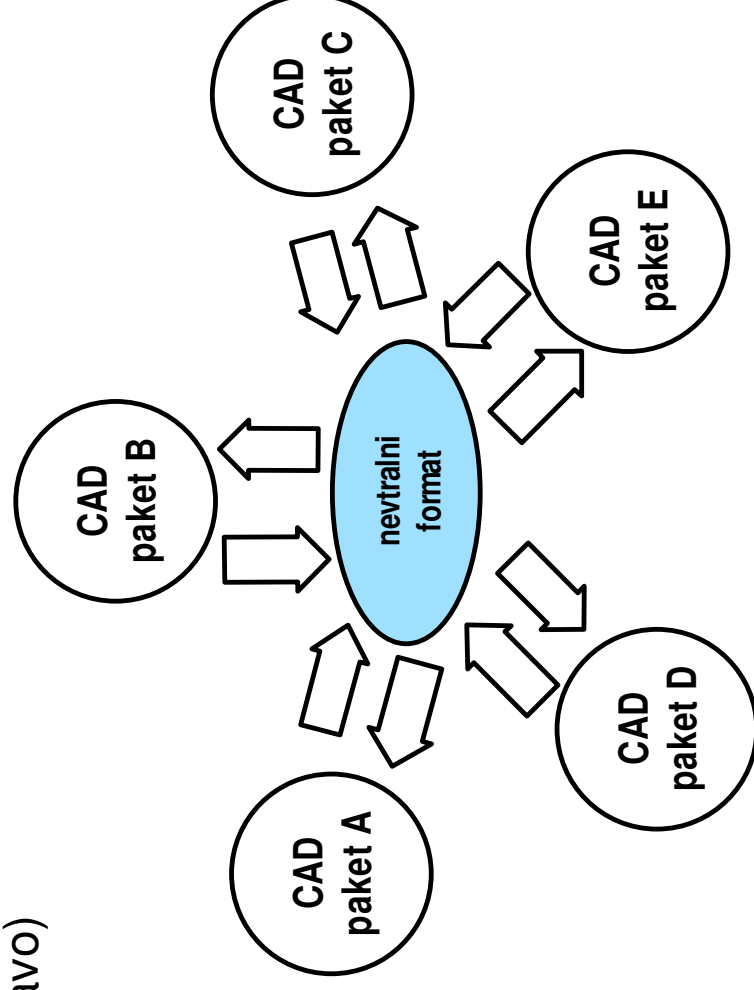
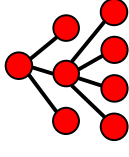


Grafični formati za izmenjavo CAD podatkov:

- vektorski formati
- IGES standard (za primerjavo)
- STEP standard
 - struktura
 - uporaba



Pomen nevtralnega formata pri prenosu podatkov med različnimi CAD paketi.



Vektorski in rasterski formati

Vektorska grafika temelji na predstavitvi objektov z daljicami, poligoni, krivuljami, ki so numerično določeni s ključnimi točkami. Vektorski popis je primeren predvsem za tehnične probleme (risbe, modele), kjer potrebujemo natančne podatke o dimenzijah.

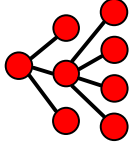
Primer enostavnega **vektorskega formata DXF** (Data eXchange Format, AutoDesk). Poleg osnovnih 2D elementov kot so loki in poligoni, omogoča tudi zapis za šrafure, kote, 3D objekte.. Primer zapisa posameznih elementov v DXF formatu:

```

0
SECTION
2
ENTITIES
0
LINE
8
0
10
25.0
20
235.0
30
0.0
11
147.5
21
130.0
31
0.0
ENDSEC
0
EOF

```

risalna ravnina
x - koordinata
y - koordinata
z - koordinata
podatki o drugi točki



IGES Standard Initial Graphics Exchange Specification

Osrednja ameriška vladna organizacija za standarde:

1980 IGES 1.0 prvič objavljen

Do danes je bilo objavljenih 5 verzij standarda, ki so se dopolnjevale z novostmi.

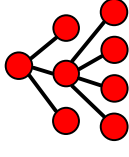
IGES je najbolj razširjen standard pri prenosu grafičnih podatkov med CAD sistemi. IGES uporablja koncept nevtralnih datotek.

Oblika podatkov v datotekah:

ASCII datoteke (80 znakov v vrstici) ali binarne datoteke

Slabosti IGESa:

- koncept je bil postavljen konec 70-ih let in ni več primeren za današnje stanje razvoja
- ne razlikuje med fizično in konceptualno shemo
- metode za testiranje niso definirane
- premajhna zanesljivost v 3D, izgubi se struktura...



Struktura IGES datoteke

Struktura IGES datotek:

Podatki so razvrščeni v 5 sekcij, posamezna sekcija je razpoznavna iz _črke v 72-ti koloni.

začetna sekcija (S)

Prosti tekst na začetku, ki služi dokumentiranju datotek.

globalna sekcija (G)

V globalni sekciji se nahaja 24 parametrov kot so podatek o procesorju, ime datoteke, avtor, datum kreiranja, uporabljene enote, natan_nost predstavitve števil v datoteki, ..

področje vhodne sekcije (D)

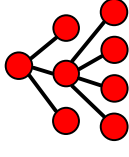
Vsebuje podatke, ki so skupni za vse entitete v datoteki, kot npr. barva, tip črt, risalne ravnine, pogledi, transformacijske matrike..

parametrična sekcija (P)

V parametrični sekciji so podatki o entitetah npr. koordinate za točke, vozlišča za daljice.. Ta sekcija je običajno najbolj obsežna.

zaključna sekcija (T)

V zaključni sekciji so podatki o številu vrstic v posamezni sekciji.

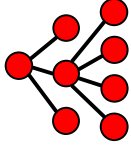


Primer IGES datoteke:

IGES file generated from an AutoCAD drawing by the IGES translator from Autodesk, Inc., translator version IGESOUT-3.04.
 „,7HUNNAMED,29HC:\tavcar\STEP\VAJA1.IG,10HAutoCAD-12,12HIGESOUT-3.04,32,38,6,99,15,7HUNNAM,1.0,1,4HINCH,32767,3.2767D1,13H950511.141517,2.8D-7,280.0,22Hprof.dr. Joze Duhovnik,6H LECAD,6,0;

| | | | | | | | |
|--|---|---|---|---|--------|------------------|----------|
| 304 | 1 | 1 | 2 | | | 00000200D0000001 | S0000001 |
| 304 | | | 1 | 2 | HIDDEN | D0000002 | S0000002 |
| 110 | 2 | 1 | 1 | | | 00000000D0000003 | G0000001 |
| 110 | | | 1 | | | D0000004 | G0000002 |
| 100 | 3 | 1 | 1 | 0 | | 00000000D0000005 | G0000003 |
| 100 | | | 1 | | | D0000006 | |
| 100 | 4 | 1 | 1 | 0 | | 00000000D0000007 | |
| 100 | | | 1 | | | D0000008 | |
| 116 | 5 | 1 | | | | 00000000D0000009 | |
| 116 | | | 1 | | | D0000010 | |
| 304,2,0,25,0,125,1H2; | | | | | | 1P0000001 | |
| 110,25,0,235,0,0,0,1,475D2,130,0,0,0; | | | | | | 3P0000002 | |
| 100,0,0,105,0,2,375D2,1,475D2,2,375D2,1,475D2,2,375D2; | | | | | | 5P0000003 | |
| 100,0,0,80,0,1,98046875D2,2,0D1,1,825D2,1,075D2,1,425D2; | | | | | | 7P0000004 | |
| 116,135,0,175,0,0,0; | | | | | | 9P0000005 | |
| S0000002G00000003D00000010P00000005 | | | | | | | |

Oznake za entitete so: 410 - pogled, 116 - točka, 212 - text, 100 - lok, 216 - kota
 110 - daljica



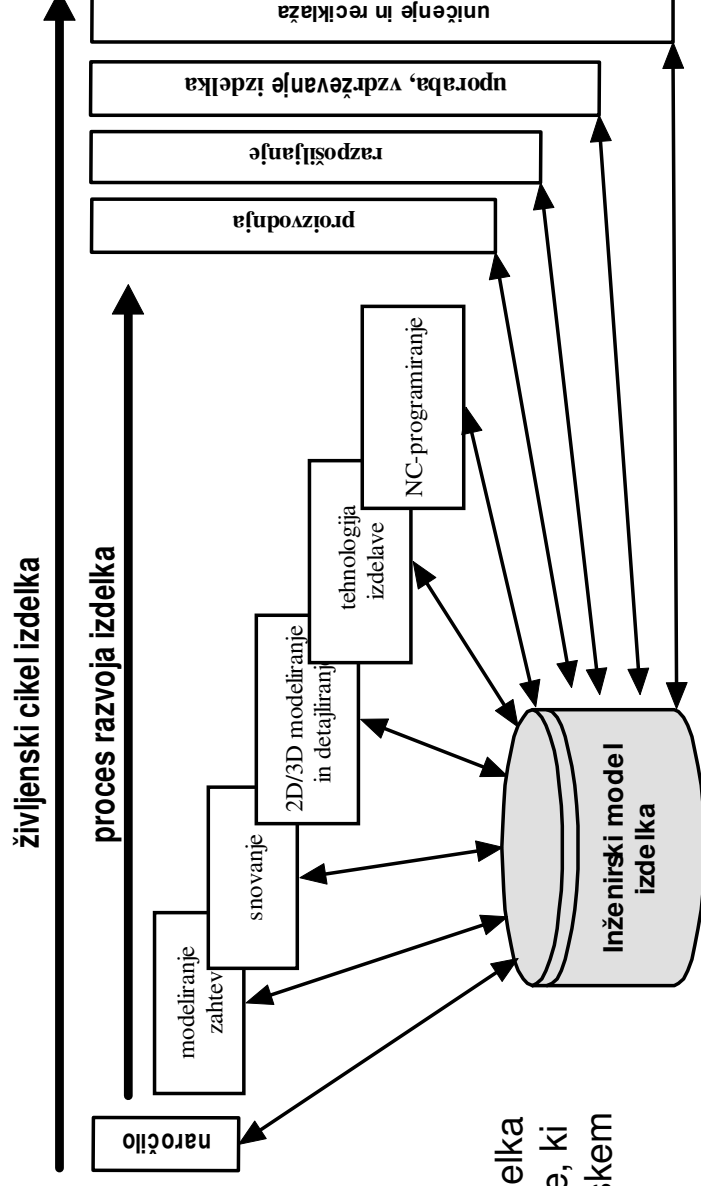
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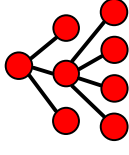
STEP - Standard za izmenjavo podatkov o izdelkih

Kakšen nevtralen format potrebujemo?

- opis vseh podatkov o izdelkih skozi celotni življenjski cikel
- neodvisen od strojne in programske opreme
- poleg zanesljive izmenjave datotek potrebujemo deljen dostop do skupne podatkovne baze
- naj ima možnost dograjevanja
- stabilen skozi daljše časovno obdobje



Inženirski model izdelka vsebuje vse podatke, ki nastajajo v življenjskem ciklu izdelka



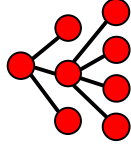
Na postavljene zahteve odgovarja STEP standard

ISO 10303 ali STEP je mednarodni standard namenjen računalniku in človeku razumljivi predstavitvi podatkov o izdelkih skozi celotni življenjski cikel.

Standard predpisuje nevtralen format za prenos datotek.

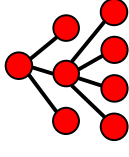
STEP je modularno in večnivojsko grajen, kar omogoča obvladovanje kompleksnih sistemov.

Enoten opis podatkov o izdelkih skozi razvojne faze odpira vrata integraciji med podjetji.



Pregled razvoj vmesnikov za izmenjavo podatkov:

| | |
|------|---|
| 1980 | IGES 1.0 (NIST) |
| 1983 | VDA-FS (VDA) - nemška avtom. Industrija |
| 1984 | SET (AEROS) - evropska letalska industrija |
| 1988 | IGES 5.x (NIST) |
| 1990 | STEP (ISO) ISO 10303, ISO 13584 VSE SILE SO USMERJENE V RAZVOJ STEP STANDARDA |



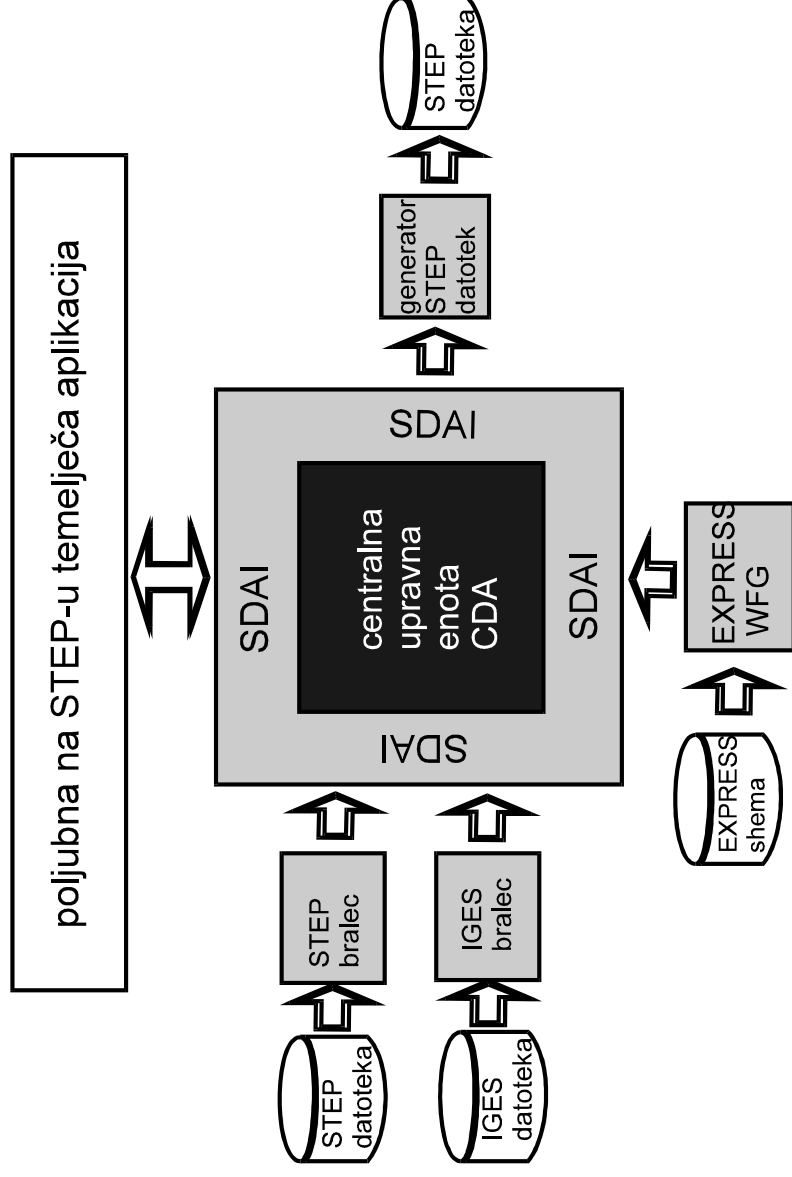
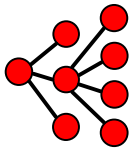
| | |
|---------------|-------------|
| opisne metode | |
| | EXPRESS #11 |

| | | | |
|---|---|---------------|-----|
| protokoli za uporabo (Application Protocols - AP) | | | |
| AP 201 | AP 202 | AP 212 | ... |
| AP 203 | AP 204 | AP 214 | |
| informacijski model splošnih podatkov (Integrated Resources) | | | |
| splošni protokoli za uporabo (Application Resources) | | | |
| tehnično risanje #101 | struktura ladij #102 | | |
| končni elementi #104 | kinematika #105 | | |
| osnovni informacijski modeli (Generic resources) | | | |
| osnove opisa izdelkov #41 | predstavitev geometrije in topologije #42 | | |
| predstavitev struktur #43 | struktura izdelka #44 | | |
| materiali #45 | vizuelna predstavitev #46 | tolerance #47 | |

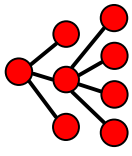
| | | | |
|---|-----------------------------|-------------------------|------|
| izmenjava fizičnih datotek #21 | programski vmesnik SDAI #22 | izvedba podatkovne baze | |
| metode za izvedbo (Implementation Methods) | | | |

metodologija testiranja #31, #32, #33, #34

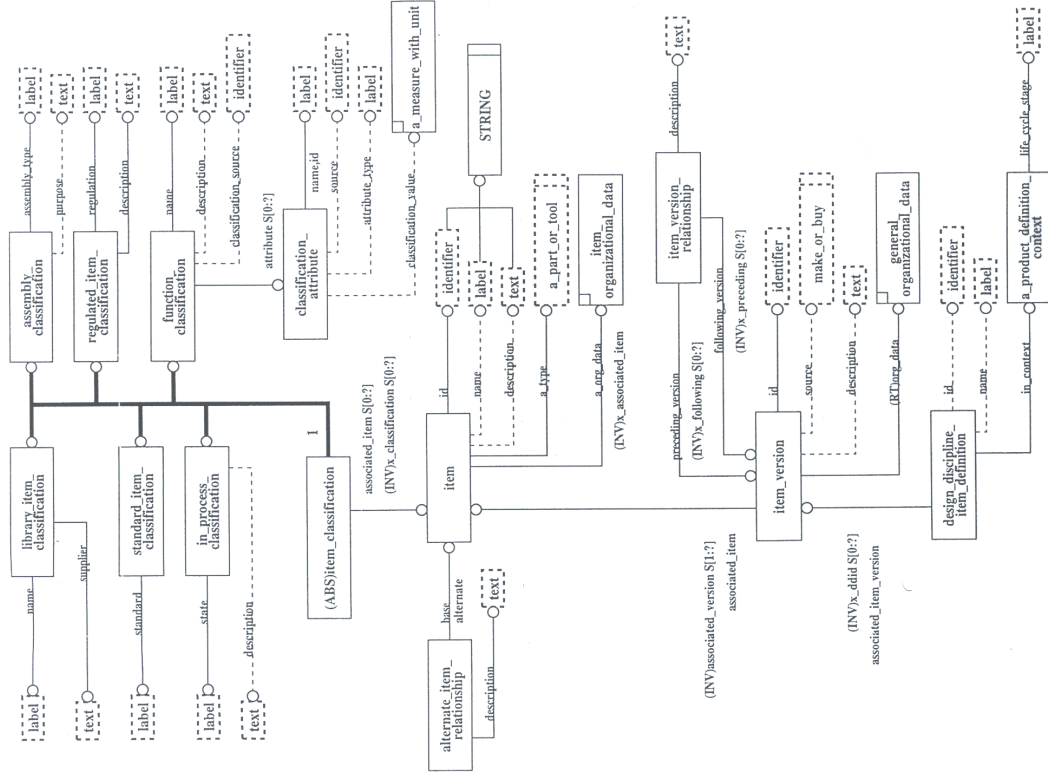
Struktura STEP standarda.

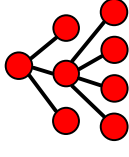


Razvojno okolje SDAI aplikacij.



Podatkovni model opisa izdelka po protokolu za uporabo AP 214.





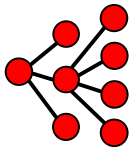
```

ISO-10303-21:
HEADER:
FILE_DESCRIPTION('Header Instances written by STEP File Formatter', '2;1');
FILE_NAME('PDMn01.stp', '15.07.1999, 10:32:10', '(N.N.),(
'ProSTEP GmbH)', 'PStep_Caselib version xyz', 'ProSTEP PDM Editor', '');
FILE_SCHEMA(('PDM_SCHEMA'));
ENDSEC;
/* ISO 10303-21 file written by STEP Caselib, ProSTEP GmbH, Germany */

DATA:
#10 = PRODUCT_DEFINITION_FORMATION('02', 'lever modified', #20);
#20 = PRODUCT('K01-42051', 'Bicycle Bell RX25B', '#300);
#30 = PRODUCT_CONTEXT('#40, ');
#40 = APPLICATION_CONTEXT('');
#50 = PRODUCT_RELATED_PRODUCT_CATEGORY('part', '#20, #60, #70));
#60 = PRODUCT('H24-1123.1', 'Fixture RX25B', '#30);
#70 = APPLICATION_PROTOCOL_DEFINITION('version 1.1', 'pdm_schema', 1999, #40);
#80 = PRODUCT_CATEGORY_RELATIONSHIP('#, #100, #110);
#100 = PRODUCT_RELATED_PRODUCT_CATEGORY('Part', '#20));
#110 = PRODUCT_RELATED_PRODUCT_CATEGORY('Assembly', $, (#20));
#120 = PRODUCT_DEFINITION_FORMATION('03', 'upper housing modified', #20);
#130 = PRODUCT_DEFINITION_FORMATION_RELATIONSHIP('sequence', '#10,
#120);
#140 = PRODUCT_CATEGORY_RELATIONSHIP('#, #150, #160);
#150 = PRODUCT_RELATED_PRODUCT_CATEGORY('Part', '#60);
#160 = PRODUCT_RELATED_PRODUCT_CATEGORY('Detail', $, (#60));
#170 = PRODUCT_DEFINITION_FORMATION('B', '#60);
#180 = PRODUCT_DEFINITION_FORMATION('DIN932.15', '#70);
#190 = PRODUCT_DEFINITION('view003', '#120, #200);
#200 = PRODUCT_DEFINITION_CONTEXT('part definition', #40, '');
#210 = PRODUCT_DEFINITION_CONTEXT_ASSOCIATION(#190, #220, #230);
#220 = PRODUCT_DEFINITION_CONTEXT('#240, 'design');
#230 = PRODUCT_DEFINITION_CONTEXT_ROLE('#, $);
#240 = APPLICATION_CONTEXT('mechanical design');
#400 = PRODUCT_DEFINITION_FORMATION('D', '#410);
#410 = PRODUCT('D40-22043', 'BellModel', '#30);
#420 = PRODUCT_RELATED_PRODUCT_CATEGORY('document', '#410));
#430 = PRODUCT_DEFINITION_CONTEXT('digital document definition', #40, '');
#440 = DOCUMENT_FILE('step-011', '#450, ', ');
#450 = DOCUMENT_TYPE('');
#460 = DOCUMENT_REPRESENTATION_TYPE('digital', #440);
#470 =
PRODUCT_DEFINITION_WITH_ASSOCIATED_DOCUMENTS('T01', 'DMU', #00, #430, #440);
#480 = PROPERTY_DEFINITION('document property', '#440);
#490 = PROPERTY_DEFINITION_REPRESENTATION(#480, #500);
#500 = REPRESENTATION('document creation', (#510, #520, #530), #540);
#510 = DESCRIPTIVE_REPRESENTATION_ITEM('creating system', 'CATIA V419');
#520 = DESCRIPTIVE_REPRESENTATION_ITEM('operating system', 'AIX 4.x');
#530 = DESCRIPTIVE_REPRESENTATION_ITEM('creating interface', 'COMSTEP');

```

Primer STEP datoteke.



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Fakulteta za strojništvo**

STEP - Standard za izmenjavo podatkov o izdelkih

Results of the 6th ProSTEP Benchmark

Example solid model

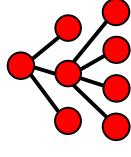
| from STEP-processor | to STEP-processor | AutoCAD Mechanical Desktop Autodesk | CADSS Theorem Solutions | CATIA Desktop Systems | CATIA ddbin Systemhours | I-DEAS SOI/C | MicroStation/J Bentley Systems | Pro/ENGINEER PTC | SolidDesigner CoCreate | Unigraphics Unigraphics Solutions | Inventor Autodesk | AutoCAD Mechanical Desktop Autodesk | CADSS Theorem Solutions | CATIA Desktop Systems | CATIA ddbin Systemhours | I-DEAS SOI/C | MicroStation/J Bentley Systems | Pro/ENGINEER PTC | SolidDesigner CoCreate | Unigraphics Unigraphics Solutions | Autoshdio Alias Wovohol | Inventor Autodesk | |
|---------------------|-------------------|-------------------------------------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------------|-----------------------|------------------------|-----------------------------------|-----------------------|-------------------------------------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------------|-----------------------|------------------------|-----------------------------------|-------------------------|-----------------------|-------|
| from STEP-processor | to STEP-processor | AutoCAD Mechanical Desktop Autodesk | CADSS Theorem Solutions | CATIA Desktop Systems | CATIA ddbin Systemhours | I-DEAS SOI/C | MicroStation/J Bentley Systems | Pro/ENGINEER PTC | SolidDesigner CoCreate | Unigraphics Unigraphics Solutions | Inventor Autodesk | AutoCAD Mechanical Desktop Autodesk | CADSS Theorem Solutions | CATIA Desktop Systems | CATIA ddbin Systemhours | I-DEAS SOI/C | MicroStation/J Bentley Systems | Pro/ENGINEER PTC | SolidDesigner CoCreate | Unigraphics Unigraphics Solutions | Autoshdio Alias Wovohol | Inventor Autodesk | |
| | | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | volume deviation < 1% | |
| | | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | volume deviation > 1% | |
| | | faces | faces | faces | faces | faces | faces | faces | faces | faces | faces | faces | faces | faces | faces | faces | faces | faces | faces | faces | faces | faces | faces |
| | | loss | loss | loss | loss | loss | loss | loss | loss | loss | loss | loss | loss | loss | loss | loss | loss | loss | loss | loss | loss | loss | loss |

Solid → solid
 Solid → no solid
 volume deviation < 1%
 volume deviation > 1%
 faces
 loss

CAX - IF



- CAX Implementor Forum was founded in spring 1999 as Joint Activities succeeding ProSTEP-“RoundTables” and PDES, Inc “StepNet” .
- Goal is the establishment of STEP solutions for the successful Data Exchange
- CAX-if focusses on prototype and beta testing of STEP Processors
- Testing takes place at vendor sites. ProSTEP collects and maintains the results in order to achieve communication among members.



Members

This vendors and systems are active members of the CAX-IF

- Alias|Wavefront (AutoStudio)
- Autodesk (Mechanical Desktop, Inventor)
- Alibre, Inc. (Alibre Design)
- Bentley (Microstation)
- CoCreate (SolidDesigner)
- Dassault Systèmes (CATIA)
- Debis Systemhaus (CATIA)
- ISD (HiCAD)
- ITI/SDRC (I-Deas)
- Matra Datavision (Euclid)
- PTC (Pro/Engineer)
- Spatial/3DShare (Stephusk)
- Steptools, Inc. (ACIS)
- Theorem Solutions (CADD5, UG)
- Unigraphics Solutions (UG)