

Promoting Design Reuse with Geometric and Attributes Based Search Capabilities

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Design Reuse – Problem Statement

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- Engineers spend a significant amount of redundant effort in the development of CAD models resulting in excessive costs and inefficient product development cycle
- New parts ripple through the system, adding effort/cost in every lifecycle phase
 - *2008 DoD “Parts Standardization and Management Committee” estimated cost >\$27K per part (government programs)¹*
 - *2011 study by the Aberdeen Group (costs between \$4.5K - \$23K)²*
- Designers and Engineers have a hard time finding the correct mechanical CAD model to use in their design

1. Presentation: Parts Management Data Sharing XSB Interim Pilot Effort, Rich Rhyne, 12 April 2011
2. Whitepaper: Re-using data to improve productivity and reduce costs, Siemens Product Lifecycle Management Software Inc, 2011

Teamcenter Part Search, Selection and Insertion

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Mission

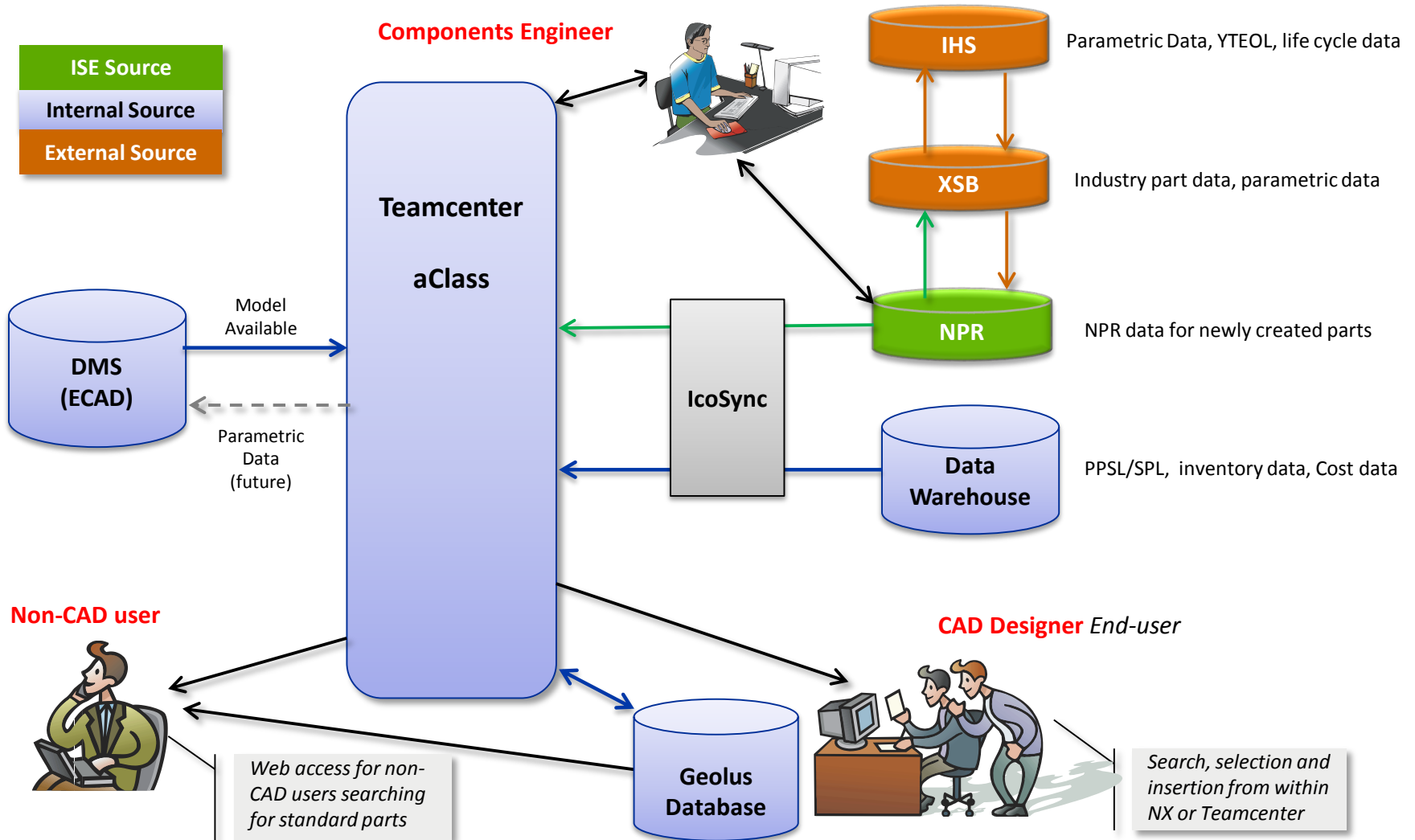
- *Increase the use of standard parts from the approved Standard Parts List (SPL) and promote reuse of existing NGC design, by providing a capability to perform part search, selection and insertion, in the design environment, directly at the designer/engineer's "fingertips" .*

Scope

- *Implement a technology based on Teamcenter / aClass / Geolus to perform part search, selection and insertion (when possible), integrated with the Mechanical and Electrical (future) Computer Aided Design (CAD) tools , in the NGC(ES) Teamcenter environment.*

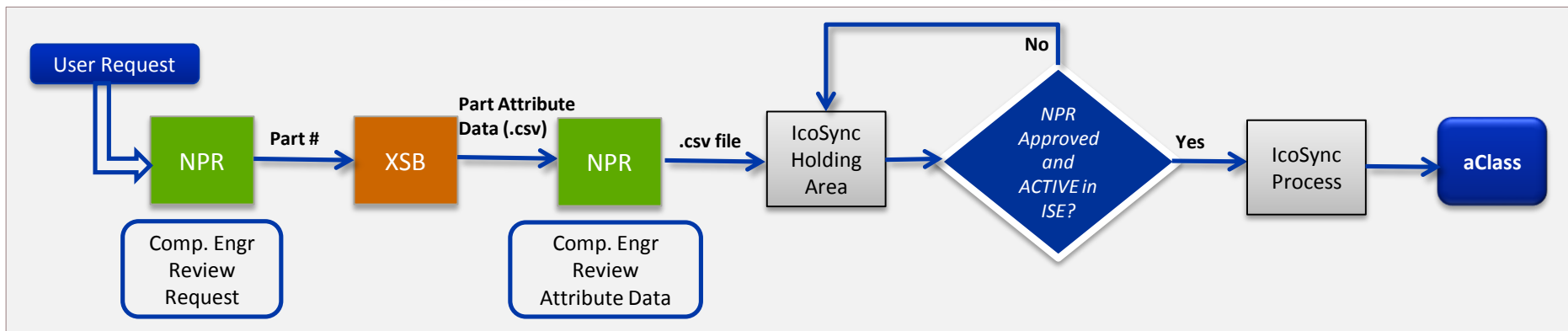
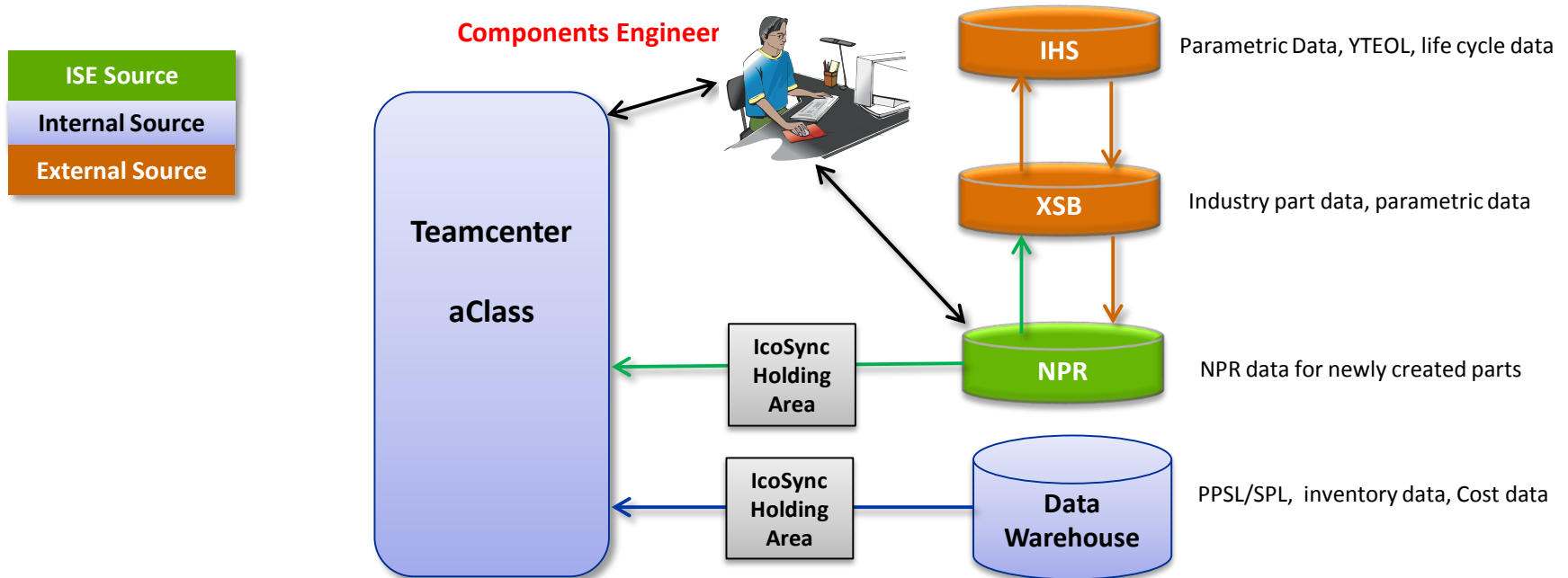
Overview: Standard Parts – Request, Search and Selection Data Flow

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Components Engineer: Standard Parts Request

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What is aClass

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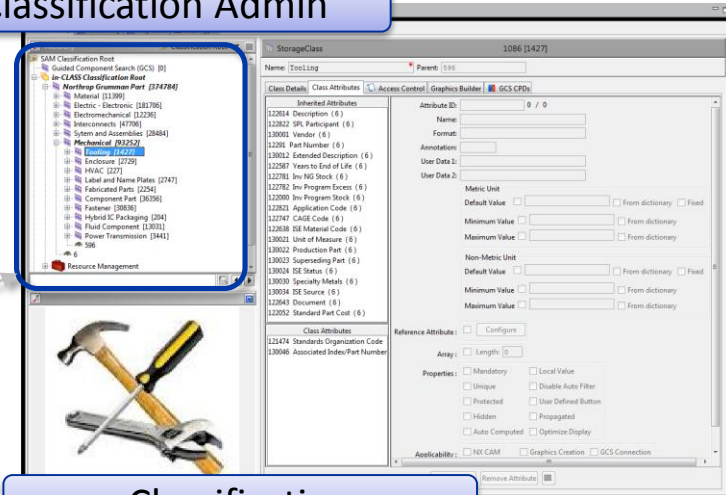
- A classification system for the structured storage and reuse of product data within Teamcenter
- A part selection tool used to perform Part Search Selection and Insertion of approved ES standard parts (Mechanical and Electrical) within the Teamcenter environment
 - Perform parametric (attribute based) searches
 - Access IHS specification data directly from the search results view
 - Can access NPR data in search results view.
 - Fully integrated with NX and allows NX users to search for standard parts from within the NX design environment and insert the 3D CAD model of the part directly into their assembly
 - Electrical parts can be accessed through DxDesigner/Expedition (future).

BCT aClass (Interface to Tc Classification)

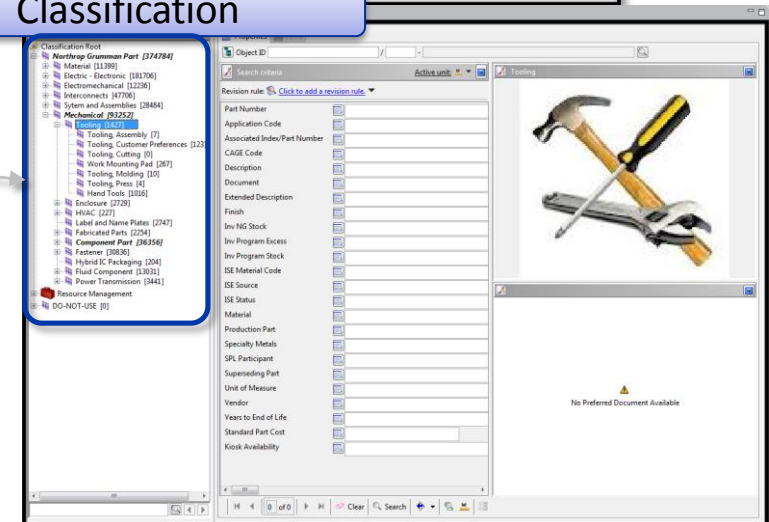
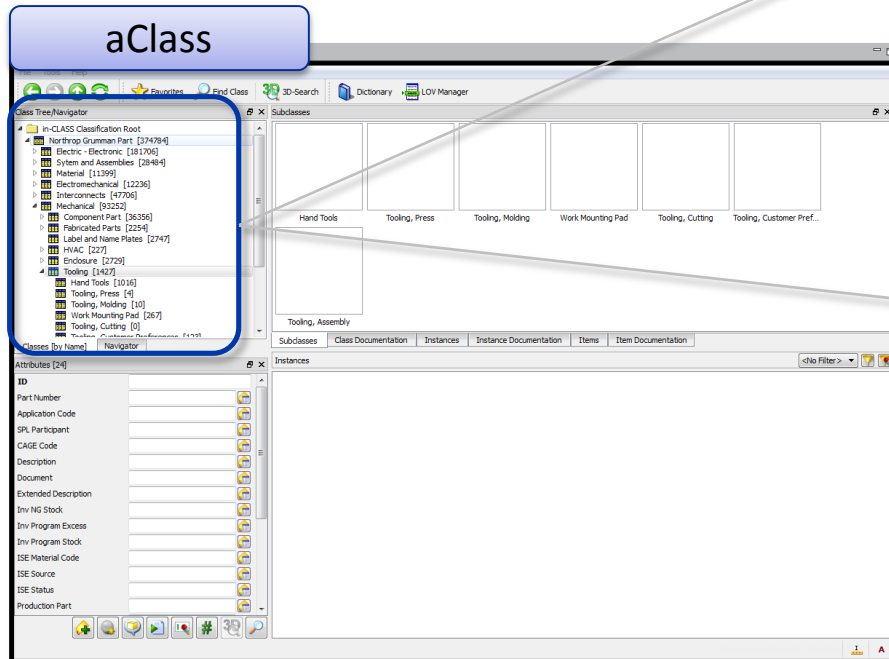
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- Access and management of classification data
 - Search / display the classification hierarchy
 - Add classification objects (ICOs) to the classification hierarchy
 - Create and modify attribute values

Classification Admin



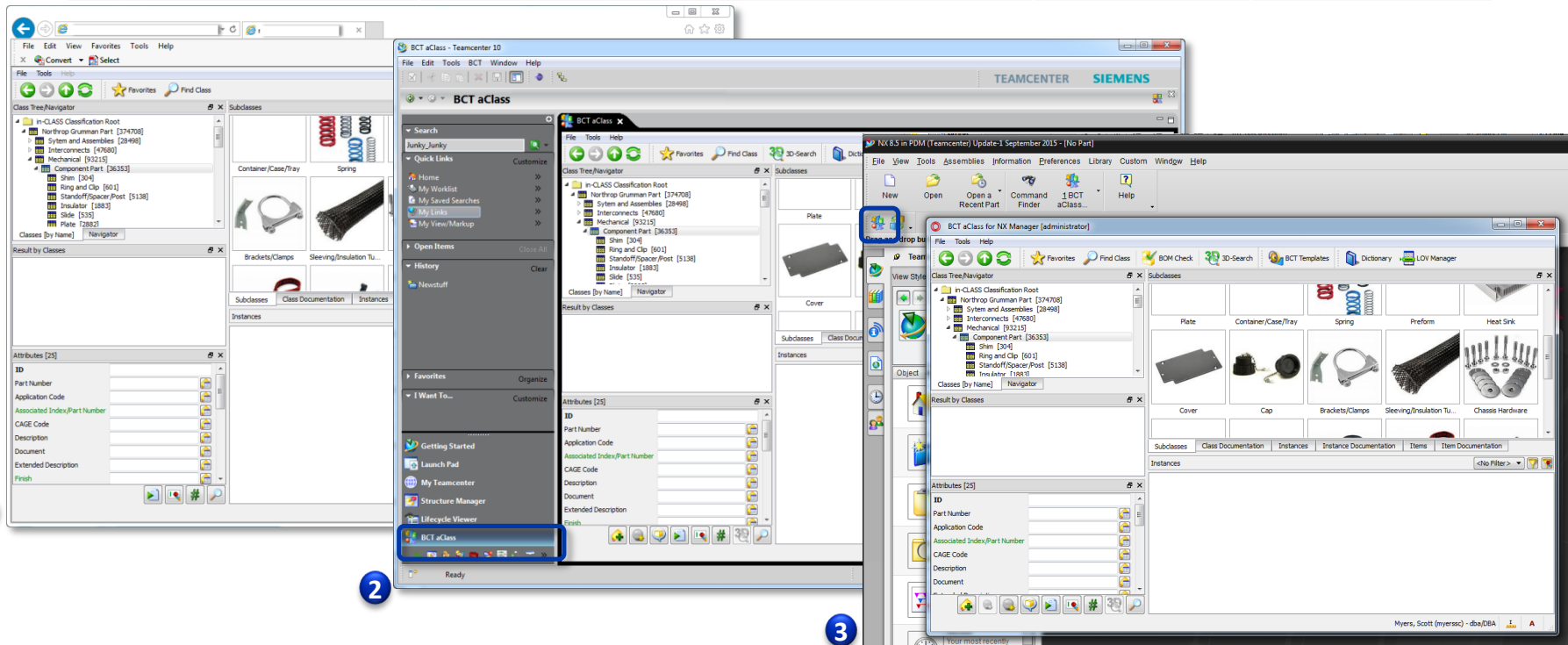
Classification



Accessing aClass - 3 User Interfaces:

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| User Interface | Search / View part specific data | Part Classification / Modification (ADMIN) | 3D Search | Assembly Part Placement |
|----------------------------------|----------------------------------|--|-----------|-------------------------|
| 1. aClass Web Client | ✓ | | | |
| 2. Teamcenter Rich Client | ✓ | ✓ | ✓ | |
| 3. Teamcenter managed NX Session | ✓ | ✓ | ✓ | ✓ |



Benefits of aClass

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- **Provides users with the capability to search and select approved standard parts by the part number or by using a parametric based search (part attributes), without leaving their design environment.**
 - Fully integrated with the Teamcenter in the OneVault environment
 - Fully integrated with NX mechanical design environment
- **Contains data for over 400,000 parts (Electrical and Mechanical) available for reuse in ES designs.**
- **Quickly identifies Standard Parts List (SPL) items, which promotes design reuse and cost savings.**

View of aClass Search Results

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Perform attribute search

The screenshot displays the BCT aClass for NX Manager [administrator] interface. The main window shows search results for '730 Bolt' (ID: 292). The results are categorized by color: Yellow for INACTIVE in ISE, Green for SPL parts in ISE, Red for CANCELLED in ISE, and Blue for DMS in ISE. The 'Instances [292]' table lists various part numbers and their applications. A callout box highlights the 'SPL Participant' column, indicating that the search results promote the reuse of SPL parts.

Parts colored in Yellow are INACTIVE in ISE

Parts colored in Green are SPL parts in ISE

Parts colored in Red are CANCELLED in ISE

Parts colored in Blue are DMS in ISE

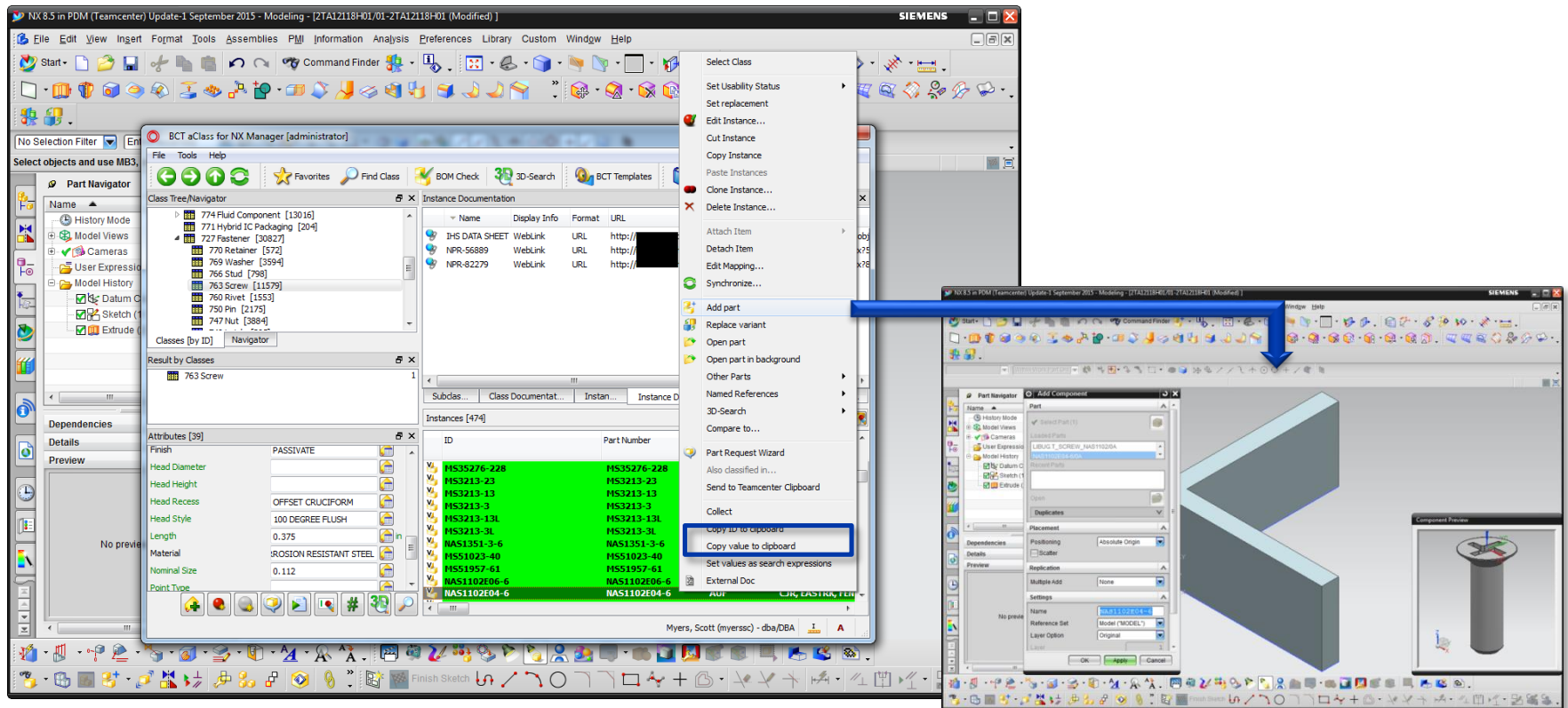
| ID | Part Number | Application | SPL Participant |
|-------------|-------------|-------------|--|
| MS35307-309 | MS35307-309 | AUF | BWI-AUF-SPL, CJR, EASTRK, RM-AUF-SPL, TP |
| MS35307-310 | MS35307-310 | AUF | BWI-AUF-SPL, CJR, EASTRK, RM-AUF-SPL |
| MS35307-311 | MS35307-311 | AUF | BWI-AUF-SPL, CJR |
| MS35307-312 | MS35307-312 | AUF | BWI-AUF-SPL, CJR, EASTRK, RM-AUF-SPL |
| MS35307-313 | MS35307-313 | AUF | BWI-AUF-SPL, TPS63S |
| MS35307-314 | MS35307-314 | | |
| MS35307-315 | MS35307-315 | | |
| MS35307-316 | MS35307-316 | AUF | AZU-SF-SPL, BWI-AUF-SPL, SBIRSZ, TPS63S |
| MS35307-317 | MS35307-317 | AUF | BWI-AUF-SPL, TPS63S |
| MS35307-318 | MS35307-318 | | |
| MS35307-319 | MS35307-319 | | |

Promotes Reuse of SPL parts

NX Designer Interaction

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- Search and Navigate Part Data
- Part Evaluation and Comparison
- Insertion of CAD Model in Open Session (Multi-Cad Support)
- Access to Associated Data (Specs, Notes, etc)
- New Part Request



Electrical Interaction – DxDesigner/Expedition

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DMS Library Researcher - Show the ECAD geometry view

The screenshot displays the DMS Library Researcher interface. The left pane shows a Class Tree/Navigator with a hierarchy of electronic components. The main pane shows a table of instances for the selected part, CDR12BG0R4ABUS. A blue arrow points from the part number in the table to a detailed view window on the right.

Part Number: CDR12BG0R4ABUS

Mentor Graphics

Catalog Group: Fixed Capacitor, Chip | Production Library: NGES_PROD_LIB | Lib Spec: NGES | Status: In Development

Description:

General | Dx Symbol | Component Alternates | View Datasheets

Creation Date: 06/25/2010 16:11:02
Last Modified Date: 04/01/2011 11:26:27

Ref Des

cdri2_sma_a | capacitor_nonpolar.1

VALUE
DCVR

Add To My Components | Exit

| ID | Part Number | Application Code | SPL Participant |
|----------------|----------------|------------------|----------------------------|
| CDR12BG0R1ABUS | CDR12BG0R1ABUS | AUF | BW1-AUF-SPL, CJR |
| CDR12BG0R2ABUS | CDR12BG0R2ABUS | AUF | BW1-AUF-SPL, CJR |
| CDR12BG0R3ABUS | CDR12BG0R3ABUS | AUF | BW1-AUF-SPL, CJR |
| CDR12BG0R4ABUS | CDR12BG0R4ABUS | AUF | BW1-AUF-SPL, CJR |
| CDR12BG0R5ABUS | CDR12BG0R5ABUS | AUF | BW1-AUF-SPL, CJR |
| CDR12BG0R6ABUS | CDR12BG0R6ABUS | AUF | BW1-AUF-SPL, CJR |
| CDR12BG0R7ABUS | CDR12BG0R7ABUS | AUF | BW1-AUF-SPL, CJR |
| CDR12BG0R8ABUS | CDR12BG0R8ABUS | AUF | BW1-AUF-SPL, CJR |
| CDR12BG0R9ABUS | CDR12BG0R9ABUS | AUF | BW1-AUF-SPL, CJR |
| CDR12BG100AFUR | CDR12BG100AFUR | AUF | |
| CDR12BG100AJUR | CDR12BG100AJUR | AUF | |
| CDR12BG100AJUS | CDR12BG100AJUS | AUF | BW1-AUF-SPL, CJR, RM-AUF-S |
| CDR12BG100AKSM | CDR12BG100AKSM | AUF | |
| CDR12BG100AKUR | CDR12BG100AKUR | AUF | |
| CDR12BG101AJUM | CDR12BG101AJUM | AUF | JRSIP |
| CDR12BG101AJUR | CDR12BG101AJUR | AUF | |
| CDR12BG101AJUS | CDR12BG101AJUS | AUF | BW1-AUF-SPL, CJR, RM-AUF-S |
| CDR12BG101AKUM | CDR12BG101AKUM | AUF | |

What is 3D Shape Search

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- Tool for searching for existing parts and designs based on geometry
 - Searches for similar solids in Geolus database
 - Database is created from Item Revision Attribute data and JT files stored in Teamcenter
- Accessed/Used from:
 - NX
 - aClass
 - Teamcenter Rich Client
 - Web interface (Coming soon. Requires separate login account)

The image displays three screenshots of the 3D Shape Search tool in use. The top-left screenshot shows the NX interface with a 'Shape Search' dialog box. A blue callout box labeled 'NX' points to the dialog. The top-right screenshot shows the Teamcenter Rich Client (Tc RC) interface with a 'Shape Search' dialog box. A blue callout box labeled 'Tc RC' points to the dialog. The bottom screenshot shows the aClass interface with a 'Shape Search' dialog box. A blue callout box labeled 'aClass' points to the dialog. The aClass interface also displays a list of search results for '763 Screw'.

| ID | Similarity | Scale | ISE Source | Class |
|---------------|------------|-------|------------|-----------|
| NAS1102-04-6B | 100 | 1 | IND | 763 Screw |
| NAS1102E04-6P | 100 | 1 | IND | 763 Screw |
| NAS1102V04-6 | 100 | 1 | IND | 763 Screw |
| 92010A120 | 99.932 | 1.05 | VPH | |

The Geolus Database

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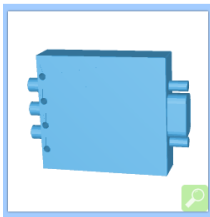
Initial Population (Geolus Teamcenter Indexer)

- Initial mode – queries Teamcenter server
 - Generate list of Item Revisions matching the given criteria
 - Extract JT and PLMXML file
 - Convert JT and PLMXML file to Geolus XML files
 - Upload to Geolus Server

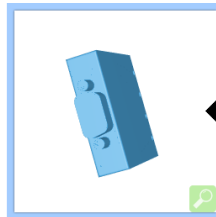
Updates

- Based on JT (Direct Model) created in Teamcenter by:
 - Nightly batch process that creates JT file for all NX piece part designs modified during the day (no Assembly JT)
 - NX Save when “Save JT” option is turned ON
- Nightly - Geolus “indexing” process creates “fingerprint” of the geometry and metadata from Teamcenter
- Generation of Smart Thumbnails

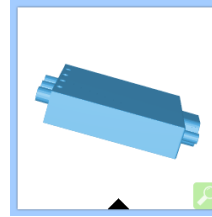
ISO



LEFT



BOTTOM



Use Cases of Shape Search

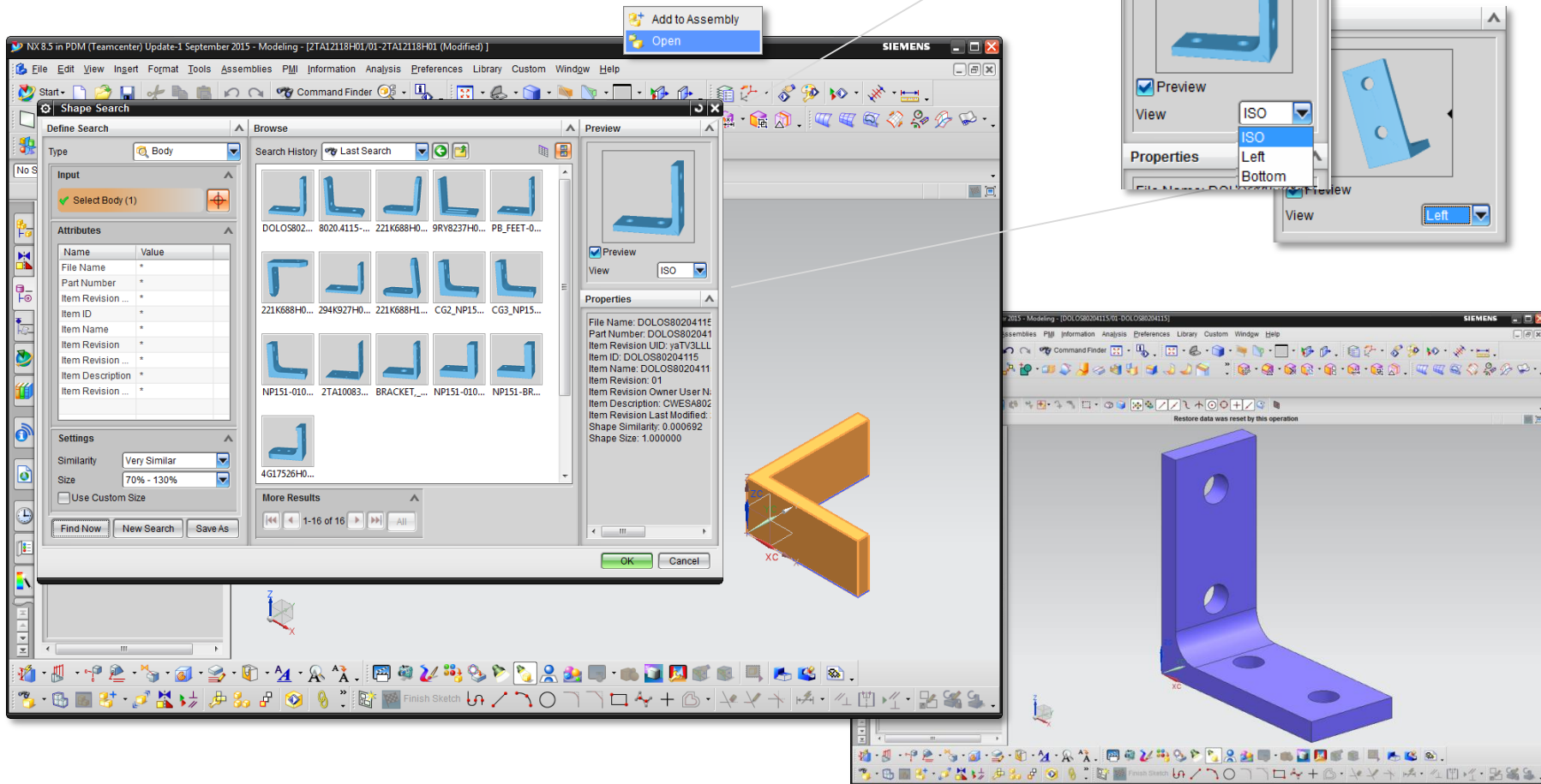
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- **Design phase:**
 - Search for similar parts to use as “start parts”
 - Search for similar parts to use in assembly
- **Analysis phase:**
 - Search for similar parts for similar analysis methodology
- **Manufacturing and NC Programming**
 - Reuse of NC tool path from similar parts
 - Reuse of tooling and fixtures
 - Promote group technology (similar geometry -> similar manufacturing process)

Search for similar parts to use as “start parts”

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- Start with Quick Sketch of part
- Tools -> Shape Search...
- Right-Click thumbnail of chosen part to display action menu



Geolus - Similar Parts

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Start with Attribute Search – 120 Results

Run Geometry Search – 16 Results

The image is a collage of screenshots from the Geolus web application, demonstrating its search capabilities. The main window shows a search interface with 'Attribute Filters' and 'Geometric Filters'. A search for 'Switch*' yields 120 results. A specific part, '176 - 026-B137-A3D-4A0/01', is highlighted, and a geometry search is run on it, resulting in 16 similar parts. A table on the right shows the similarity scores for these parts.

| Query Part | Similarity | Size |
|---------------------------|------------|---------|
| 176 - 026-B137-A3D-4A0/01 | 100.00% | 100.00% |
| 026-B137-A3D-4A0/01 | 100.00% | 100.00% |
| 026-B137-A3D-4A0/01 | 97.56% | 100.00% |
| 026-B137-A3D-4A0/01 | 92.25% | 100.00% |
| 026-B137-A3D-4A0/01 | 101.98% | 100.00% |
| 026-B137-A3D-4A0/01 | 103.95% | 100.00% |
| 026-B137-A3D-4A0/01 | 103.99% | 100.00% |
| 026-B137-A3D-4A0/01 | 75.37% | 100.00% |
| 026-B137-A3D-4A0/01 | 75.37% | 100.00% |

Geolus – Duplicate Parts

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Identical
Very Similar
Similar

90% - 110%
80% - 120%
70% - 130%
50% - 200%
25% - 400%

SIEMENS

Attribute Filters
Add Any Remove
New Attribute-only Search

Geometric Filters
Part Shape Identical
Part Size 90% - 110%
Repeat Query Part Search

Query Part - 4 - 000691/01

Result Part - 3 - 000690/01

| Result | ID | Part View | Similarity | Size | Part Number | Item ID | Item Name | Item Revision | Owner User Name | Item Description |
|--------|-------|-----------|------------|---------|--------------------------|-----------------------|---------------------------|---------------|------------------------------|---|
| - | 4 | | Query Part | 100.00% | 000691/01 | 000691 | 000690 | | Biancavilla, Barney (bianca) | 000690 |
| 1 | 3 | | | 100.00% | 000690/01 | 000690 | 000690 | | Biancavilla, Barney (bianca) | 000690 |
| 2 | 7570 | | | 100.00% | 5793708-1/00 | 5793708-1 | HULL ISOLATION VALVE, GAS | | Biancavilla, Barney (bianca) | LIBUG.SOC_VAL_5793708_1 |
| 3 | 73691 | | | 100.00% | LIBUG.VALVE_PLC_12211/01 | LIBUG.VALVE_PLC_12211 | Cpv_valve | | Hartman, Joe (hartmjo) | \\jagsevr1\public\ug1\ug_std_parts\subing\cpv_valves\libug_valve_plc_12211-01 prt |

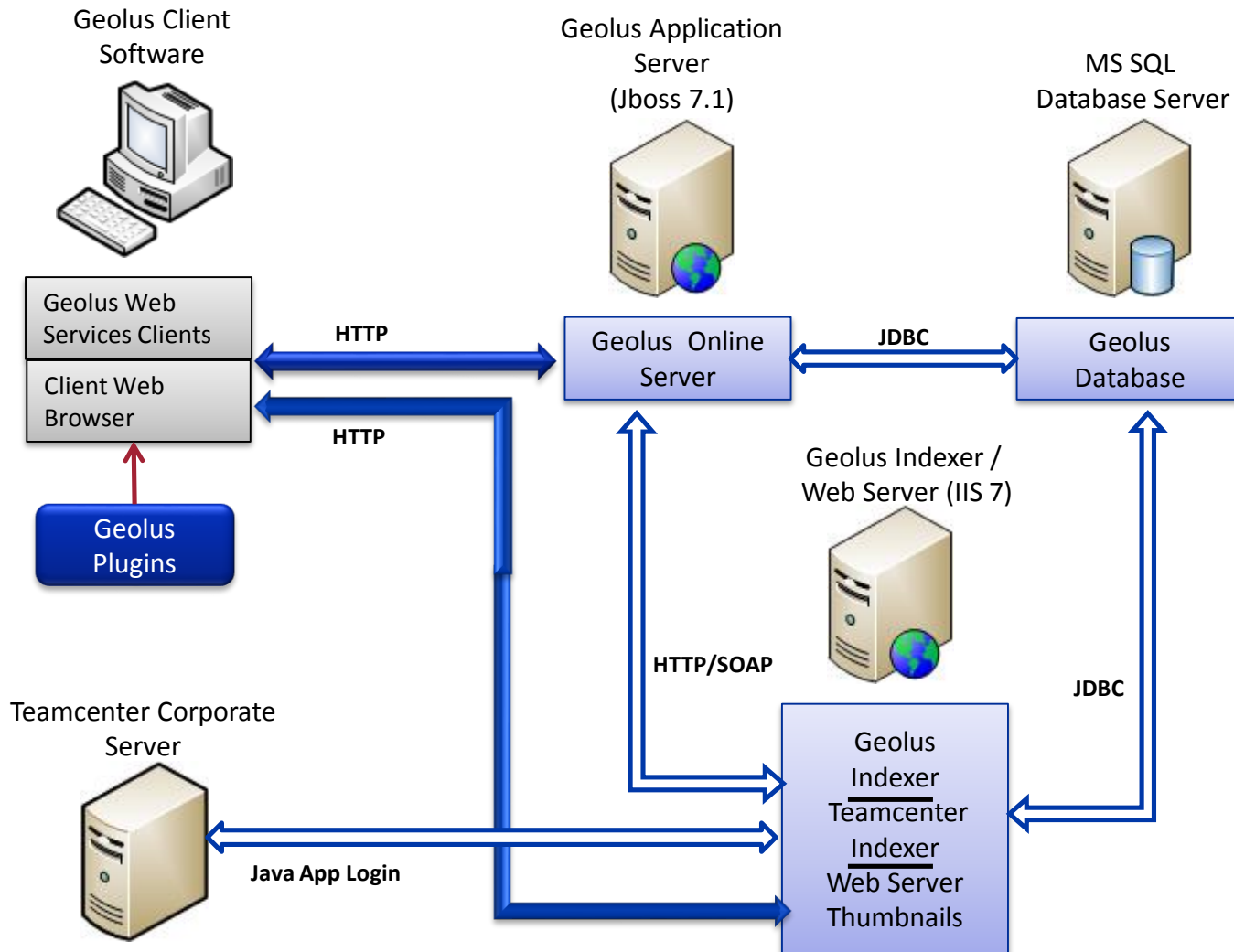
Benefits of 3D Shape Search

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- Promotes reuse of NGC Designs
- Promotes reuse of existing standard parts
- Saves design cycle time by finding existing parts with similar geometry that can be modified for reuse
- No need to know part numbers to find existing designs/parts
 - Company acquisitions (legacy PDM, nomenclature)
 - Programs using different naming conventions
- Eliminate time and expense related to the redesign or purchasing of duplicate parts.
- Find similar NGC Designs for Classification

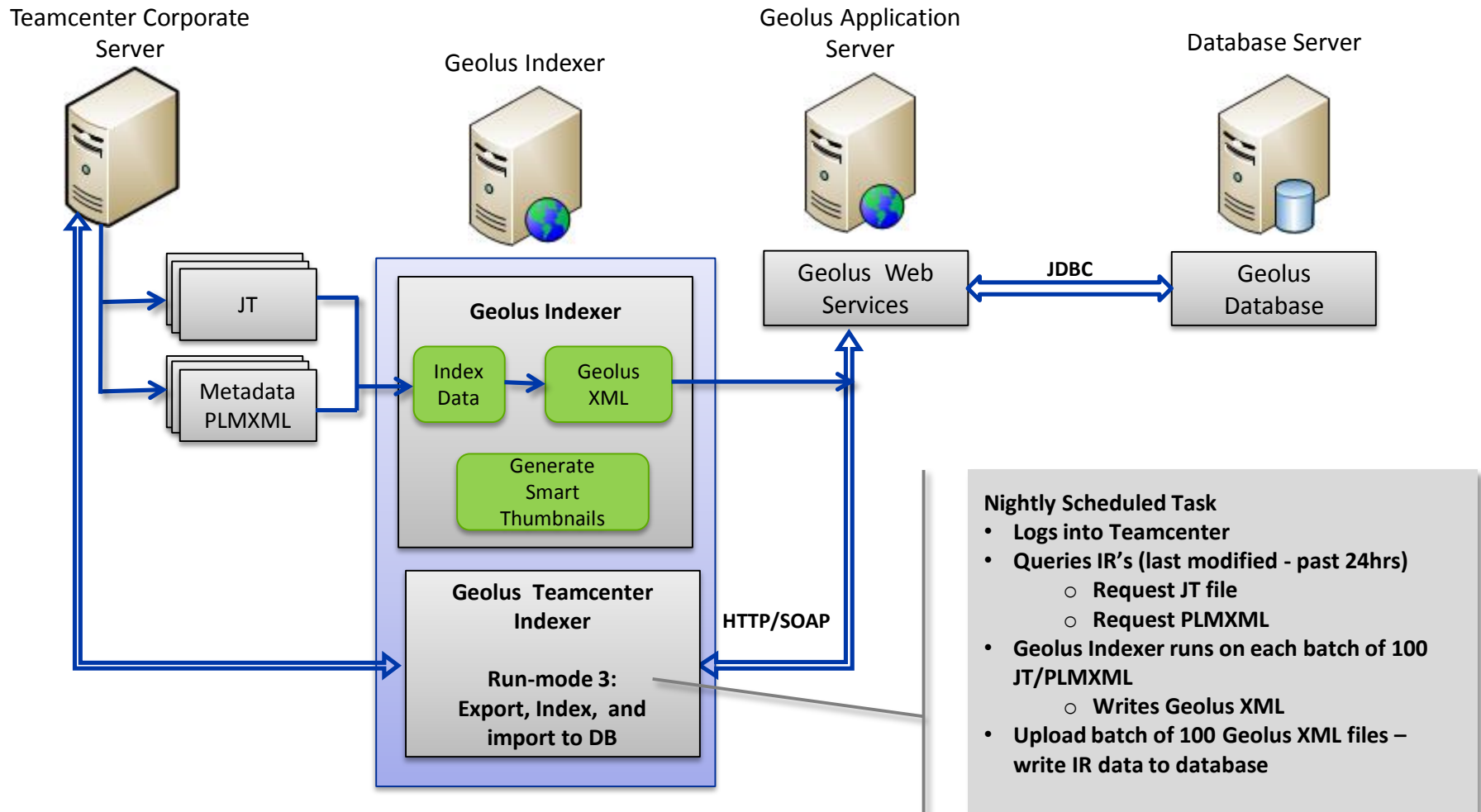
Geolus v8.0 Architecture Diagram

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Geolus Daily Indexing Process Flow

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Thank You

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