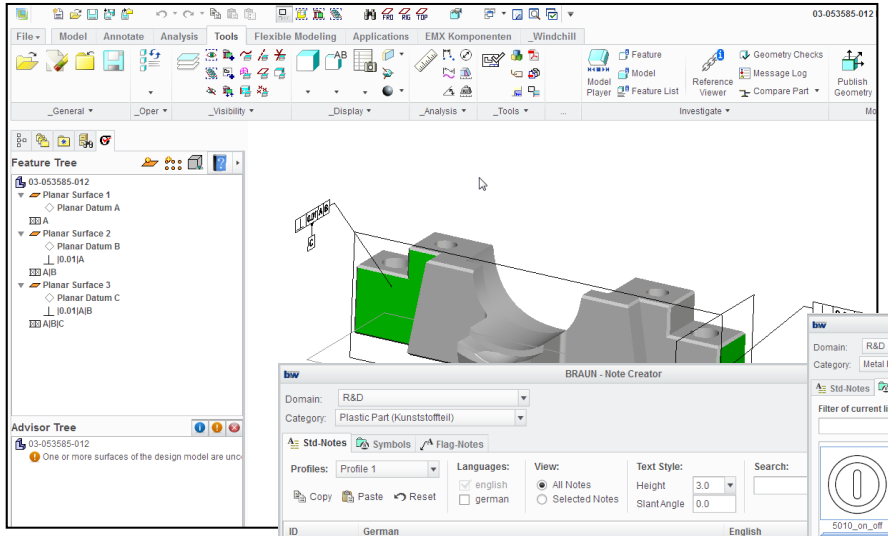
1.6 Open Pre-populated Start Models

1.7 Convert Existing Model to MBD schema

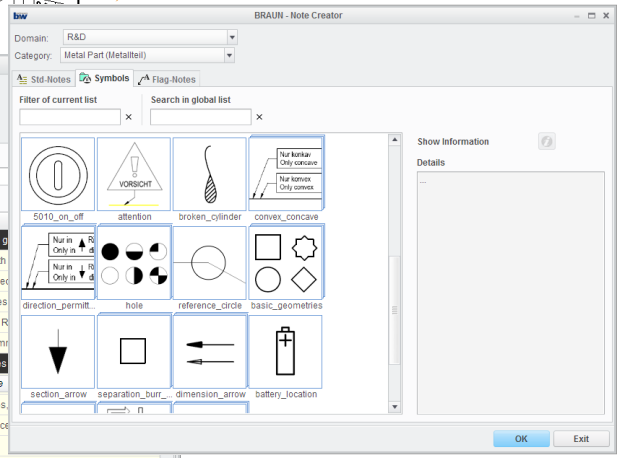
1.8 Create Model Annotations

1.9 Organize Annotations

End Step 1.0



Third party apps to help support GD&T, standard notes, symbols, x-sec, …



1.0 Create & Organize Annotated 3D Model

1.9 Organize Annotations in Model tree and Graphics

→ Tips & Tricks | → 1.0 Story Board

Design Engineer

Start Step 1.0

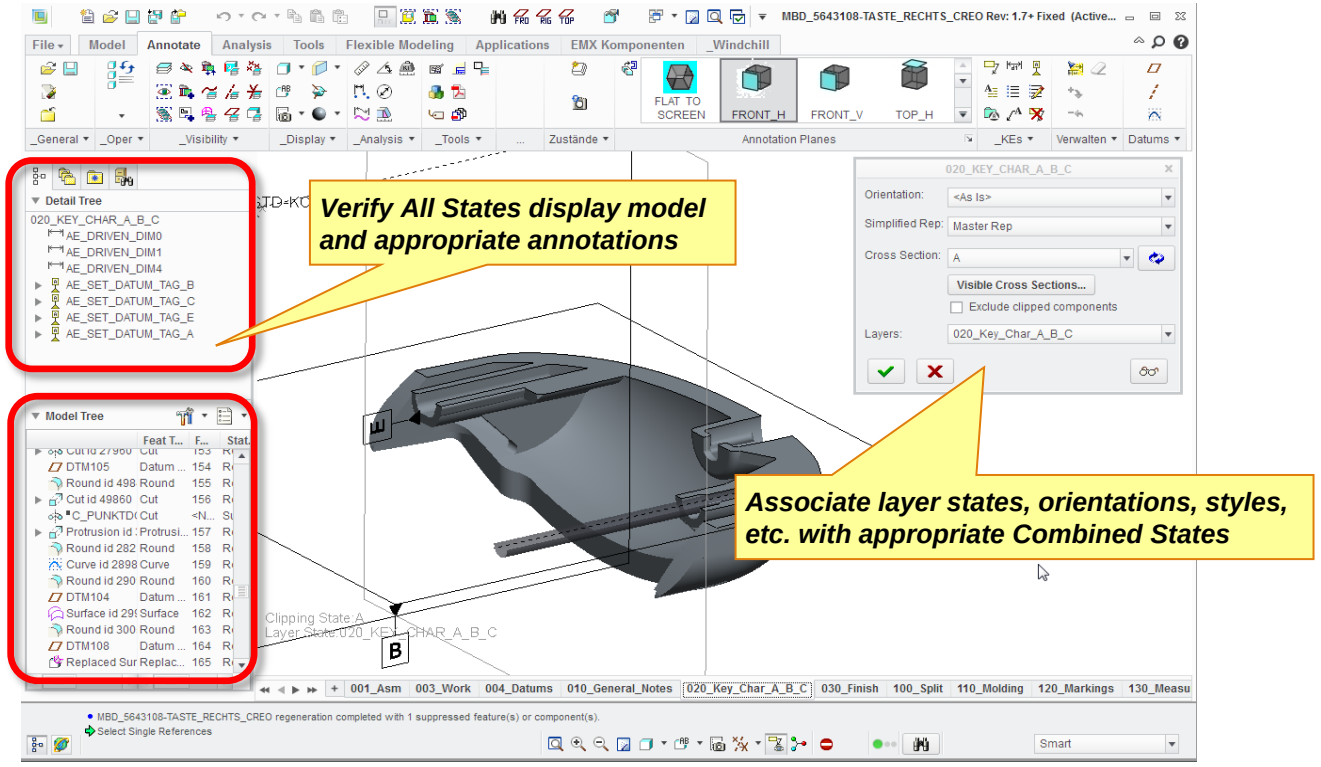
1.6 Open Pre-populated Start Models

1.7 Convert Existing Model to MBD schema

1.8 Create Model Annotations

1.9 Organize Annotations

End Step 1.0



Process Storyboard Steps/Activities Overview

Design Engineer

Start Best Practice

1.0 Create & Organize Annotated 3D Model

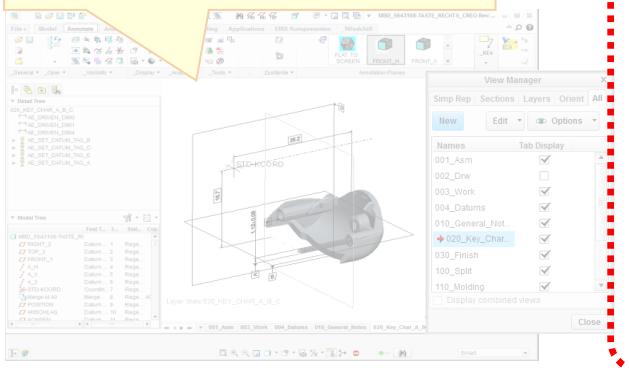
2.0 Deploy Annotated Content via Visualization

3.0 Create 2D Deliverables (optional)

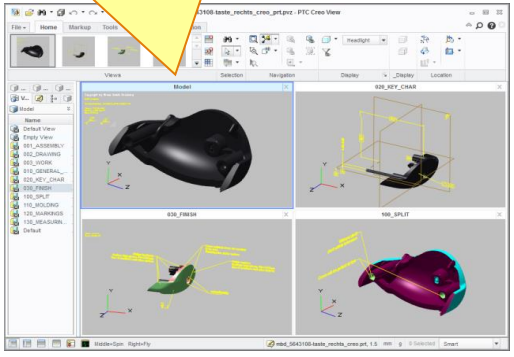
4.0 Create Digital Product Definition Package

End Best Practice

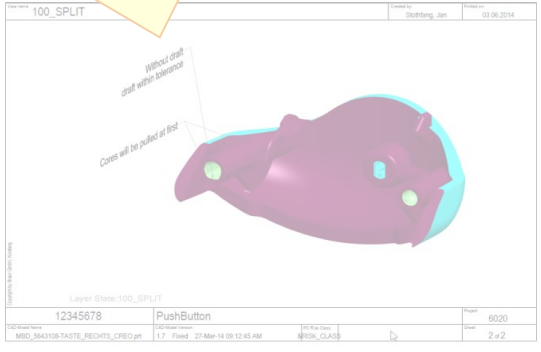
1.0 *Create & Organize Annotation content in Creo/Parametric 3D model*



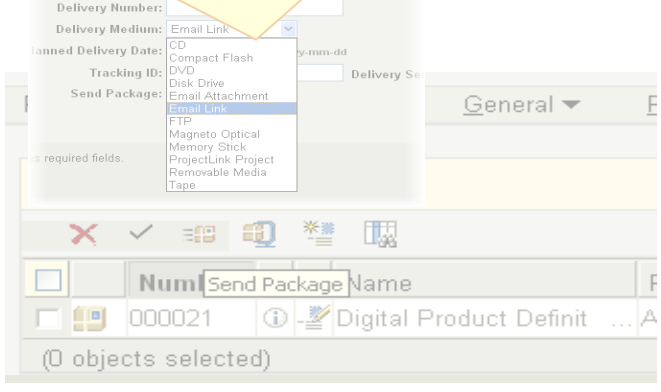
2.0 ***Publish to and Access PMI and Combined States in a 3D viewer***



3.0 *Create 2D deliverables (optional)*

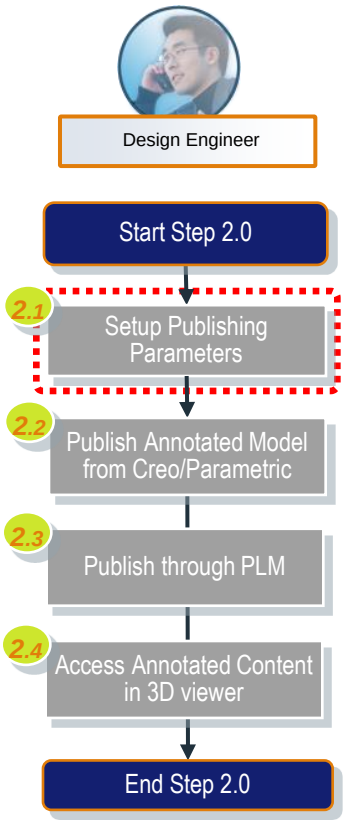


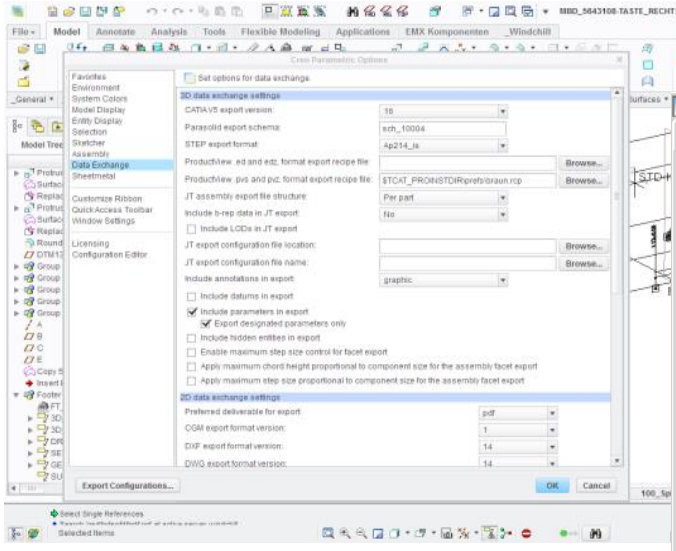
4.0 *Assemble & make Digital product Definition Package available to consumers*



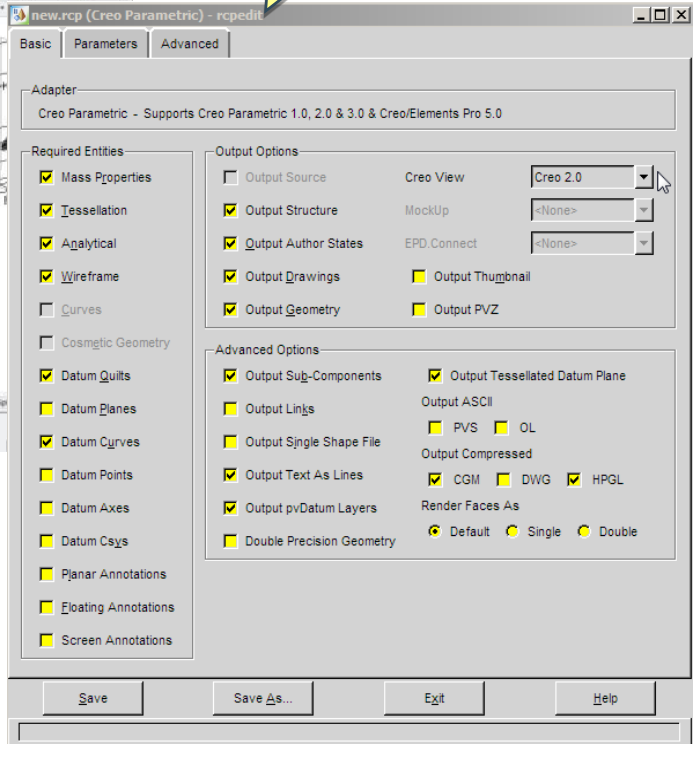
2.0 Deploy Annotated Content via Visualization

→ 2.1 Setup Parameters for publishing to Creo/View





Make appropriate selections



Setup publishing recipe file for Creo Object adapter

2.0 Deploy Annotated Content via Visualization

2.2 Manually publish annotated model to Creo/View

Design Engineer

Start Step 2.0

2.1 Setup Publishing Parameters

2.2 Publish Annotated Model from Creo/Parametric

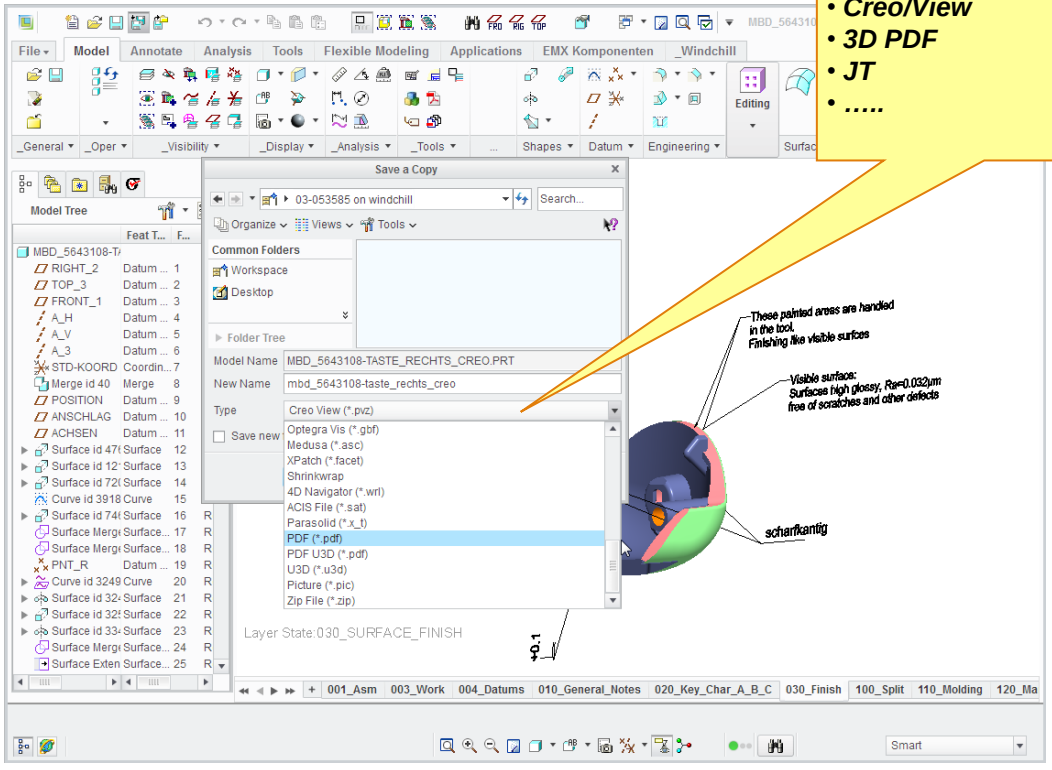
2.3 Publish through PLM

2.4 Access Annotated Content in 3D viewer

End Step 2.0

'Save as' annotated model to any of the 3D viewing formats

- ***Creo/View***
- ***3D PDF***
- ***JT***
- ***…..***



2.0 Deploy Annotated Content via Visualization

2.3 Publish Through PLM

Design Engineer

Start Step 2.0

2.1 Setup Publishing Parameters

2.2 Publish Annotated Model from Creo/Parametric

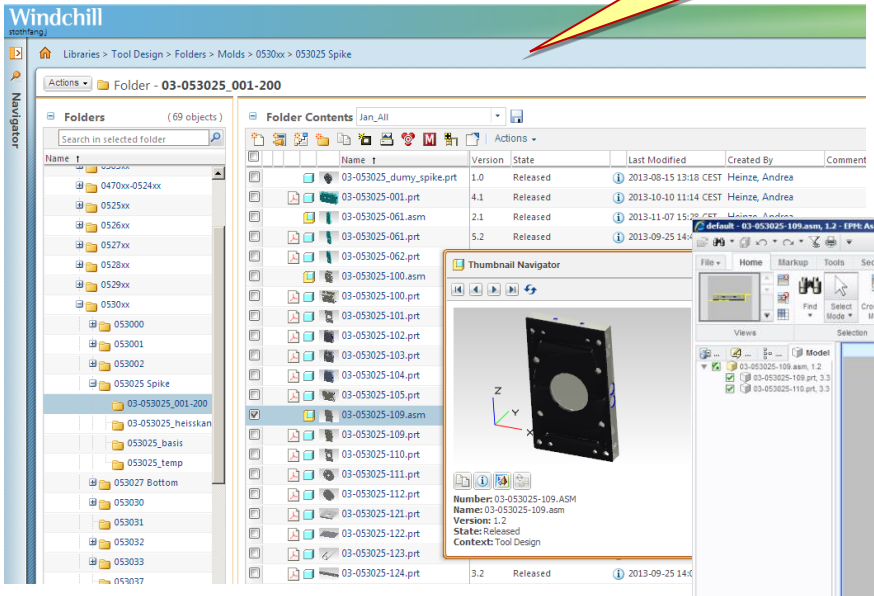
2.3 Publish through PLM

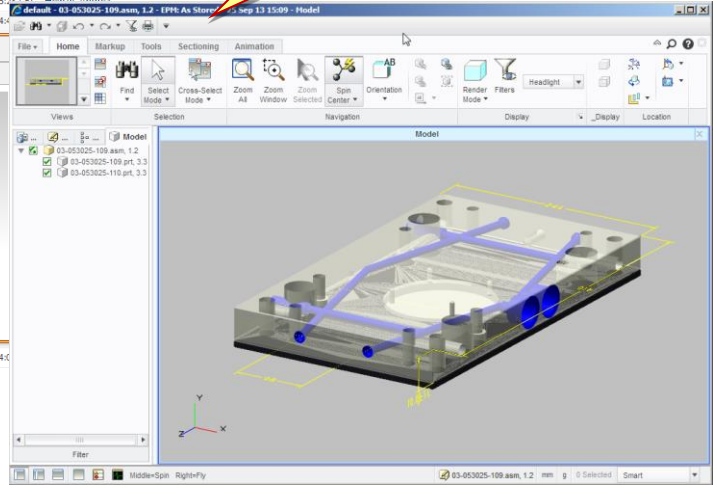
2.4 Access Annotated Content in 3D viewer

End Step 2.0

Access to visual information via thumbnails and/or Creo/View application for more complete interrogation of PMI in the 3D model

Access provided to all stakeholders: Procurement, Resource Planning, Quality, Manufacturing, Maintenance…





2.0 Deploy Annotated Content via Visualization

2.4 Access Annotated Content in 3D viewer

Downstream Consumer

Start Step 2.0

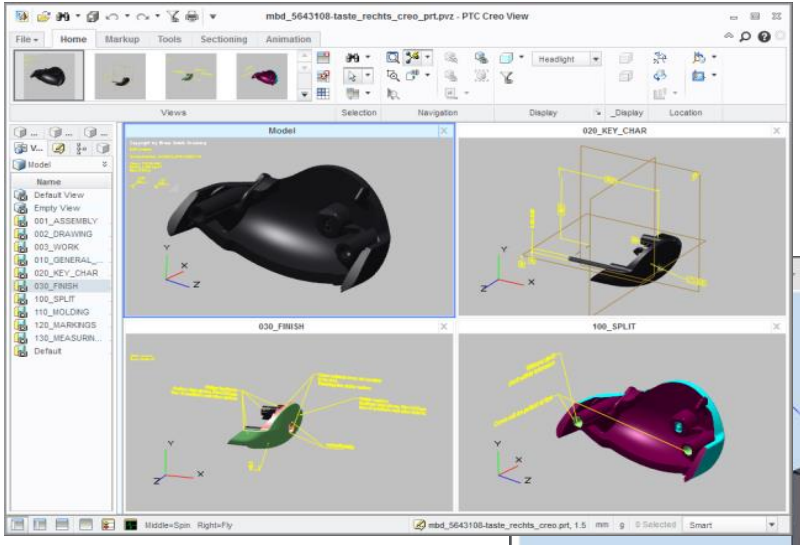
2.1 Setup Publishing Parameters

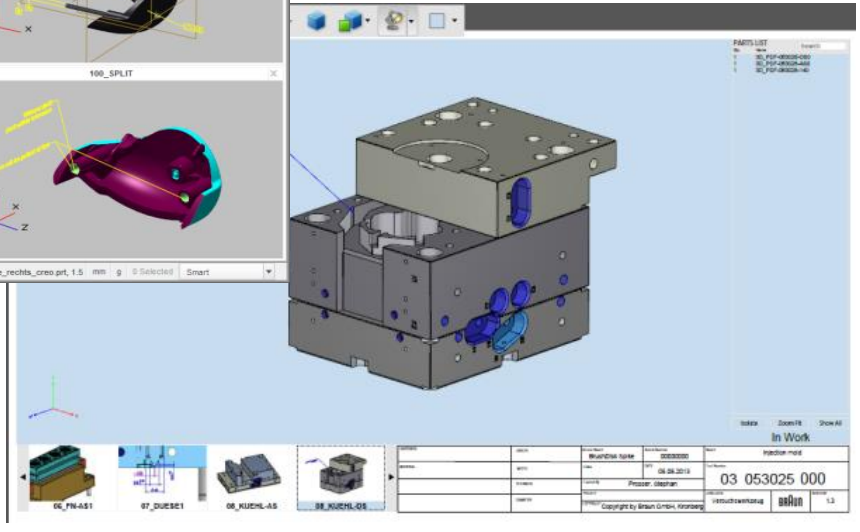
2.2 Publish Annotated Model from Creo/Parametric

2.3 Publish through PLM

2.4 Access Annotated Content in 3D viewer

End Step 2.0





Process Storyboard Steps/Activities Overview

Design Engineer

Start Best Practice

1.0 Create & Organize Annotated 3D Model

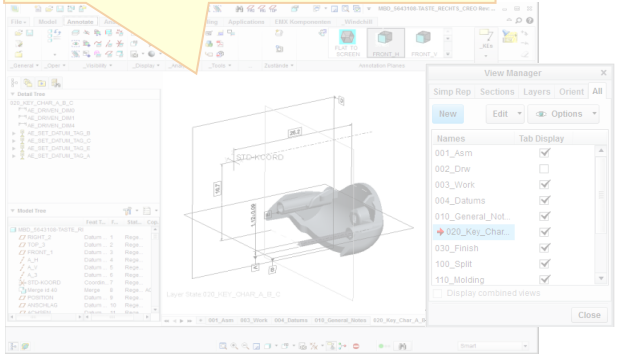
2.0 Deploy Annotated Content via Visualization

3.0 Create 2D Deliverables (optional)

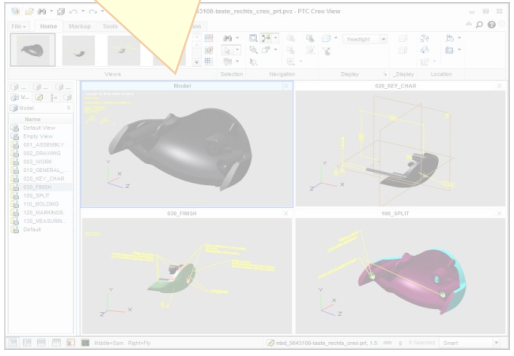
4.0 Create Digital Product Definition Package

End Best Practice

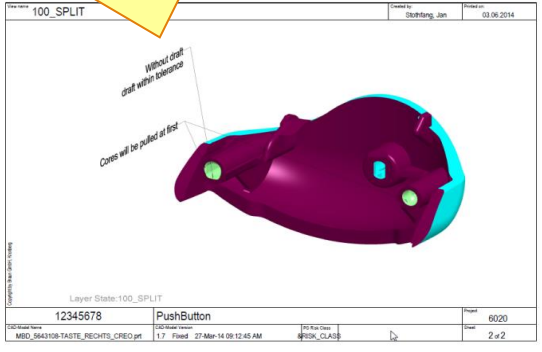
1.0 *Create & Organize Annotation content in Creo/Parametric 3D model*



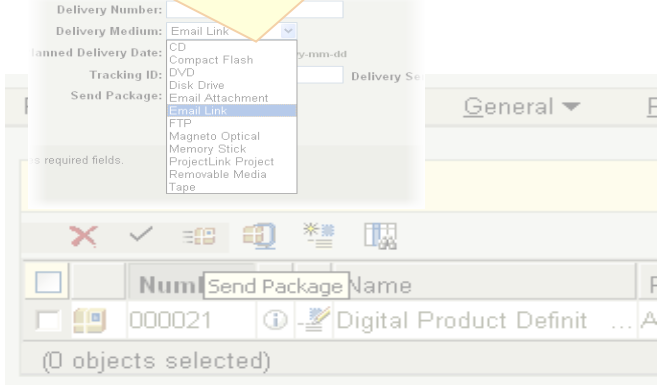
2.0 *Publish to and Access PMI and Combined States in a 3D viewer*



3.0 ***Create 2D deliverables (optional)***



4.0 *Assemble & make Digital product Definition Package available to consumers*



3.0 Create 2D Deliverables (optional)

3.1 Create Reduced Dimension Drawings

Design Engineer

Start Step 3

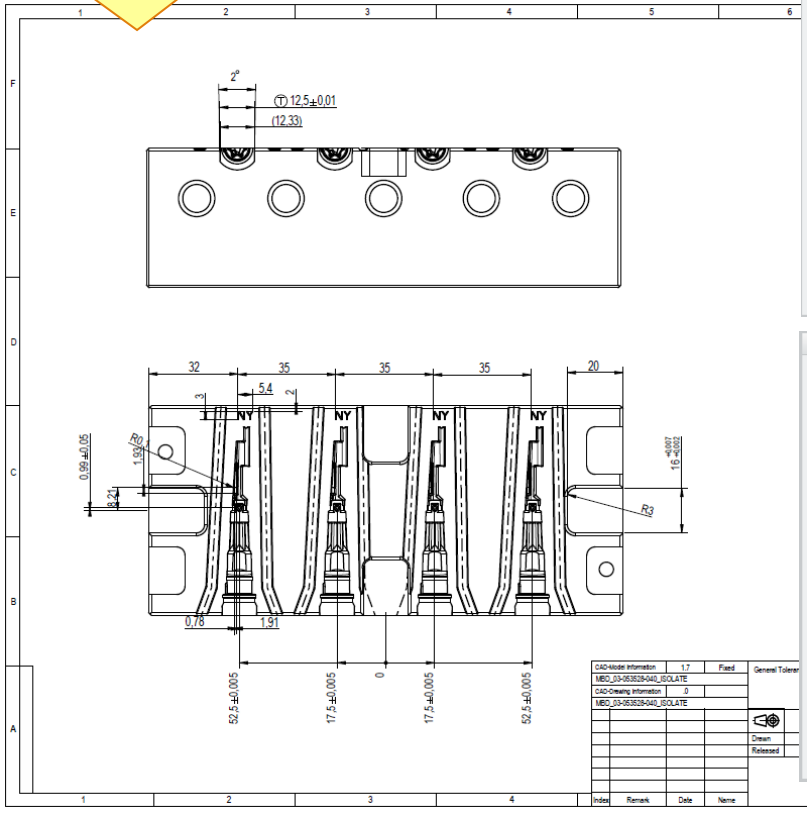
3.1 Create Reduced Dimension Drawings

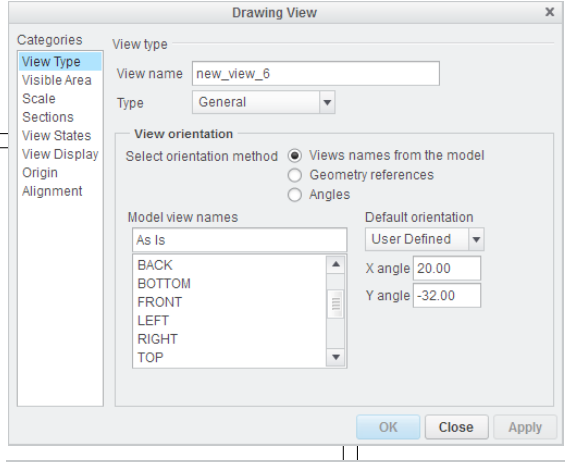
Print out

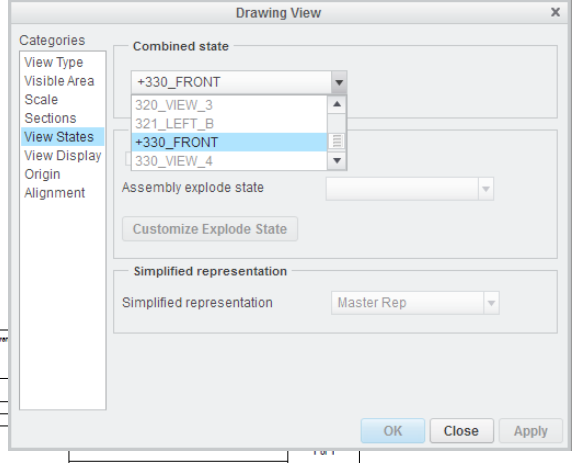
Publish through PLM

End Step 3

Create reduced dimension drawings leveraging All States (optional)

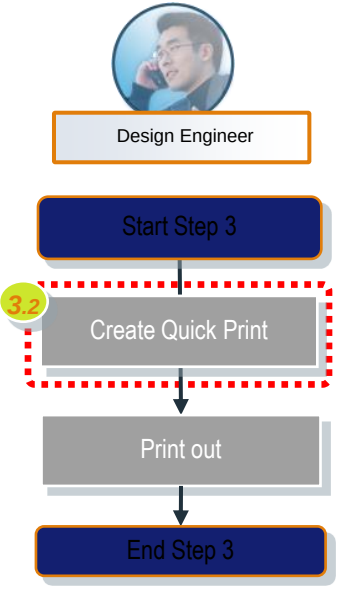


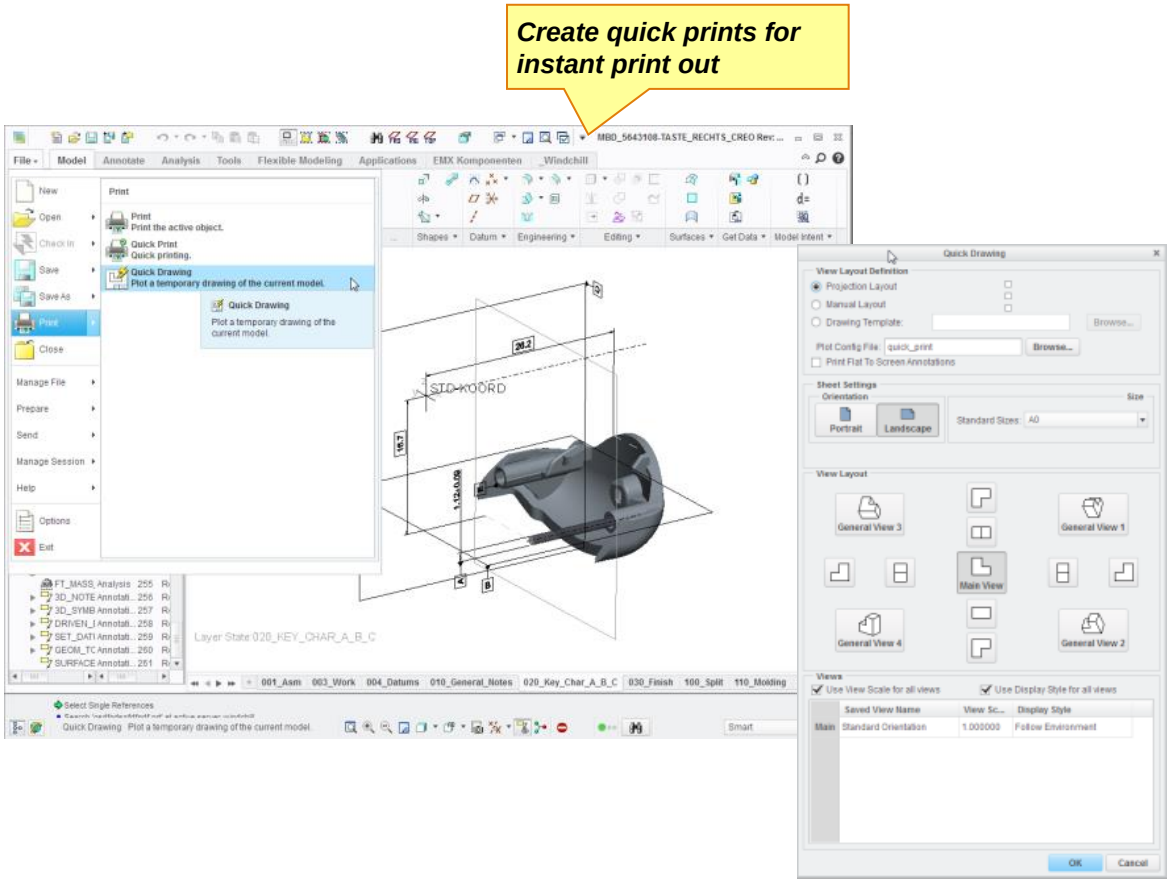




3.0 Create 2D Deliverables (optional)

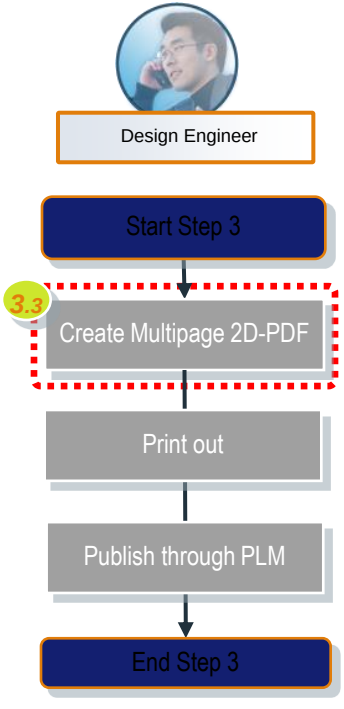
3.2 Create Quick Print



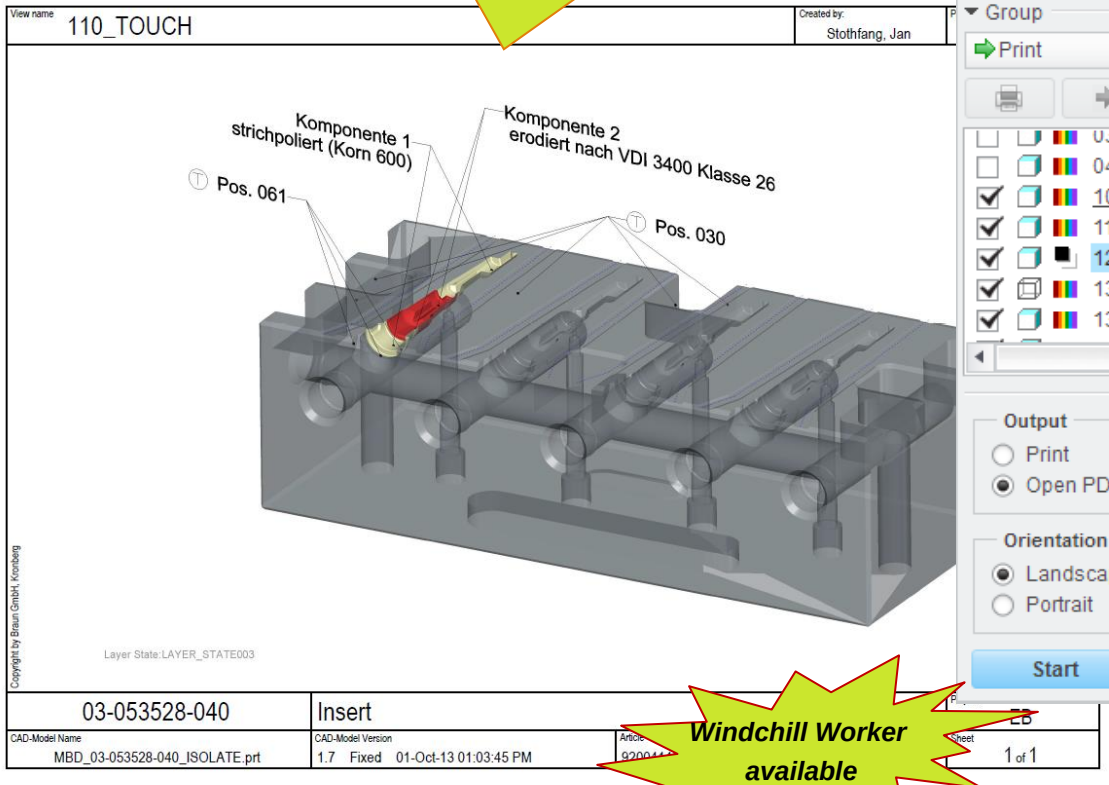


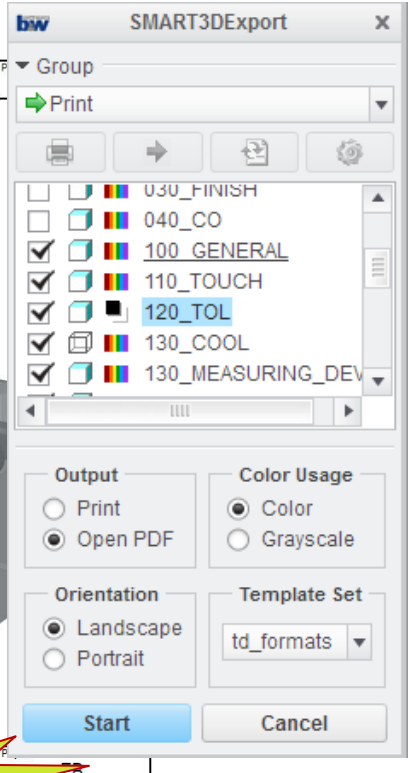
3.0 Create 2D Deliverables (optional)

→ 3.3 Create Multipage 2D-PDF



Create Multipage 2D-PDF leveraging selected combined states, display options and drawing templates





Windchill Worker available

Process Storyboard Steps/Activities Overview

Design Engineer

Start Best Practice

1.0 Create & Organize Annotated 3D Model

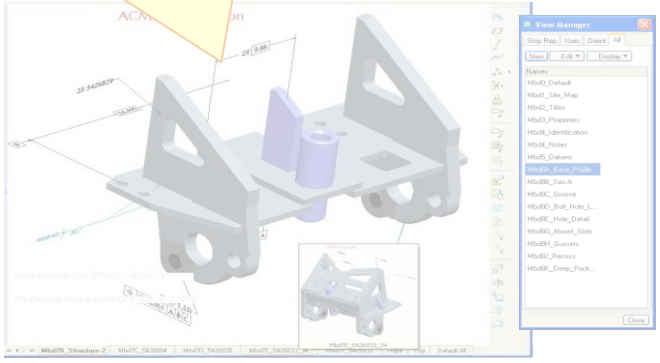
2.0 Deploy Annotated Content via Visualization

3.0 Create 2D Deliverables (optional)

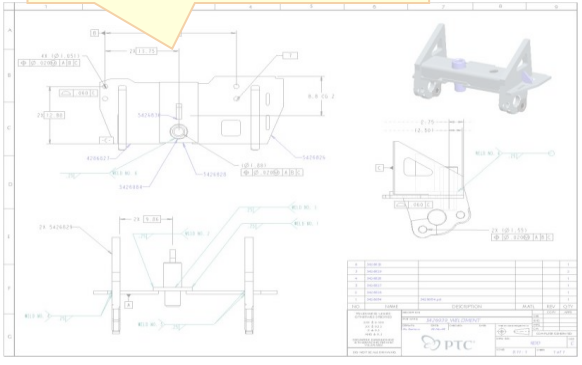
4.0 Create Digital Product Definition Package

End Best Practice

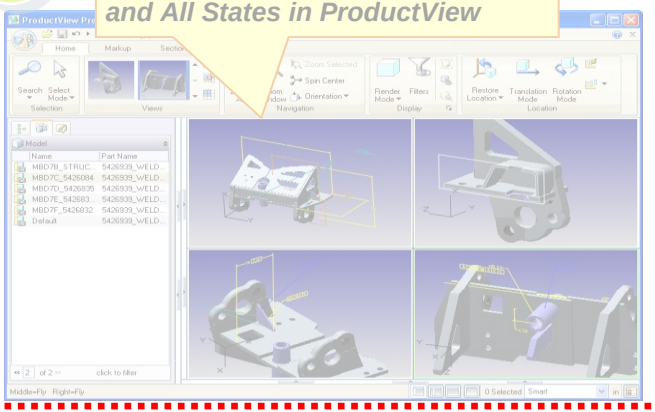
1.0 *Create & Organize Annotation content in Pro/ENGINEER 3D model*



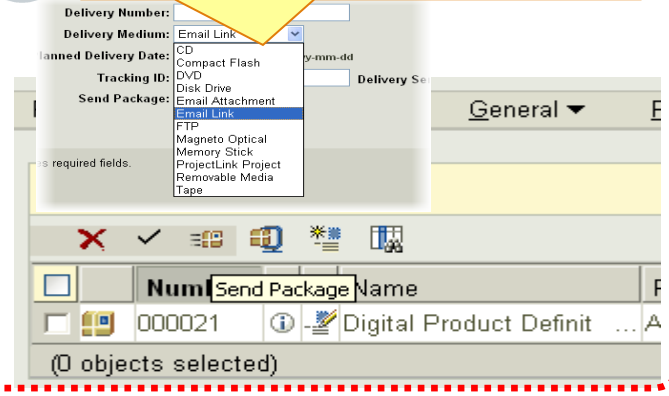
3.0 *Create reduced dimension drawings (optional)*



2.0 *Publish to and Access PMI, layers and All States in ProductView*



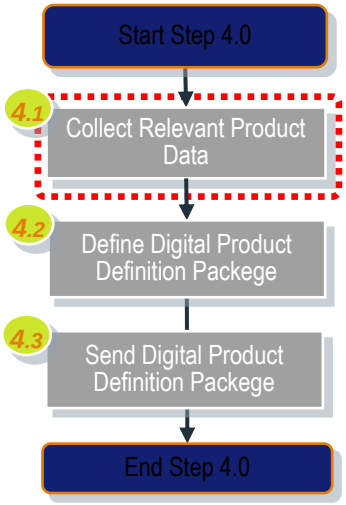
4.0 ***Assemble & make Digital product Definition Package available to consumers***



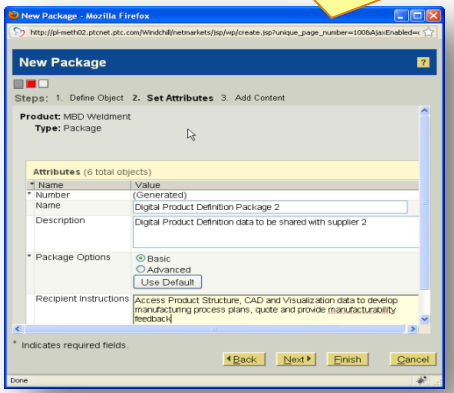
4.0 Create Digital Product Definition Package

4.1 Collect Relevant Product Data

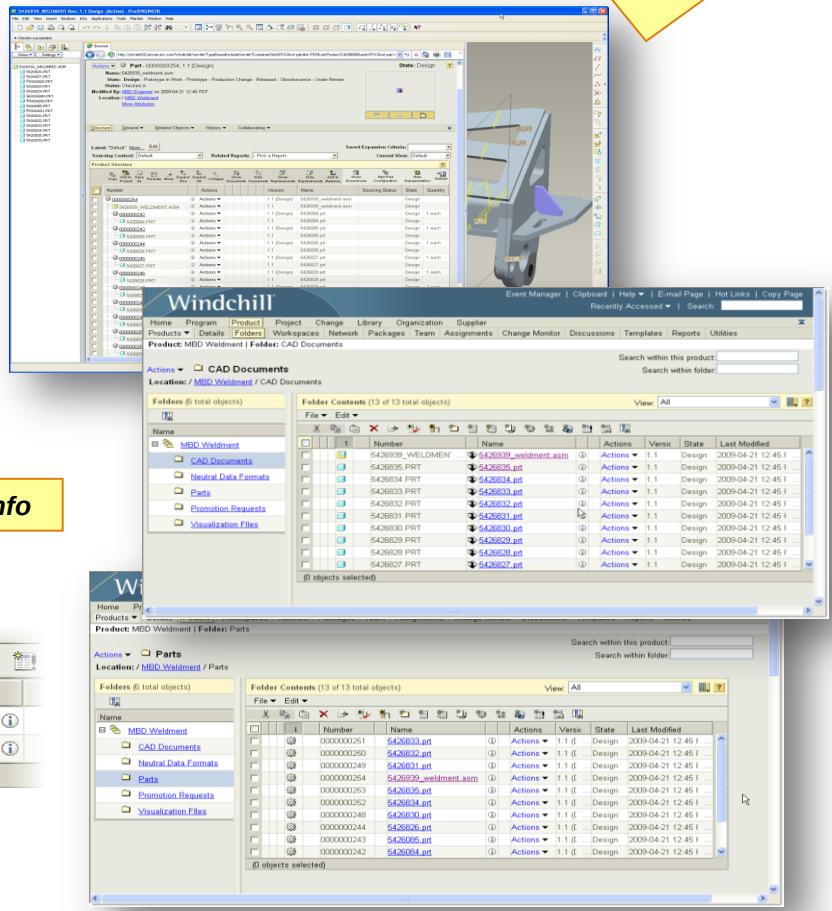
Design Engineer



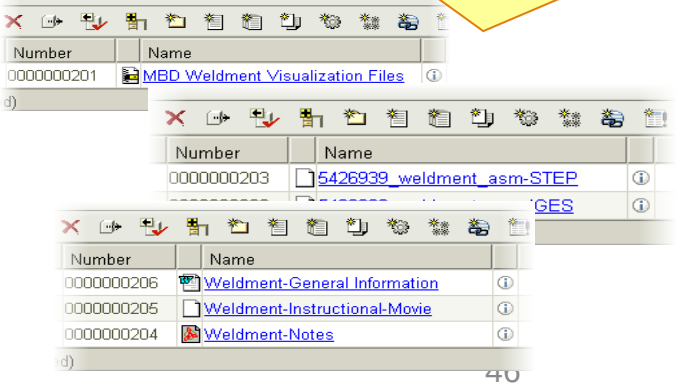
Create New Package (name, description)



Collect Parts, CAD Files



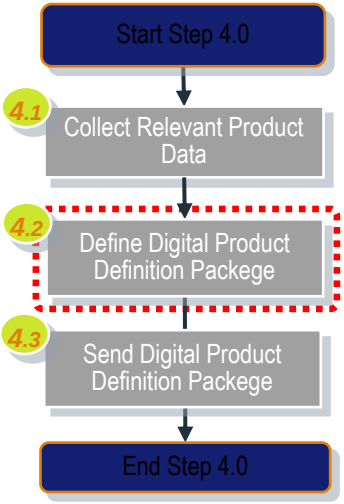
Collect Viz files, IGES/STEP, Notes, General Info



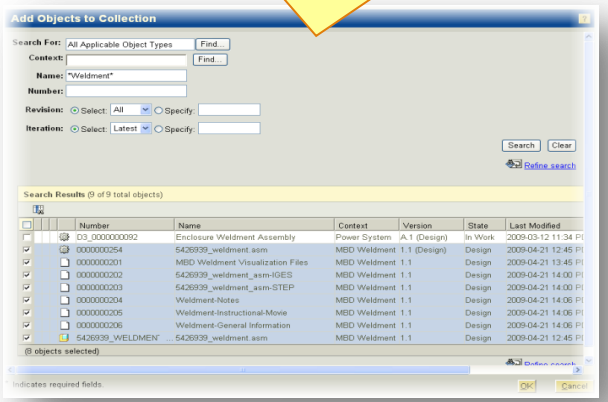
4.0 Create Digital Product Definition Package

4.2 Define Digital Product Definition Package

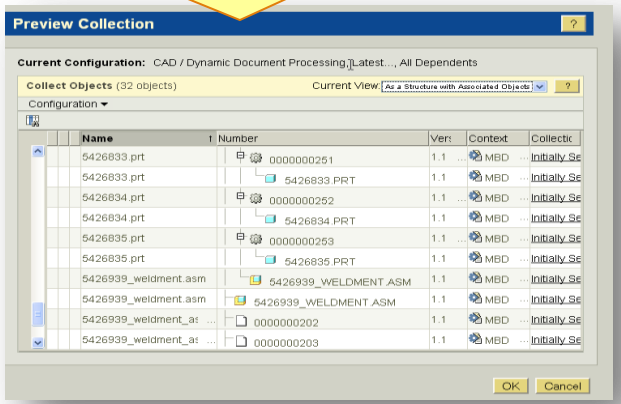
Design Engineer



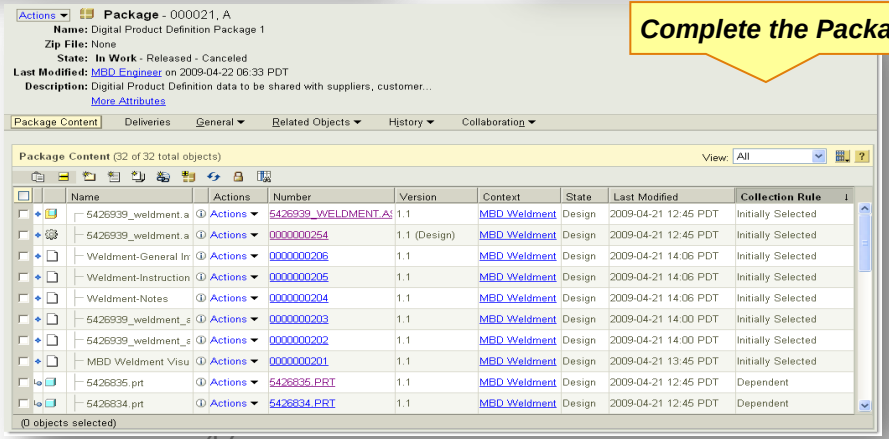
Build a Package Collection



Preview the collection for completeness



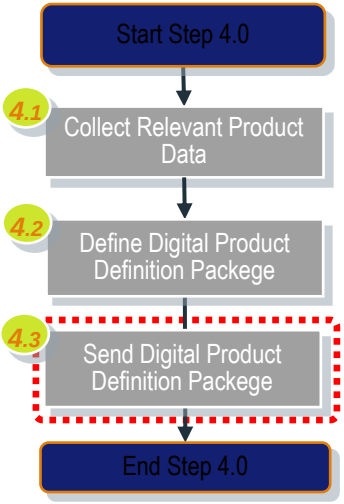
Complete the Package creation



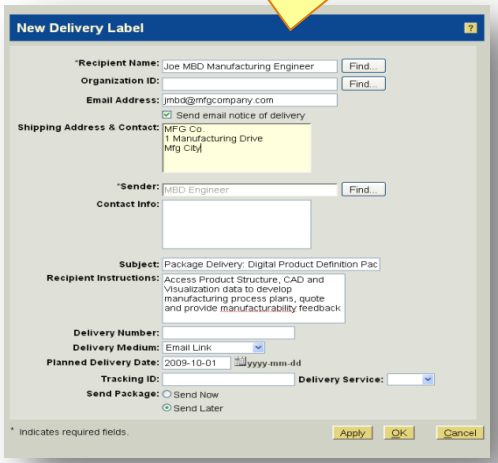
4.0 Create Digital Product Definition Package

4.3 Send Digital Product Definition Package

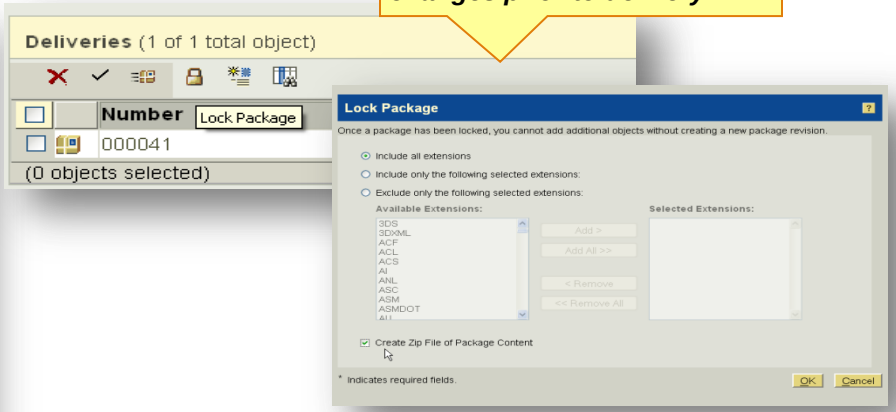
Design Engineer



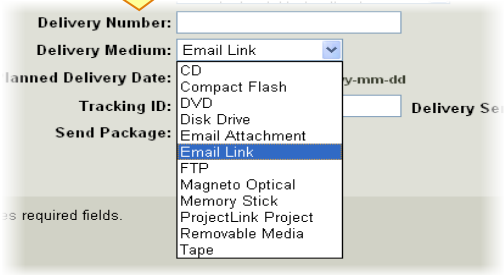
Create a Delivery Label



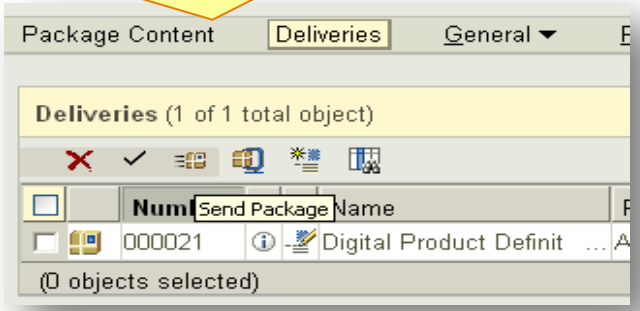
Lock the Package to prevent changes prior to delivery



Select delivery medium



Send the Package to designated recipient



1.1 Create Pre-populated Start Models

→ 1.1 Start models

- **How to access the setup file?**
  - Access through File → Prepare → Model Properties → Detail Options
    - Tip: Bring the icon to a more visible location in the QuickAccessToolbar
- **Why do I have to deal with this file?**
  - A setup file is asigned to all parts and assemblies automatically in Creo/Parametric
  - Default for all options is the ASME standard !!!!!! (Does this satisfy your needs?)
- **How to deal with it?**
  - We are checking for options with the B&W software SMART Update and let the user apply either single options or a complete *.dtl file
    - Tip: Apply the customized setup file to your Creo Start models
    - Tip: Use your current drawing setup file as a basis
- **What are the most important options?**
  - default_tolerance_mode (successor of config.pro option TOL_MODE)
  - default_tolerance_display_style
  - text_heigth

1.1 Create Pre-populated Start Models

→ 1.1 Start models

- **How to access ‚Combined States' ?**
  - Through View Manger
  - In ‚Annotate mode' through bottom Tabs
- **How to customize the display of the Tabs?**
  - Tip: To initially display Tabs in all modes use this config option
    - Display_combined_views yes (default = no) from PTC Creo2 M040
  - Tip: To hide the little popup window use this config.pro option
    - Show_combined_views_preview no from PTC Creo2 M060
  - Tabs are ordered alphanumerically (PTC Creo2 M060)
    - Tip: Use a numbering scheme and short names (space is limited)
  - You can hide individual States from the display as Tabs by
    - Deselecting the marker from the View Manager
    - Right-Mouse-Click on the Tab → Hide
    - Caution: Even ‚hidden' States will be translated to PTC Creo View !!! To avoid that, you have to delete the State(s)

1.1 Create Pre-populated Start Models

→ 1.1 Start models

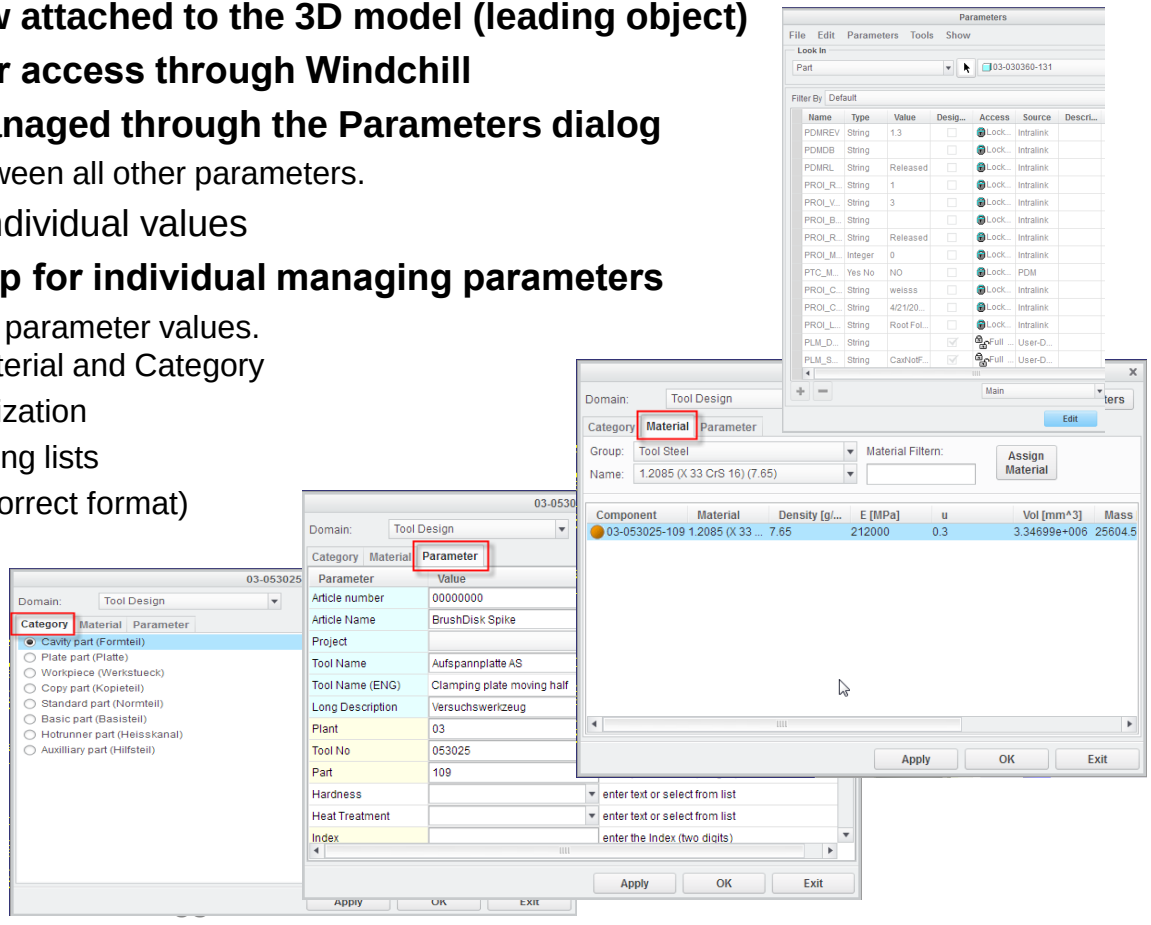
- **How to create a Layer State?**
  1. View Manager → Layer State → New
  2. Set your intended layer configuration
  3. Your new state will be marked as modified (+)
  4. Save the configuration by RMB → Save in the View Manager or layer tree
  - Caution: ‚Save Status' does not save the State, but saves the layer configuration when retrieving the file!!!!
- **What makes Layer States difficult?**
  - You need to completely understand the general layer mechanism
  - Creating a new layer will mark all previous layer states as modified (+)
    - Tip: Pre-define as many layers as possible (i.e. A layer per Combined State)
  - Content of a new layer is ‚shown' by default and may corrupt your previous states
    - Tip: Use ‚Isolating' layers to avoid corruption (see our prevoius presentation on layers: ‚Ich sehe was, was Du nicht siehst'
    - Caution: Do not put the *SolidGeom* on a hidden layer, even if it is isolated by another layer, because exporting to STEP, IGES and PTC Creo View fails in this case.

Tips & Tricks

1.2 Define list of attributes

→ 1.2 Attributes list

- **Parameters (Meta Data) are now attached to the 3D model (leading object)**
- **‚Designate' MBD parameters for access through Windchill**
- **By default the attributes are managed through the Parameters dialog**
  - MBD parameters are burried between all other parameters.
  - Difficult to manage and apply individual values
- **‚Parameter Manager' Toolkit App for individual managing parameters**
  - Provides the ability to easily fill in parameter values.
    Used currently for Meta data, Material and Category
    - Supports individual customization
    - Supports all kinds of selecting lists
    - Supports value checking (correct format)
    - Multi language support
  - Benefits
    - Standardization
    - Easy
    - Customized by domain



1.3 Prepare conversion of existing models

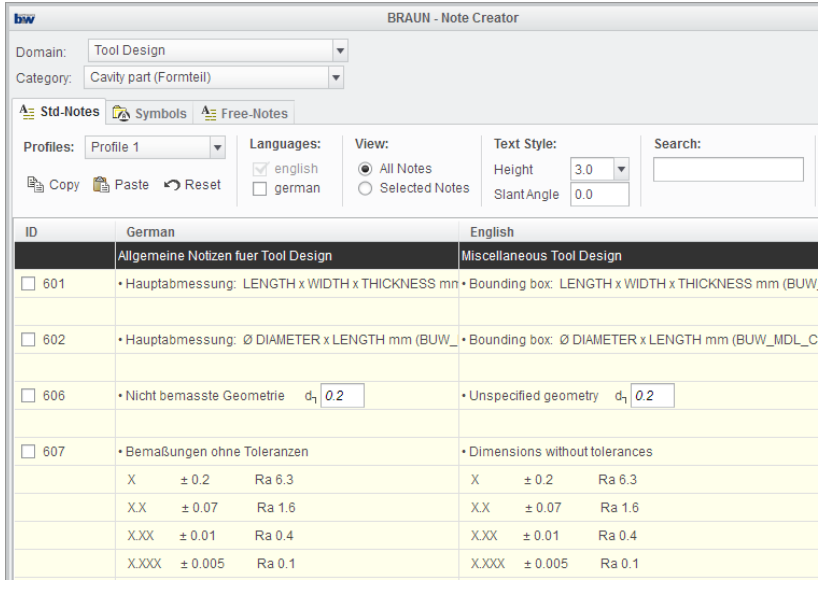
→ 1.3 Model conversion

- **Updating existing models to MBD requirements is essential**
- **Mapkeys are a manual update tool**
  - Difficult to create and manage
  - Do not work in every context
- **‚SmartUpdate' Toolkit App provides a configurable update mechanism**
  - Automatic updating existing models to latest startpart requirements
    - Adding Layers, Layer states, Combined states, Annotation features, ...
    - Check for parameters and relations
  - Semi- automatic update for quality proposals
    - Accuracy, Units, Material, ...
  - Benefits
    - Too many to elaborate.....
    - Reusing existing models
    - Standardization
    - User support

1.4 Create Notes Database

→ 1.4 Notes Database

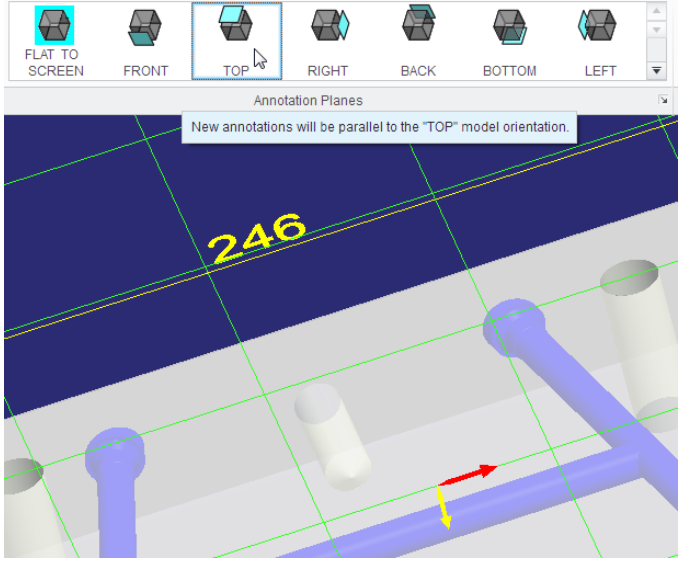
- **Like on 2D drawings a ‚standard' note and symbol library is very beneficial**
  - Hard to administrate
  - Placement is more difficult than on 2D drawings
- **‚Annotation Manager' Toolkit App provides the ability to select notes and symbols from a database and place them flat-to-screen or within model**
  - Multi Language support
  - Saved profiles
  - Search capabilities
- **Benefits**
  - Standardization
  - Quick and easy access
  - Ca be used in Startparts already



1.9 Organize Annotations in Model tree and Graphics

→ Next

- **How and where to create Annotations?**
  - Go to the Annotate tab and use the same mechansims as in 2D drawings
    - Tip: Use the Annotation feature as container for all annotation elements.
  - You may position the Annotation feature everywhere in the model tree, even in the footer.
    - Tip: Think of a naming convention for annotation features and on pre-defining empty annotation features in your start models.
- **How to orient my annotation?**
  - Set (or create) the annotation plane previous to creation.
    - Yellow arrow: Direction of viewing
    - Red arrow: Direction of text orientation
  - You also may redefine the orientation after the creation
  - ‚Flat-to-screen‘ puts notes and symbols into the graphics area without rotating with the model



1.9 Organize Annotations in Model tree and Graphics

→ 1.9 Organization

- **When are my annotations visible?**
  - Annotations live in Combined States – no other visibility mechanism necessary
  - Annotations can be displayed in multiple Combined States and be moved from one State to another
  - Annotations can be erased or removed from the state. To delete the annotation completely you have to redefine the annotation feature and delete the element from the list.
    - Caution: Annotations that are removed from all Combined States, but not deleted are not anymore visible, but still remain in the model and are translated to PTC Creo View