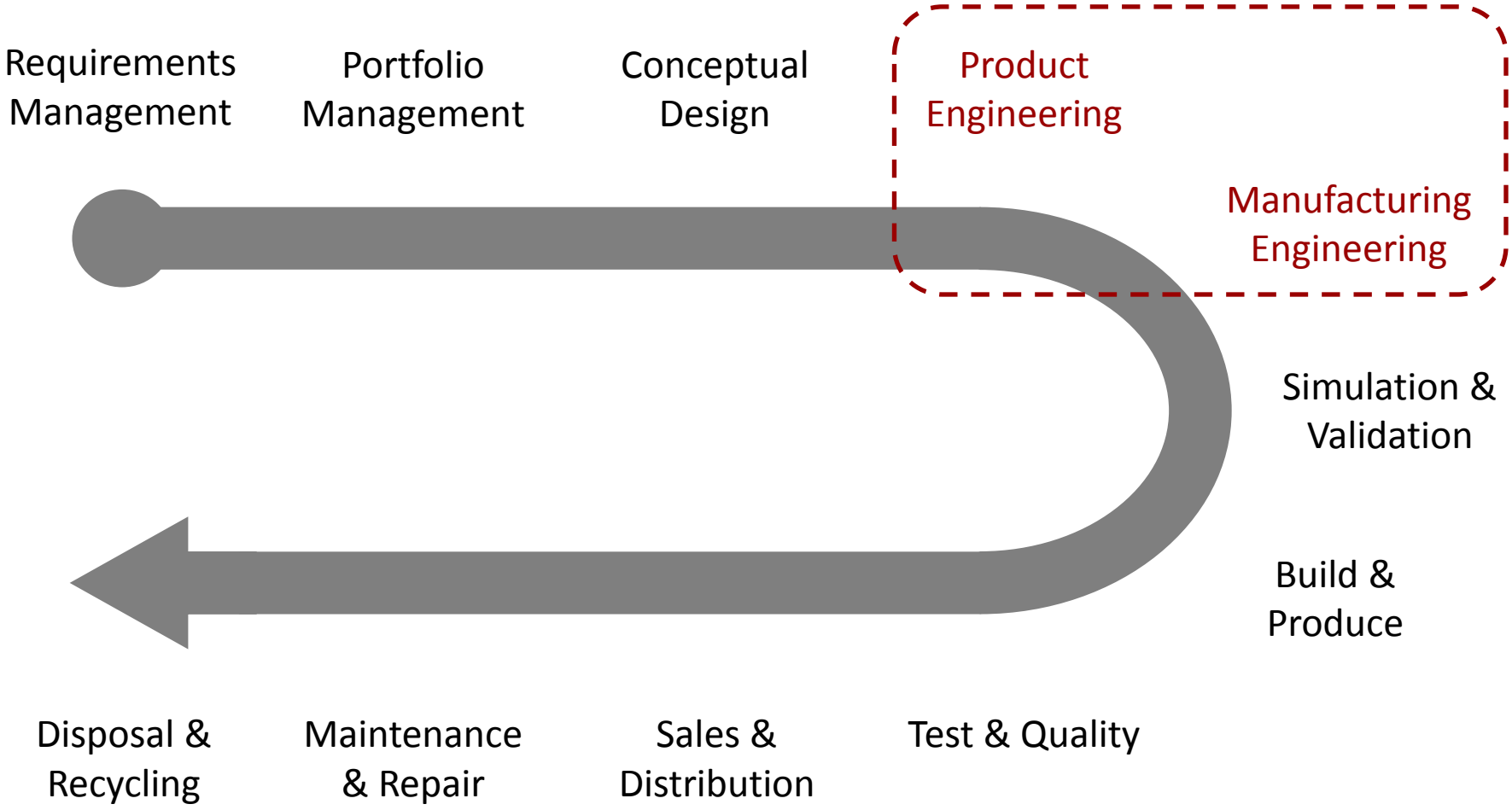
Carnegie Mellon University

Week 4 - Lecture
Assemblies

Lecture Topics

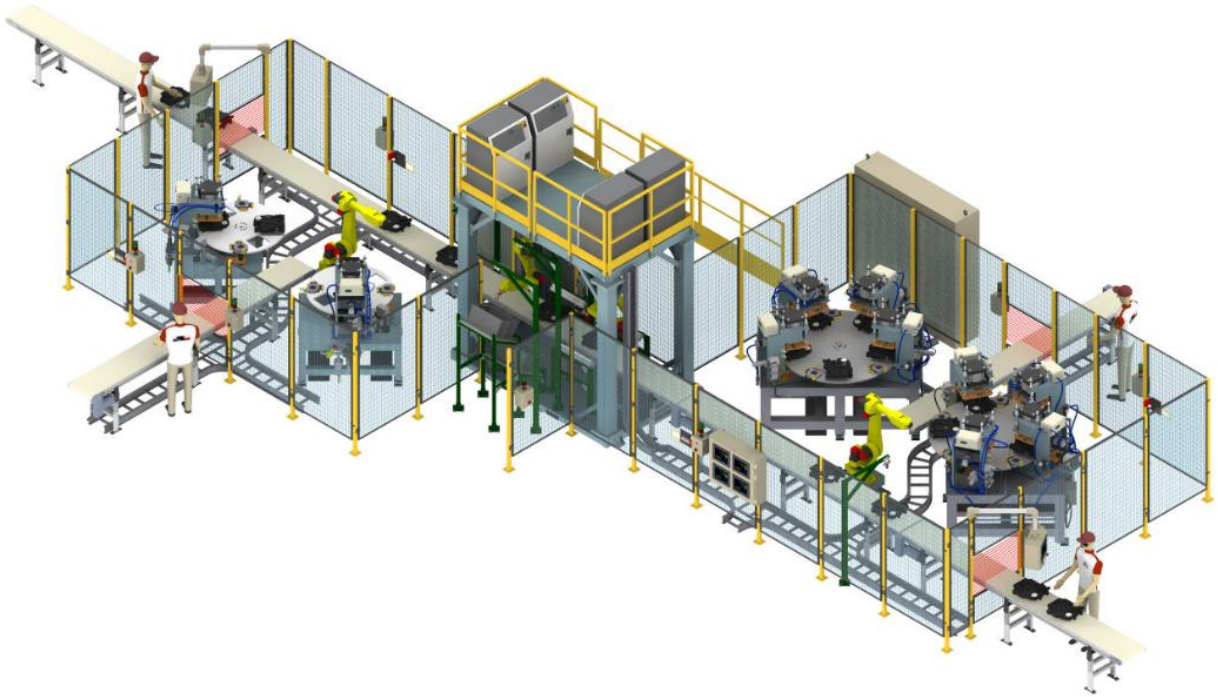
- Assemblies and Product Structure
- Bill of Materials
- PLM Role and Definition
- Design for Assembly Overview
- Case Study Examples

Product Lifecycle – Week 4



What is an Assembly

- Digital prototype of actual product consisting of parts and sub-assemblies.

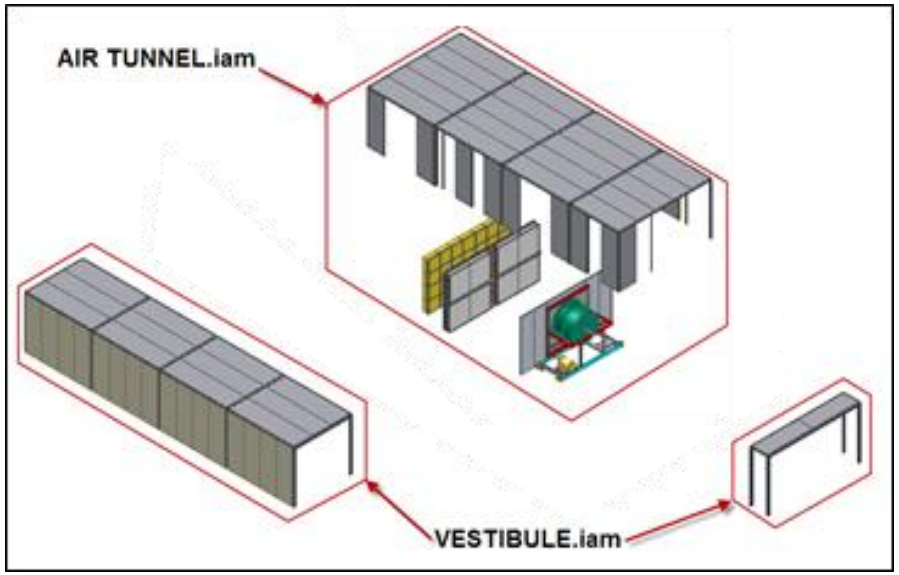


Terms

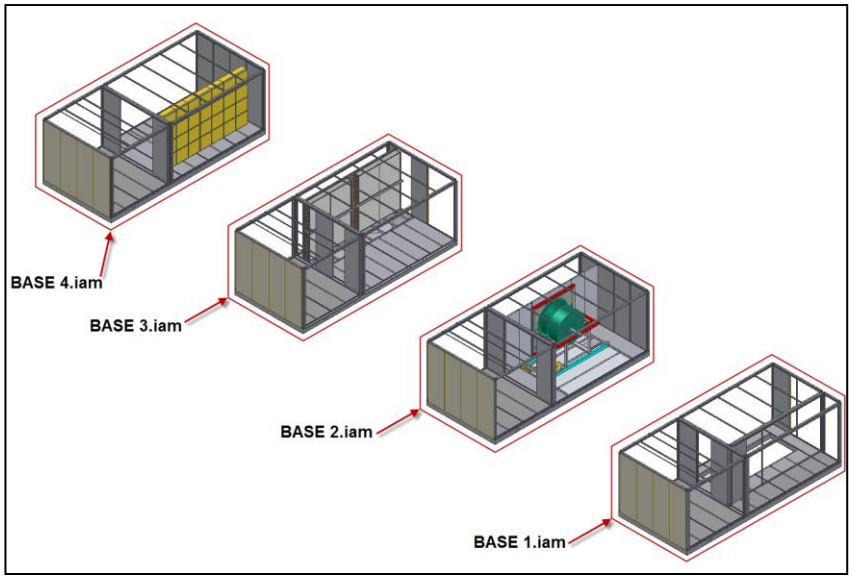
- Bill of Material (BOM)
  - Master list of items and their quantities to assemble a product
- Engineering Bill of Material (EBOM)
  - Reflects the product as it is designed by engineering
- Manufacturing Bill of Material (MBOM)
  - Focuses on the items needed to manufacture a product
- Product Structure
  - The hierarchical structure of a product

Difference Between EBOM and MBOM

EBOM



MBOM



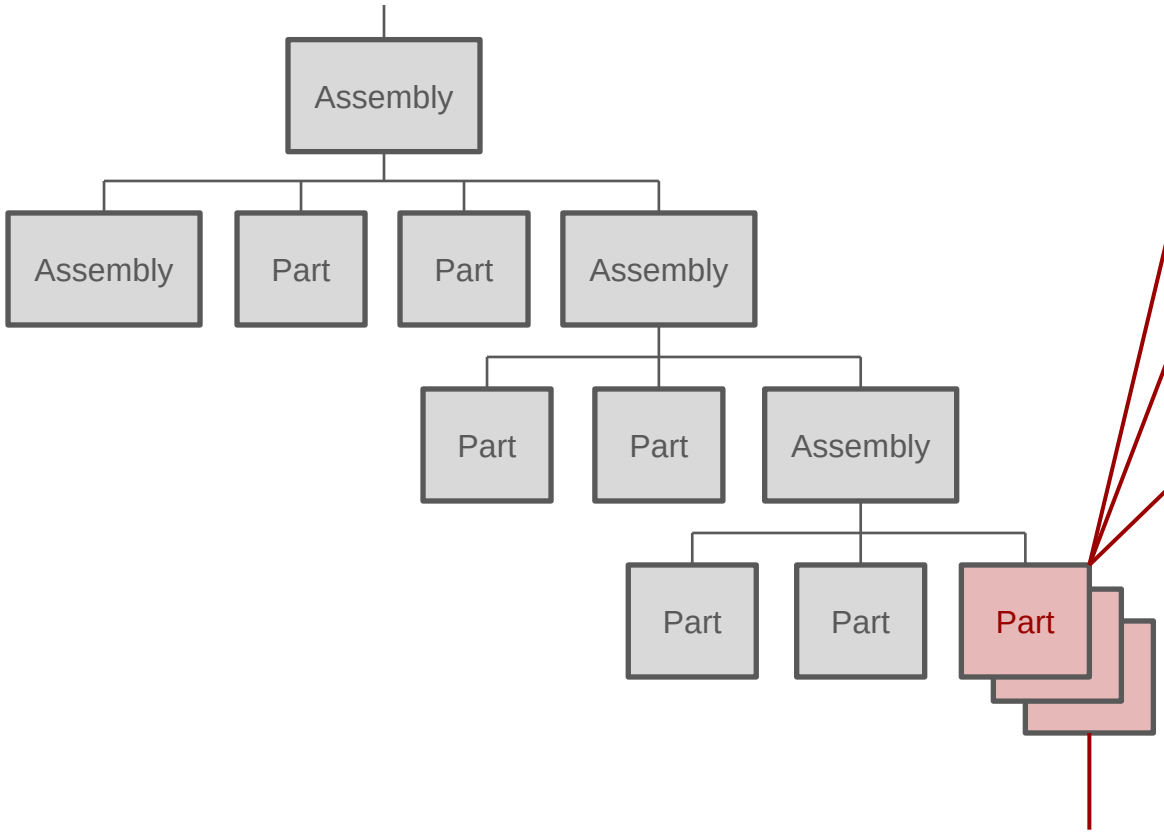
Product Architecture

- Determining your product architecture and structure is critical for product configuration and concurrent engineering.

Bill of Material (BOM)

Packaging Option 1
Packaging Option 2
Power US
Power German
Assembly
Assembly
Part
Part
Part
Part
Assembly
Part
Part
Assembly
Part
Part
Part
Part
Part
Assembly
Part
Part
Part

Product Structure



Attribute Values
- Part Name
- Part Number
- Manufacturer Number

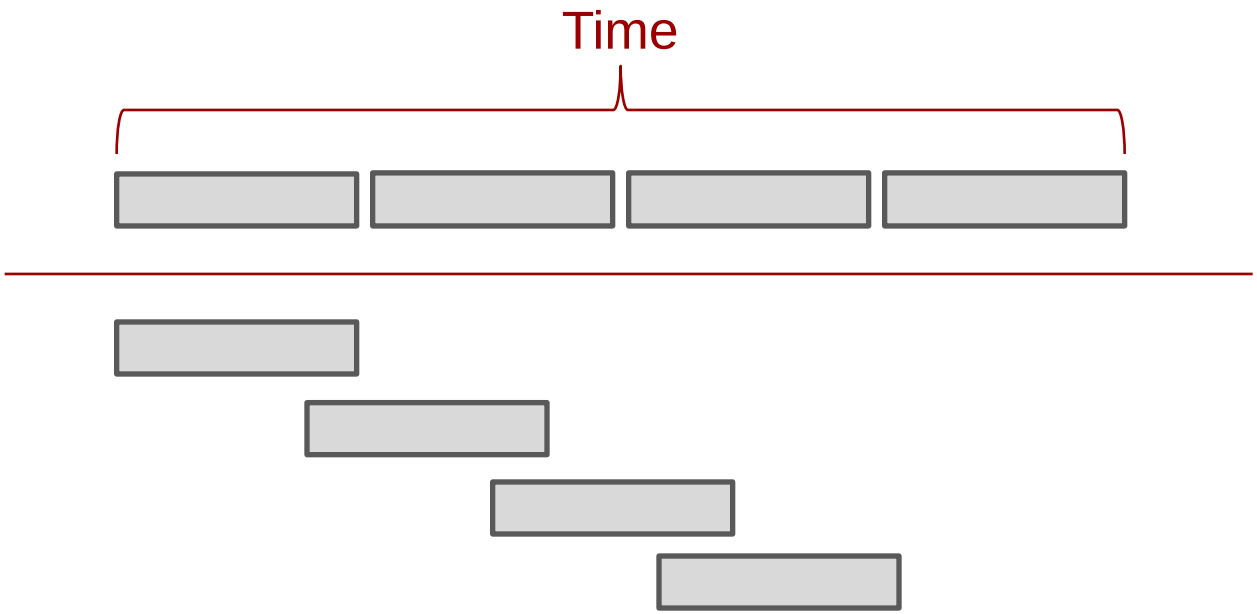
Data Set Files
- 3D Models
- Drawings
- Requirements
- Viewable File

Related Data
- Manufacturing Data
- Tooling Data
- Costing Data
- Change Orders

File versions for each type of file related.

Concurrent Engineering

- Concurrent engineering is the approach to having multiple people or groups working together at the same time on a product.

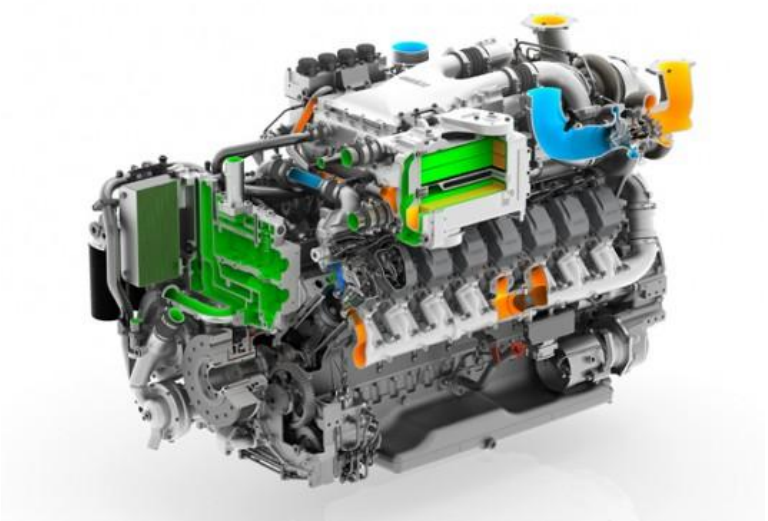


Notes on Concurrent Engineering

- In all cases only one person can work on a part or assembly at the same time. This impacts concurrent design. This is also true for design responsibility.

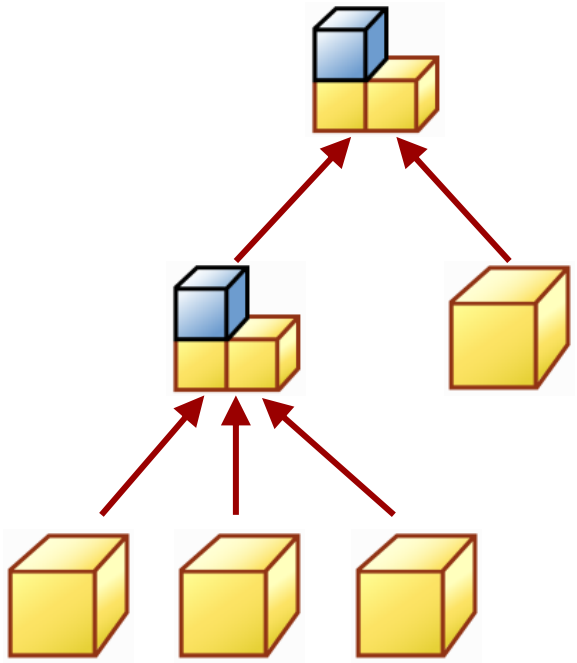
Assembly Structure Tips

- Establish the sub-assemblies and parts just like you would assemble the real product.
- To ensure the most optimal reuse, group items into logical sets for standardization.

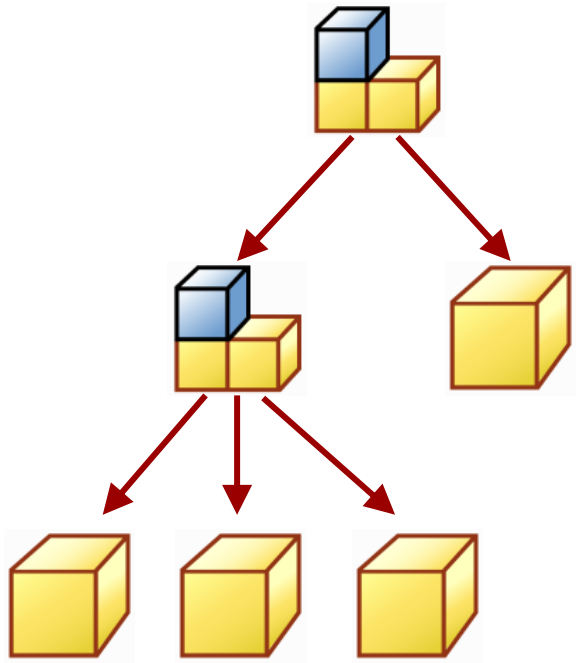


Assembly Creation Methods

Bottom-Up

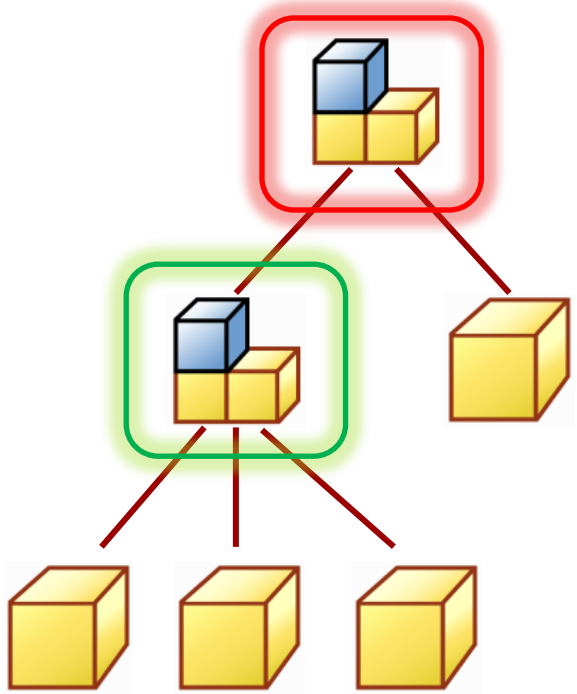


Top-Down



Bill of Materials Example

Product



Item	Qty.	Part #	Description
1	1	10001	Motor Assembly
2	1	10002	Stop Block

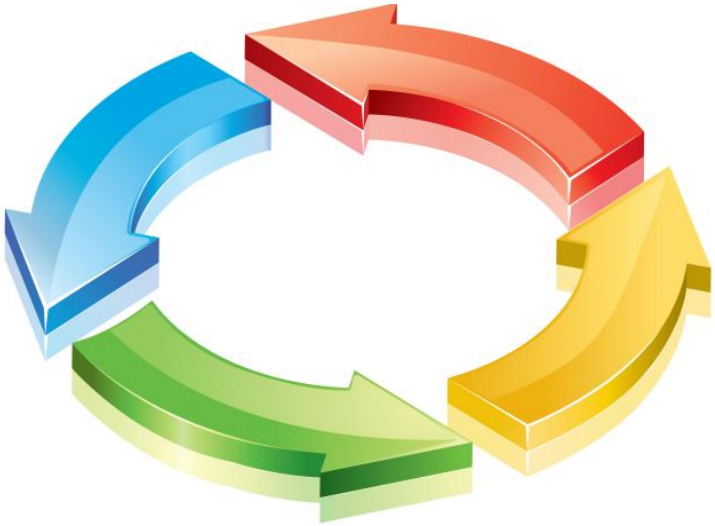
Item	Qty.	Part #	Description
1	1	20001	Shaft
2	1	20002	Bearing
3	1	20003	Case

Product Lifecycle Management

- **P**roduct **L**ifecycle **M**anagement (PLM)

- PLM is a business approach to solving the problem of managing product definition information.

- PLM is not a definition of technology.



Source: CIMdata www.cimdata.com

PLM Definition

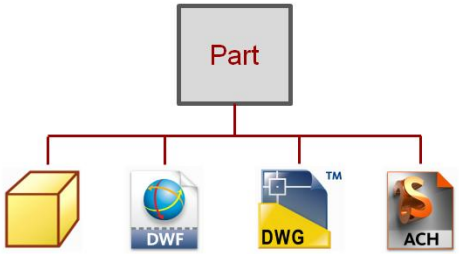
- A strategic business approach that applies a consistent set of business solutions that support the collaborative creation, management, dissemination, and use of product definition information.
- Supporting the extended enterprise (customers, design and supply partners, etc.)
- Spanning from concept to end of life of a product.

- Integrating people, processes, business systems, and information.

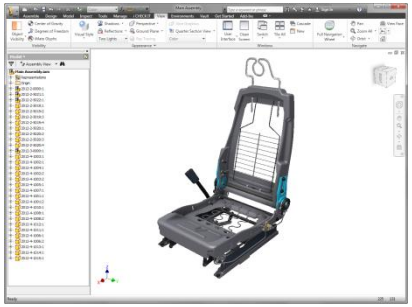
Source: CIMdata www.cimdata.com
PLM Think tank http://plmtwine.com

PLM Primary Functions

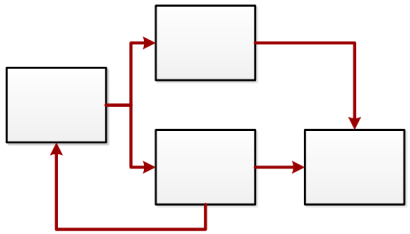
Data Vault & Document Management



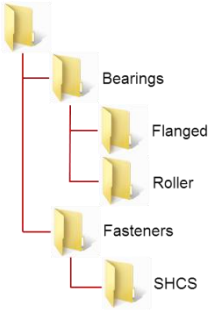
Data Authoring (CAx)



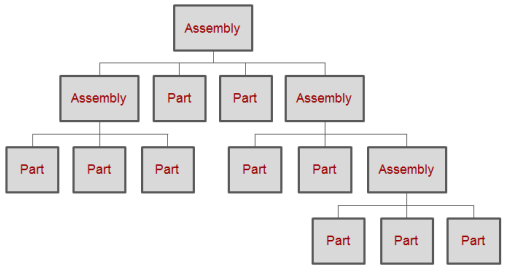
Workflow & Process Management



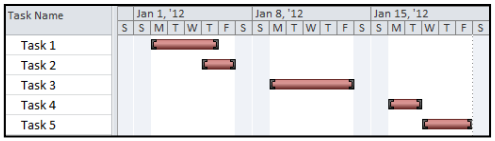
Classification Management



Structure Management



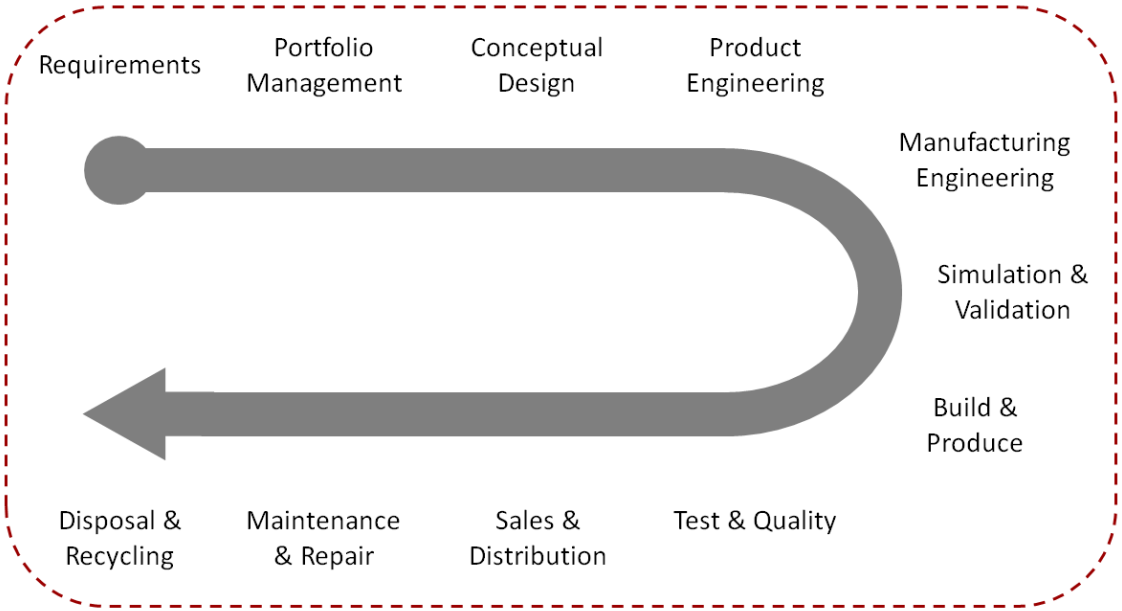
Program & Project Management



Source: CIMdata www.cimdata.com

PLM Summary

- PLM manages the complex and complete product definition.



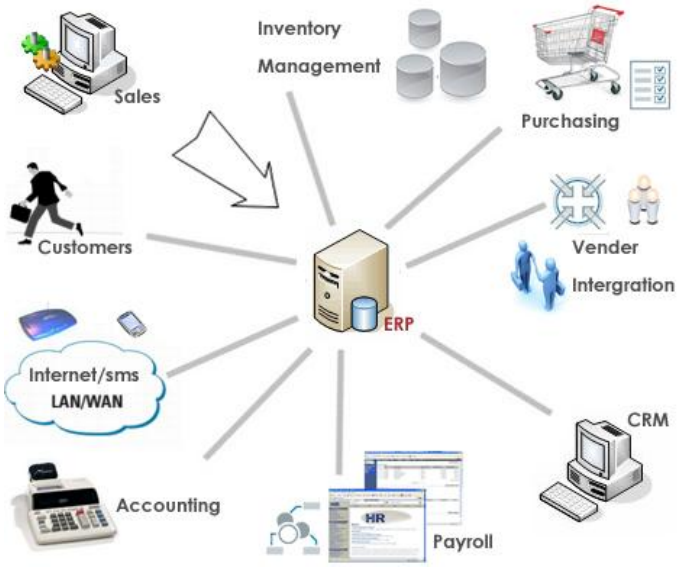
Product Data Management

- Product Data Management (PDM) is the system that is used for the managing and tracking of product design data primarily focused around engineering.

- Product Data Management (PDM) is often one element of an overall PLM strategy.

ERP Role

- The PLM system most commonly integrates with the ERP business system.
- The ERP manages the physical item information of a product.

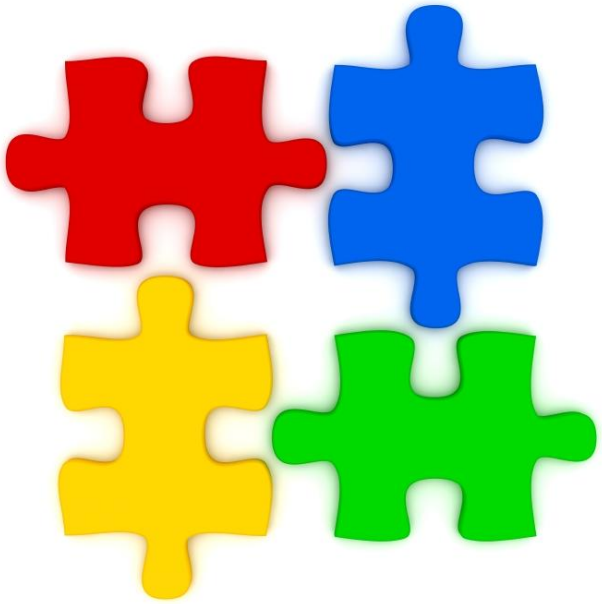


- The Bill of Material information is most commonly linked between PLM and ERP.

Source: WhatIsERP.net http://whatiserp.net

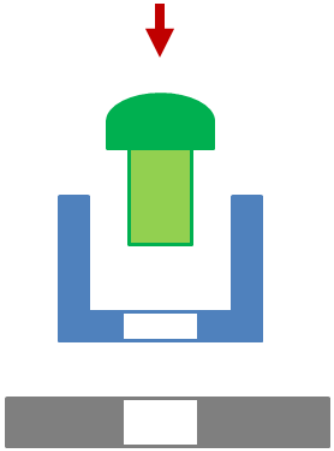
Design for Assembly (DFA)

- Design for Assembly (DFA) is the proactive approach to designing a product for ease of assembly to reduce cost and time.

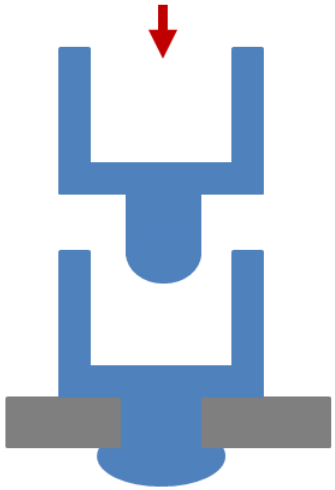


Design for Assembly Example

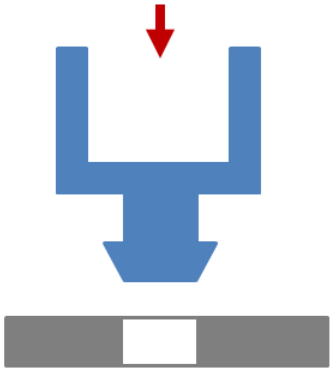
- 3 Parts
- Requires a screwdriver
- Needs careful alignment
- Time Consuming



- 3 Parts
- Requires a rivet gun
- Alignment not as delicate
- Assembly Time Less



- 2 Parts
- Integrated Fastener
- Requires machine to secure the head of the fastener



- 2 Parts
- Integrated Fastener
- Can be hand pressed into place and removed

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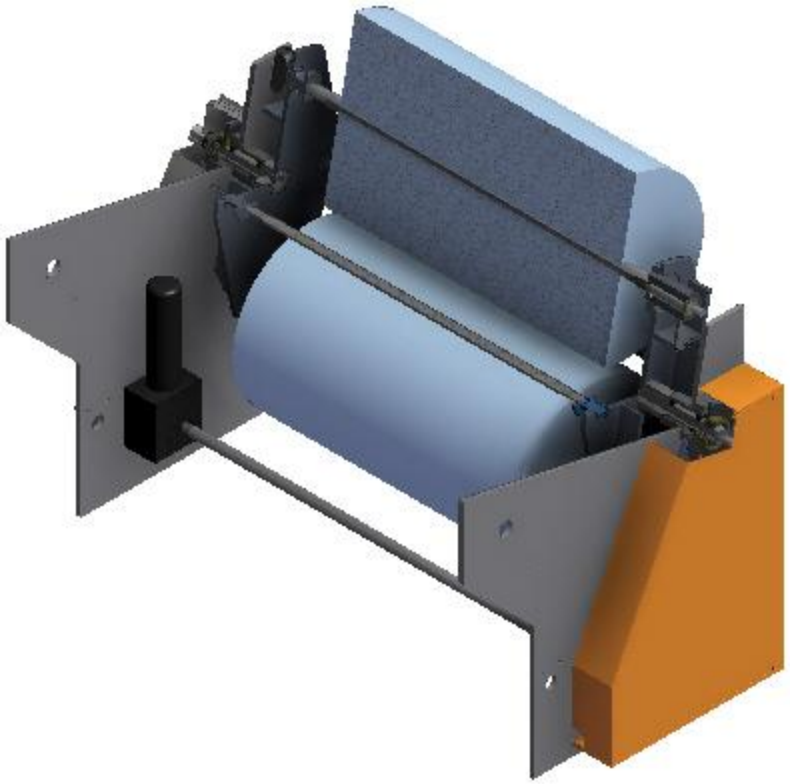
Computer-Cluster Projects (CP3)

Cluster Project 1

- Guides instructions for learning general assembly constraints.

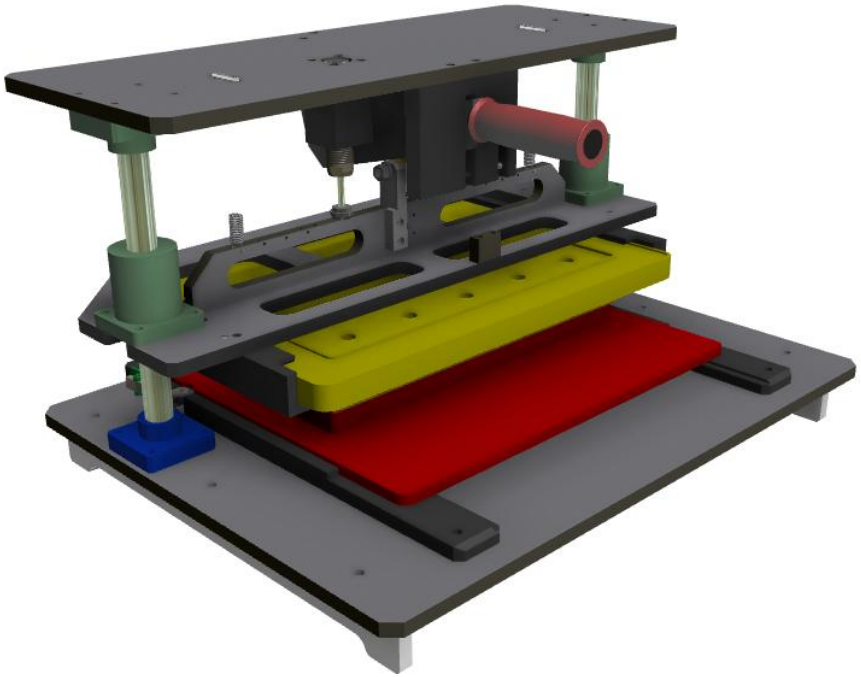
Cluster Project 2

- Guided instructions for assembly visualization and manipulation.



Cluster Project 3

- Guided instructions for designing in the assembly context (Top Down).



Problem Set Assignment

- Problem set assignment for assembling the lower seat frame assembly.

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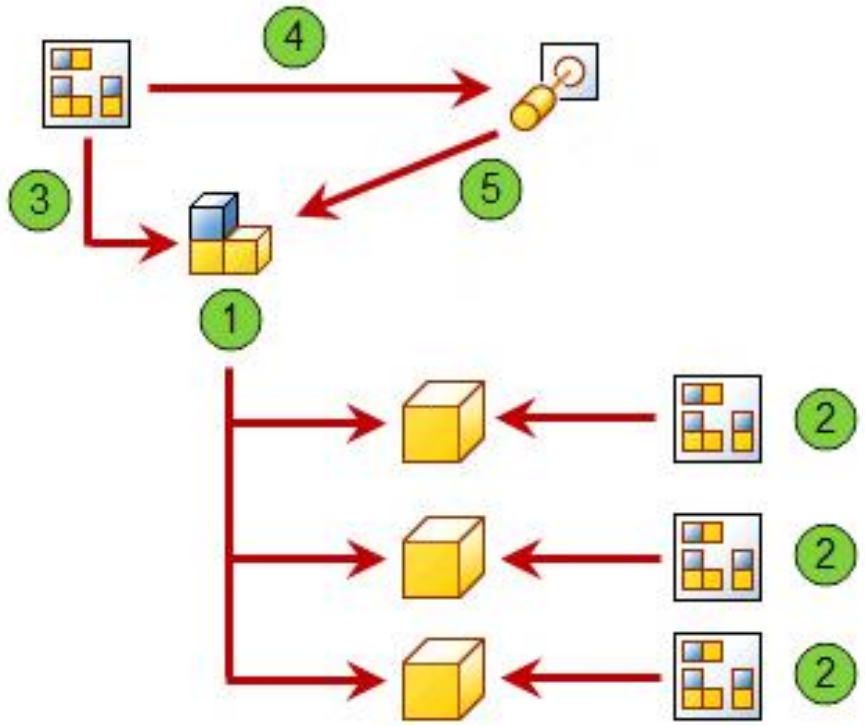
Assemblies
Demo Topics

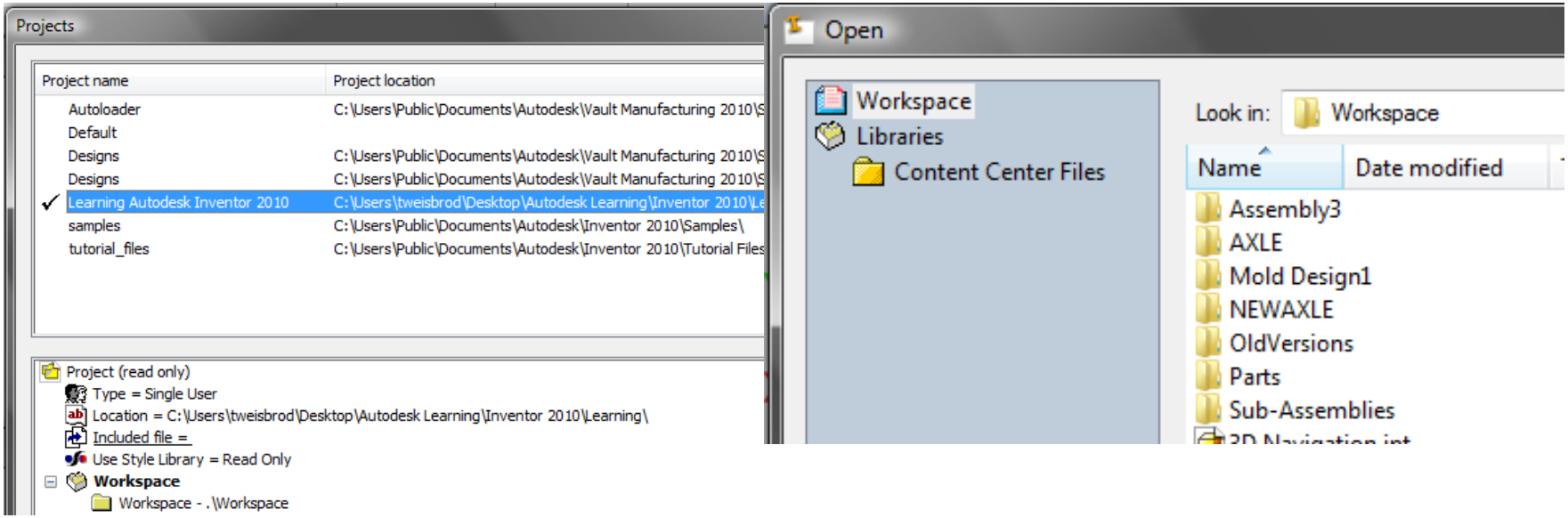
About Project Files



1. Assemblies reference parts
2. Drawings reference parts.
3. Drawings reference assemblies.
4. Drawings reference presentations.
5. Presentations reference assemblies

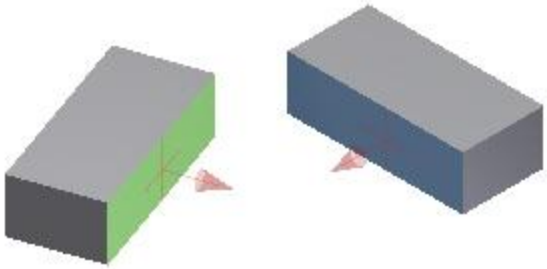
Project File Configuration

- Projects Dialog Box
  - Used to create, edit, or set a project current.
  - Top pane shows the available projects, and the lower pane shows the settings and configured options for the selected project.



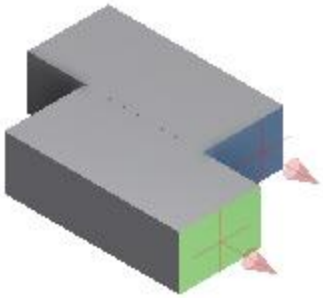
Assembly Constraints

- **Mate/Flush Constraint**
  - The Mate/Flush constraint is used to align part features such as faces, edges, or axis.
- Before Mate Constraint

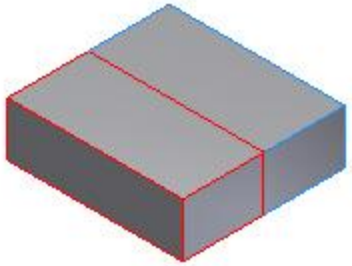


After Mate Constraint

- Before Flush Constraint



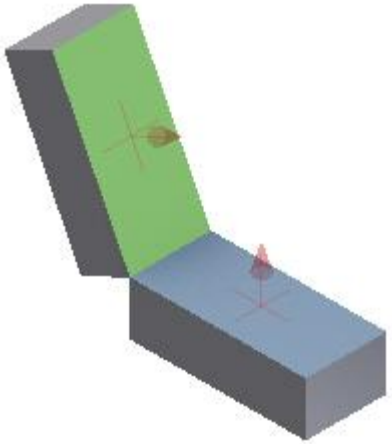
After Flush Constraint



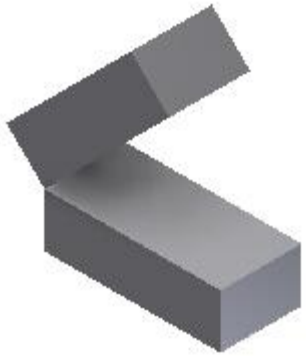
Assembly Constraints

- **Angle Constraint**
  - Used to specify an angle between two parts. The angle constraint is applied to faces, edges, or axes.

- Before Angle Constraint



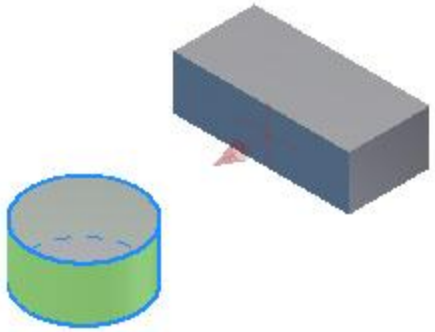
After Angle Constraint



Assembly Constraints

- **Tangent Constraint**
  - Used to define a tangential relationship between two parts. The tangent constraint is generally applied to circular faces and planar faces. One of the selected faces must be circular.

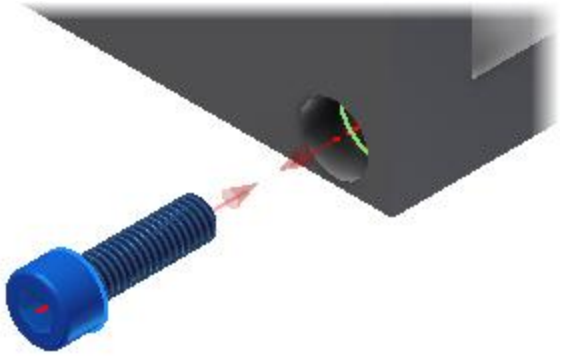
- Before Tangent Constraint After Tangent Constraint



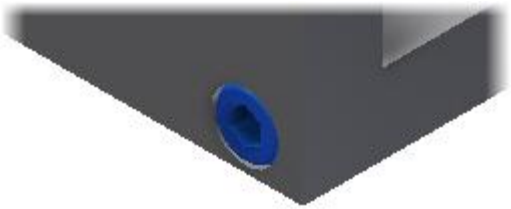
Assembly Constraints

- **Insert Constraint**
  - This constraint is used to insert one component into another. This constraint effectively combines a mate axis/axis and a mate face/face constraint. Generally the insert constraint is applied to bolts, or pins, or any part that needs to be inserted into a hole on another part. It is applied by selecting a circular edge on each part.

- Before Insert Constraint



After Insert Constraint



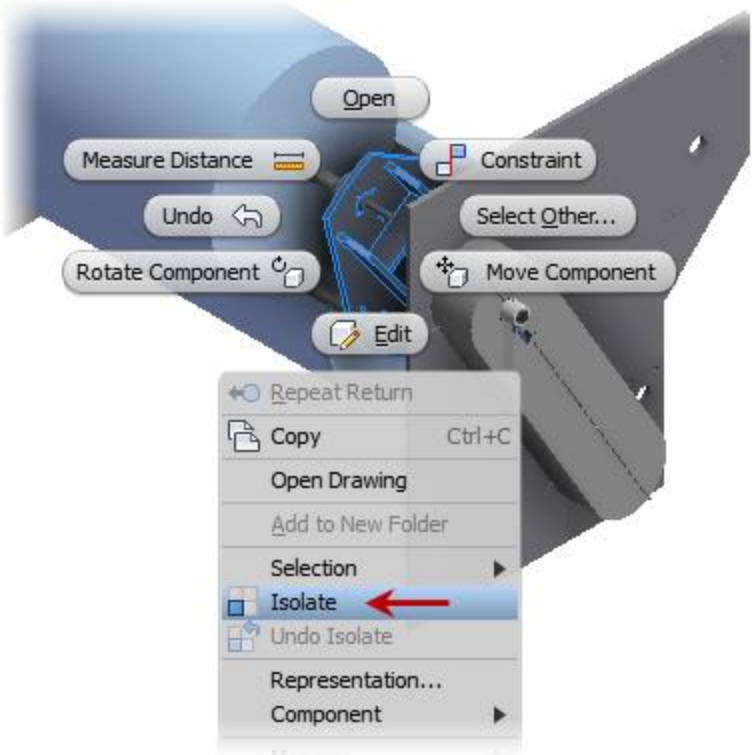
Isolating Components

- **Isolate**

  Isolate: Overflow Menu: **Right-click a selected component > Isolate**

- **Undo Isolate**

  Undo Isolate: Overflow Menu: **Right-click in the browser** or **graphics window > Undo Isolate.**



Find in Browser

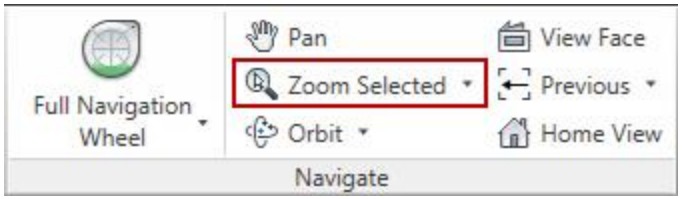
- **Find In Browser**

  Overflow Menu: Right-click a selected component in the graphics window.

Zoom Selected

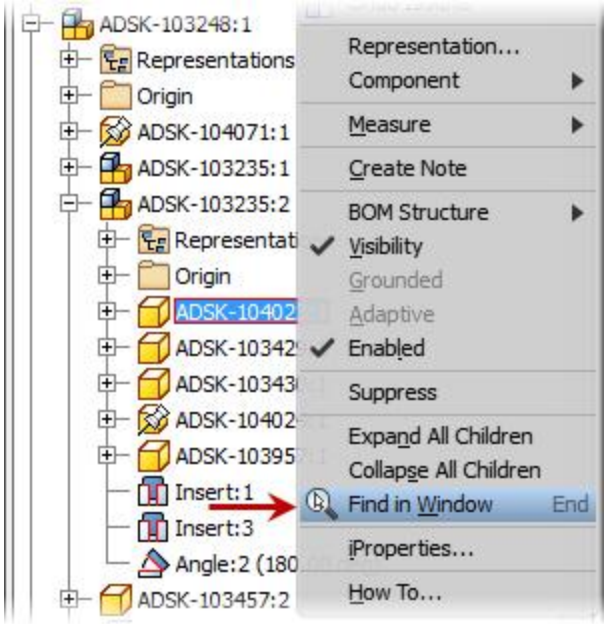
- **Find in Window, Zoom Selected**

  Ribbon: View tab > Navigate panel



- Keyboard: **END**

  Overflow Menu: Right-click a selected component in the browser.

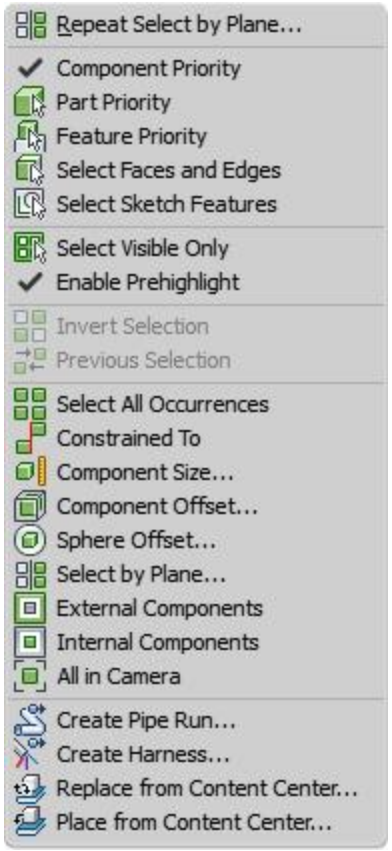


Selecting Components

- **Selection Filters**

  Quick Access Toolbar: **Component Priority Flyout > Select** 

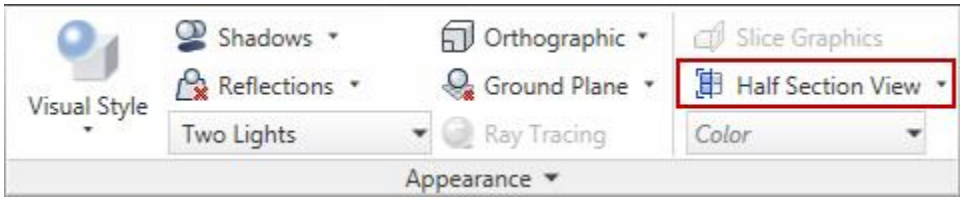
  Keyboard: **SHIFT+right-click**



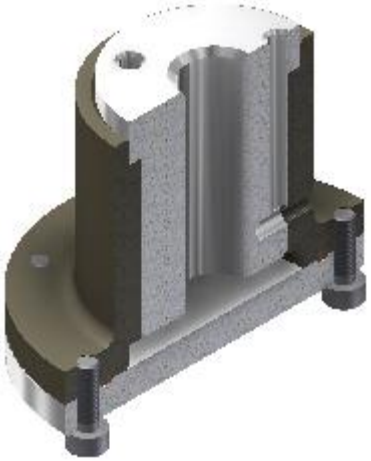
Sections

- **Assembly Sections**

Ribbon: **View tab > Appearance panel**



Half-section view:

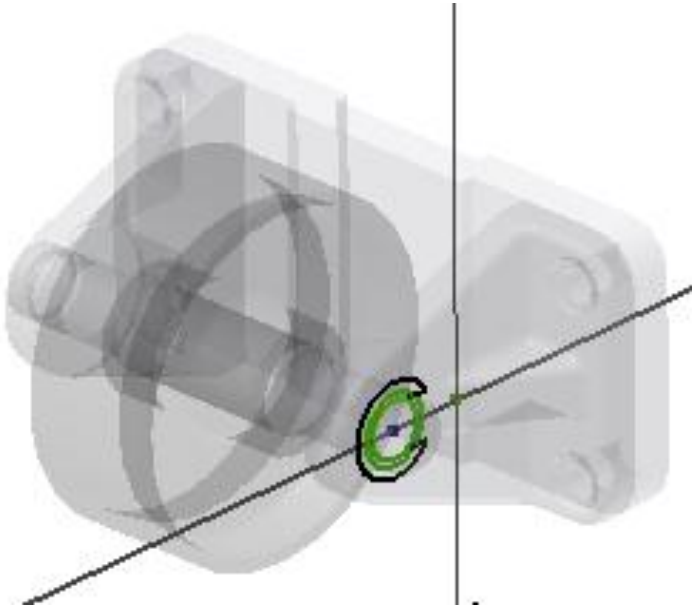


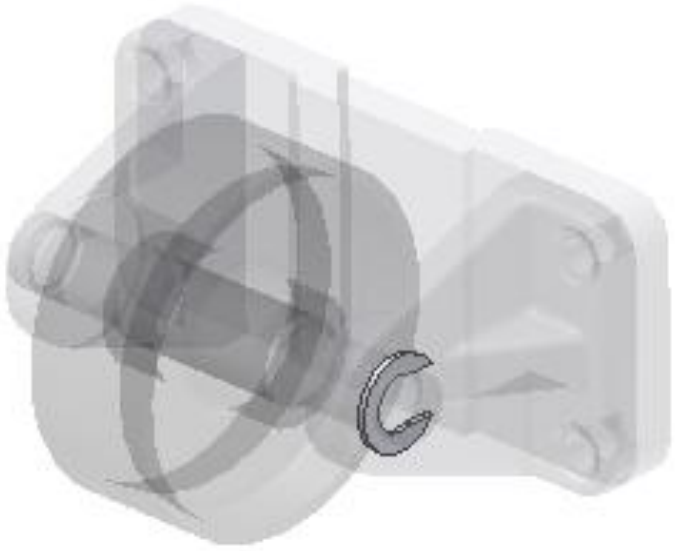
Quarter-section view:

Three-quarter section view:

Designing components in-place

- Create Components in Context
  - Design each component while still in the assembly environment.
  - As you design each component, you are applying the required assembly constraints, and are making changes to parts based upon their relationships to other components in the assembly.

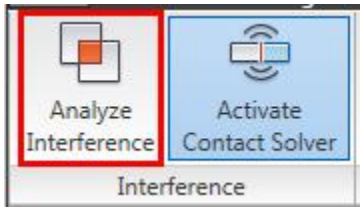


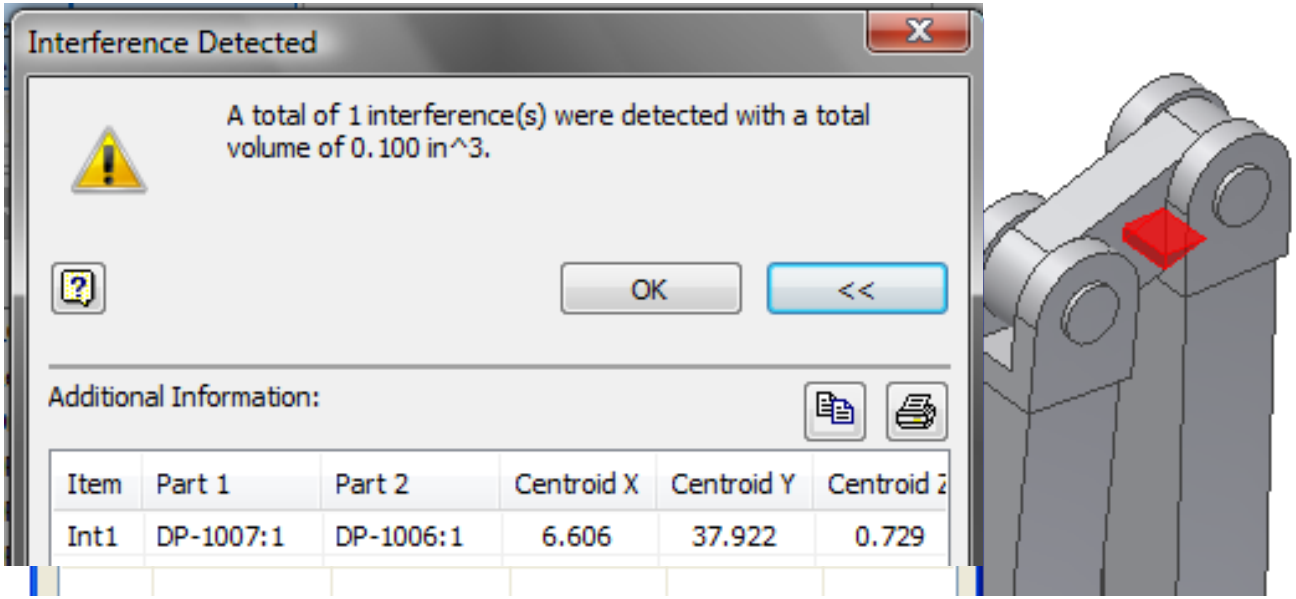


Checking for Interferences

- Interference

Ribbon: **Inspect tab > Interference panel > Analyze Interference**

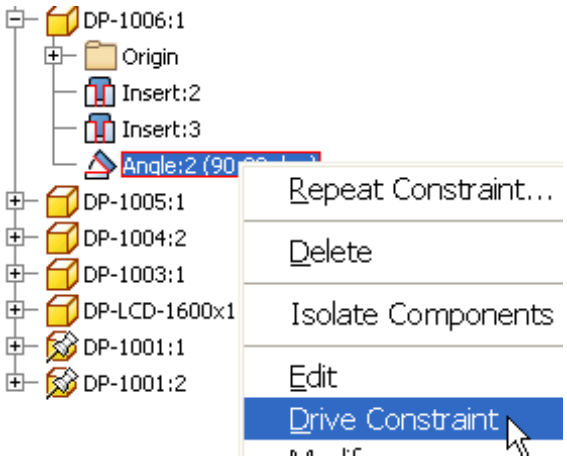


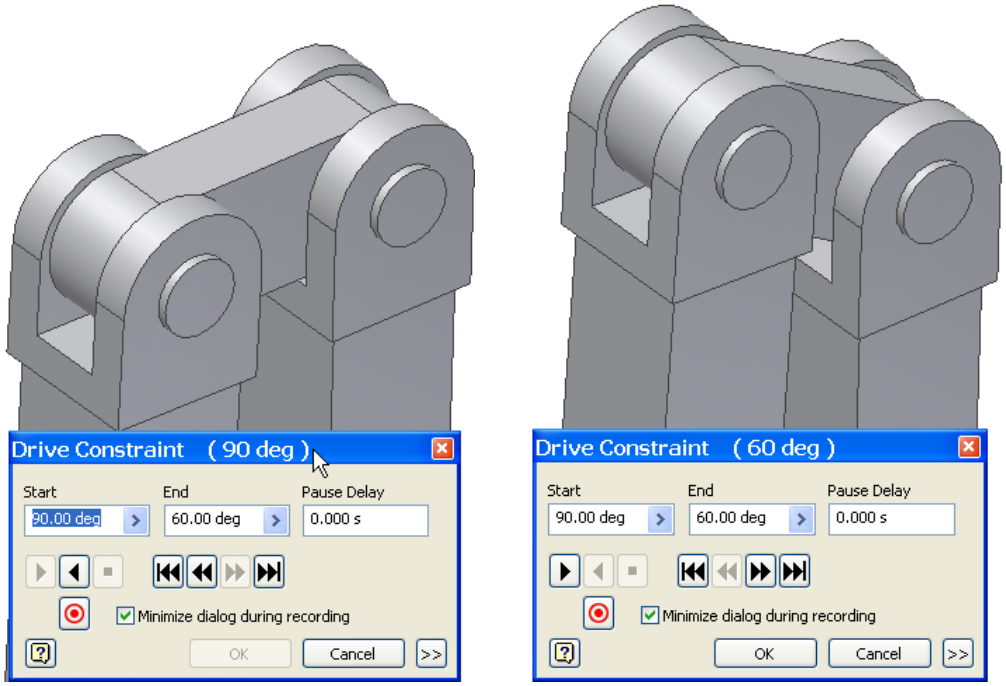


Driving Constraints for Simple Motion and Analysis

- Drive Constraint

  RMB on the constraint in the browser **> Drive Constraint**





Placing Standard Components Using the Content Center

- Content Center

  Ribbon: **Assemble** tab **> Component** panel **> Place from Content Center**