Transferring 2-D Drawings Files Between Different CAD Software

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ABSTRACT - *Transferring an electronic drawing from one CAD software package to another can be unpredictable. This paper will discuss several methods of transferring 2-D CAD files from one CAD software to another. The most common type of 2-D transfer uses Cut and Paste. For example cutting and pasting one AutoCAD drawing into another AutoCAD drawing or pasting an AutoCAD drawing into Microsoft Word or PowerPoint. Using cut and paste however can be less that desirable. Instead of cutting and pasting, there is a third party software designed to transfer AutoCAD drawings into Microsoft products while allowing control over scale, line weight, line type, and color. A 2-D detailed drawing generated from a 3-D parametric model can be transferred into 2-D drawing software such as AutoCAD. This transfer from a 3-D model, to a drafting sheet, then into 2-D software is useful when a drawing is very difficult to draw in 2-D software and it is much easier and more accurate to model the object in a 3-D parametric modeler then produce the orthographic views in the draft environment. When you have a lot of 2-D legacy data, it is very efficient to take a 2-D drawing and transfer it into the sketching format of a 3-D parametric modeling software. The sketch can then be utilized in functions such as extruding or revolving. The final type of file transfer to be discussed is taking a 2-D draft file from one parametric modeling software package to the draft environment of another 3-D parametric modeling software.*

I. Introduction

When using CAD software there is often the need to transfer drawings between the different manufacturers of software. This file transfer could be: 2-D to 2-D, 2-D to 3-D, or 3-D to 3-D. This paper is limited to 2-D file transfers using the following software: AutoCAD, Autodesk's Inventor, Siemens' Solid Edge, and Furix's BetterWMF.

II. CAD System Kernels and Translators

The central core of any 3-D CAD system is its kernel or as is sometime referred to as the "CAD engine". Table 1 lists four kernels accompanied by a short description.

Table 1: Five common kernels

ACIS:
- Named for Alan, Charles, and Ian's system (Alan Grayer, Charles Land and Ian Braid)
- 3D geometric modeling kernel
- Owned Dassault Systems
- Two types of files: 1) Standard ACIS Text (*.sat), and 2) Standard ACIS Binary (*.sab)
- File extension: *.sat and sab.*

Parasolid:
- 3D geometric modeling kernel
- Owned by: Siemens (formally UGS)
- File extension: *.X_T or *.X_B

Catia Proprietary:
- 3D geometric modeling kernel
- Stands for: **C**omputer **A**ided **T**hree **D**imensional **I**nteractive **A**pplications
- Owned by Dassault Systems
- File extensions: *.CATPart or *.CATProduct

Pro Engineer's Granite One:
- 3D geometric modeling kernel
- Developed by Dr. Samuel P. Geiberg in the mid 1980's
- Owned by Parametric Technology Corporation (PTC)
- Used in Pro Engineer and Pro Mechanical
- 2002 introduced the CAD software Wildfire with a dramatically changed interface
- File extensions: *.prt and *.asm

To communicate between CAD programs that use these different kernels, neutral file formats must be used. Two common neutral file formats are IGES and STEP. Table 2 provides a brief description of these neutral file formats.

Table 2: Two Neutral File Formats

IGES:

- **I**nternational **G**raphics **E**xchange **S**pecification
- Official title: Digital Representation for Communication of Product Definition Data
- Started in 1979 by corporations with help from the National Bureau of Standards (now NIST) and the US Department of Defense (DOD)
- File extension *.igs or *.ige or *.iges

STEP:

- **S**tandard for **E**xchange of **P**roduct **D**ata
- Official title: Industrial Automotive Systems and Integration – Product data representation and exchange
- ISO 10303 standard
- Developed by ISO Technical committee TC 184, Technical industrial automation systems, subcommittee SC4 Industrial data
- File extension: *.stp or *.step

The three to ten letter file extensions (most commonly three to four) following the file name and period and identifies what software the graphic or model was developed in e.g. AutoCAD uses *. dwg while Solid Edge uses *.par. Some proprietary software uses the same extensions e.g. Solid Edge and CADKEY both use the file extension *. par.

Table 3 summarizes the different file extensions, type of kernel or standard, and short description.

Table 3: Standard File Extensions

File Extension	Modeling Kernel or Neutral Format or Standard	Description
Kernels		
X_T, XMT_TXT	Parasolid kernel	Parasolid solid geom. kernel - text file Owned by Siemens-NX (formally Unigraphics)
X_B, XMT_BIN	Parasolid kernel	Parasolid solid geom. kernel - binary file Owned by Siemens-NX (formally Unigraphics)
SAT	ACIS kernel	ACIS solid geometry kernel Owned by Dassault Systems
CATPart or CATProduct MOD (part)	Catia proprietary kernel	solid geometry kernel Owned by Dassault Systems Catia = Computer Aided Three Dimensional Interactive Application
PRT	Granite One proprietary kernel	solid geometry kernel Owned by (PTC) Parametric Technology Corporation Used in ProEngineer or ProMechanical
Neutral		
IGS, IGE, IGES	Standard	Initial Graphics Exchange Specification
STEP, STP	Standard	ISO 10303 Standard for the Exchange of Product Model Data
VDA	Standard	German automobile industry
WRL	Standard	Virtual Reality Modeling Language
STL	Standard	Stereo lithography file
DXF	AutoCAD	Drawing Exchange Format developed by Autodesk has become the de facto 2-D standard

Native Formats (CAD)		
DWG	AutoCAD	Owned by Autodesk 2D drawing file
PAR	Cadkey	Cadkey part file ASIC kernel
CATPart or CATProduct	Catia	Dassault Systems Catia proprietary kernel
IPT (part), IAM (assembly), IDW(draft)	Inventor (Autodesk)	Owned by Autodesk ASIC kernel
ICS (ICD 2D)	IronCAD	ACIS and Parasolid kernel
PRT or XPR (part), ASM or XAS (assembly), DRW (draft) w/ additional #	Pro/Engineer	Pro/Engineer (Wildfire) part model file (PTC) Parametric Technology Corporation PTC's Granite One proprietary kernel
PAR (part), DFT (draft), ASM (assembly)	SolidEdge	Owned by Siemens Parasolid kernel
SLDPRT or EPRT (part), SLDDRW EDRW (draft), SLDASM or EASM (assembly)	SolidWorks	Owned by Dassault Parasolid kernel Owned by Siemens
PRT	NX (formerly Unigraphics)	Parasolid kernel Siemens (NX) based

III. AutoCAD to BetterWMF to Microsoft Word or PowerPoint

For many years members of EDGD have asked Autodesk to provide a way to transfer AutoCAD drawings into Microsoft Word or Microsoft PowerPoint while keeping both designated line weights and scale. To the author's knowledge, this has not happened. Figure 1 illustrates an image copied directly from AutoCAD into Microsoft Word using *Copy, Paste*.. Note the single extremely thin lines.

Top   Isometric View

Front   Right
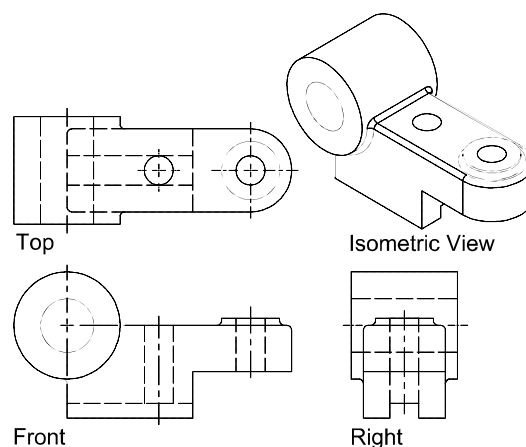
Figure 1: AutoCAD drawing copy and pasted directly from AutoCAD to Microsoft Word

Many instructors need to transfer AutoCAD drawings into training materials for class, PowerPoint lectures, research papers / presentations, or textbooks. A third party software designed specifically for transferring drawings from AutoCAD into Microsoft products is Furix's BetterWMF. It allows you to specify line weight by assigning colors to different line thicknesses. Another nice feature is the ability to specify the size of the picture prior to transferring it. For example, for a document with two columns BetterWMF can be set up so that whenever graphic is captured it is exactly the width of a single column.

BetterWMF improves the output from AutoCAD to Microsoft products by:

❑ Cropping the size of the drawing to the extent of the selected entities

❑ Removing the (black) background and making the drawing transparent

❑ Assigning nonzero line widths to all lines or individual widths based on color

❑ Presetting the exact size of the drawing as it will appear in MS-Word or Power Point

❑ Merge paper space and all viewports into one drawing

❑ Size the drawing relative to the scale of the drawing

❑ Reassign the 256 Auto CAD colors to grayscales or any of the Windows True Colors

Figure 2 illustrates the BetterWMF Options dialog box which allows you to set line width, size of the exported drawing, and more.
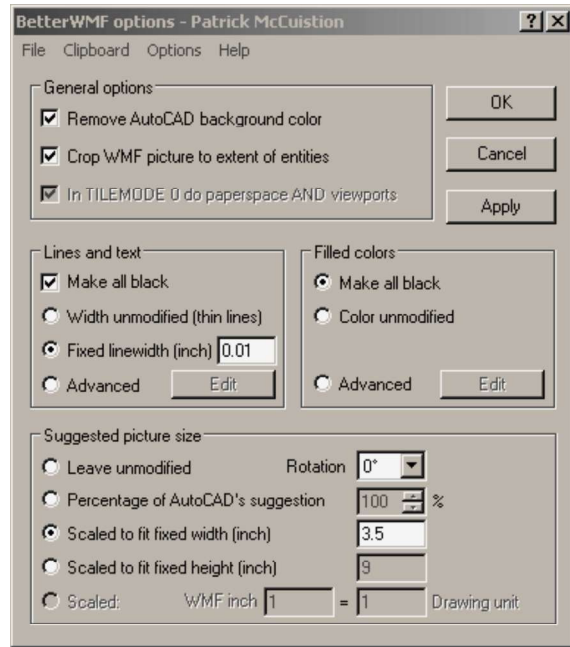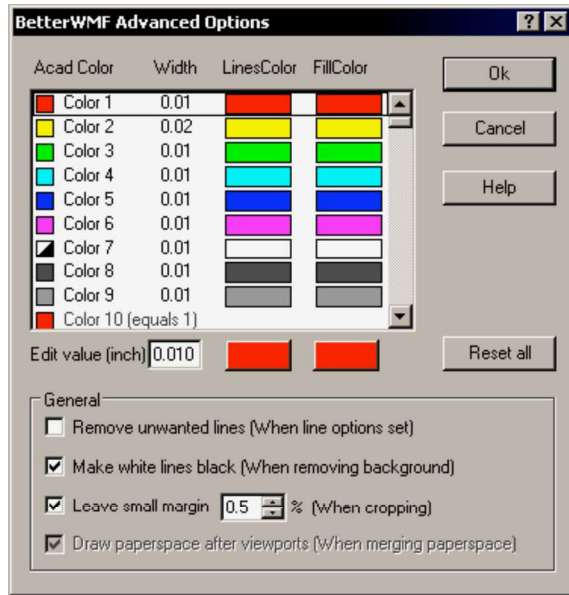

Figure 2: BetterWMF's options dialog box

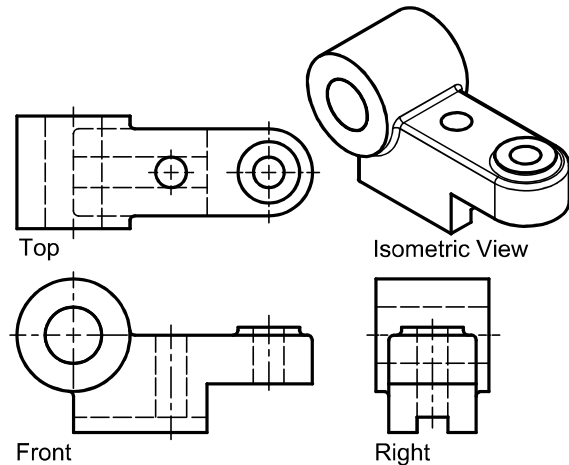The process for using BetterWMF is quite simple:
Setup of BetterWMF:

1) Load BetterWMF (it works in the background).

2) Check the box which makes all lines and fills black (or leave lines in color).

3) Set the size of the exported drawing as illustrated near the bottom of Figure 2.

4) Select **Advanced** and set line width by color as illustrated in Figure 3.

Figure 3: The BetterWMF's Advanced Options dialog box allows you to set desired line weights by color.

Figure 4: An AutoCAD image copied and pasted into Microsoft Word using BetterWMF

Transferring drawing:

1) Load an AutoCAD drawing.

2) Select **Copy** in AutoCAD.

3) Select the drawing elements desired.

4) Paste them into a MS Word or PowerPoint. Figure 4 is an illustration of an image copied from AutoCAD into Microsoft Word using BetterWMF. Note the line weights.

5) When in MS Word or PowerPoint the figure can be exploded if subtle changes are required but exploding the graphic can sometimes negatively affect the quality of the graphic.

IV. 2-D Inventor Draft to 2-D AutoCAD

Transferring a 2-D working drawing or isometric view from the Inventor's draft environment into Auto CAD can be very useful when one needs a complex drawing in a Microsoft document. If the drawing is complex, it is much easier to build a 3-D parametric model, lay out the necessary views in the draft environment, as illustrated in Figure 5, transfer the views into AutoCAD, and then transfer them into a Microsoft document using BetterWMF.

While in Inventor:

1) Select *Files, Open* and select a drafting file (*.idw).

2) Select *Save Copy As.* In the *Save Copy As* dialogue box use *Save Type As* and select AutoCAD Drawing (*.dwg).

3) Select the *Options Button* and select the settings below.

   a. *Model Geometry Only* – removes notes, dimensions, and title block.

   b. *Closest AutoCAD Mapping* (as apposed to best visual fidelity).

   c. Select the *Finish* button, and *Save.*

While in AutoCAD:

1) Select *Files, Open* to open the saved AutoCAD drawing.

2) Open the **Layers Properties Manager** and specify line color as lines come in all one color. Assigning color to lines is necessary because BetterWMF assigns weight by color.

3) Specify line scale using *Format, Line Type, Global Line Scale* or change individually lines using *Properties* if necessary.
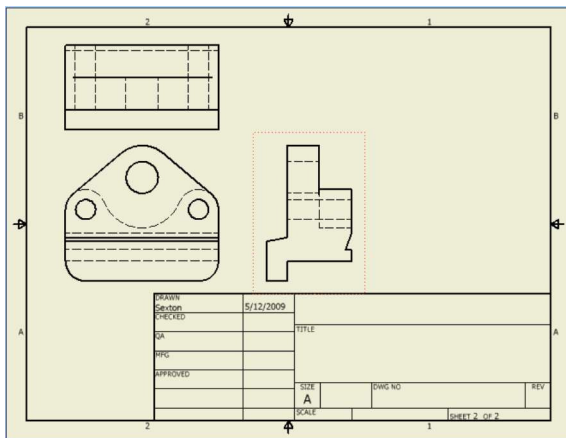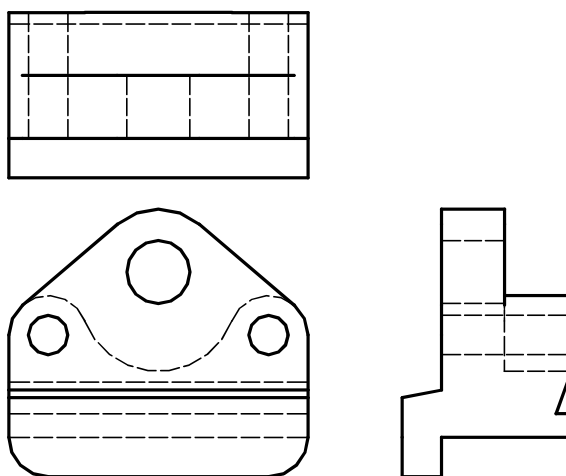

Figure 5: Drafting sheet in Inventor

Figure 6: Three views exported from Inventor Draft as a *.dwg file into AutoCAD.

V. 2-D AutoCAD into a 2-D Inventor Sketch

If you have legacy 2-D AutoCAD drawings that need to be converted to 3-D models, it is possible to insert a 2-D AutoCAD file into Inventor's sketch environment as illustrated in Figure 7. The sketch can be edited then a procedure such as extrusion or revolve can be executed. Figure 8, illustrates the imported sketch after extrusion. The 2-D AutoCAD to 2-D Inventor sketch translation problem can be completed in a couple of ways.
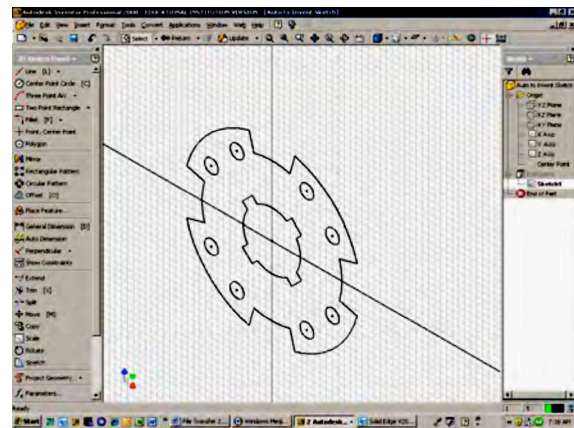

Figure 7: A 2-D AutoCAD file brought into Inventor's sketch mode by opening the file as a *.dwg

Procedure One:

While in AutoCAD:

1) Select *Files, Open* to open an AutoCAD drawing and edit it as desired.

2) Select *Edit, Copy* and copy the desired portion of the drawing.

While in Inventor:

3) Select *Edit, Paste* and paste the copied file into Inventor's sketch plane environment.

4) Position the locating rectangle on the sketch plane

- In a similar manner, a drawing can be copied using a base point which is designated in AutoCAD.

Procedure Two:

While in Inventor:

1) Select **Files, Open.**

2) In the Open dialog box under **Files of type** select *.dwg.

3) Select an AutoCAD ***.dwg** file and click on the **Open** button.

4) The drawing comes into a special environment with a black background

5) Select the desired portion of the drawing and select **Copy.**

6) Select **Edit, Paste** and paste the copied portion of the drawing into an Inventor's sketch plane.

Procedure Three:

1) When in Inventor's Sketch environment, there is a function called "**Insert AutoCAD File**". But it always crashed the software when the author tried it.
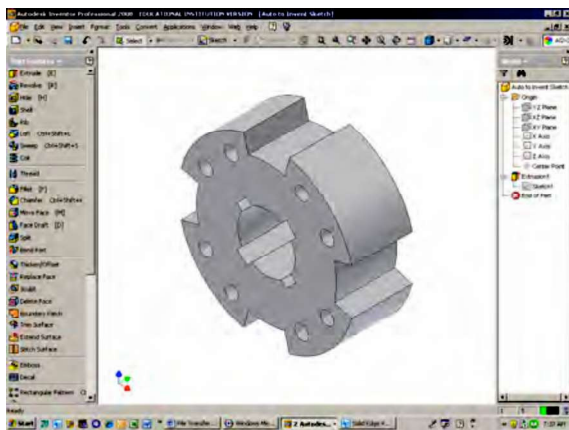

Figure 8: Solid model extruded from an AutoCAD 2-D drawing brought into an Inventor's sketch plane

VI. 2-D AutoCAD into 2-D Inventor Draft

A 2-D AutoCAD file can also be brought into the Inventor draft environment, as illustrated in Figure 9. It results in an embedded object which takes you back to AutoCAD for editing when double clicked.

1) Open a new Inventor draft sheet (*.idw).

2) Select **Insert, Object.**

3) an Insert Object dialogue box appears.

4) Select the **Create from File** radio dial.

5) Select an AutoCAD.dwg file.

6) Select the **OK** button.

7) Position the drawing and then select **OK.**

8) The drawing comes in as an embedded drawing which is not editable in Inventor. One must go back to AutoCAD to make any edits.
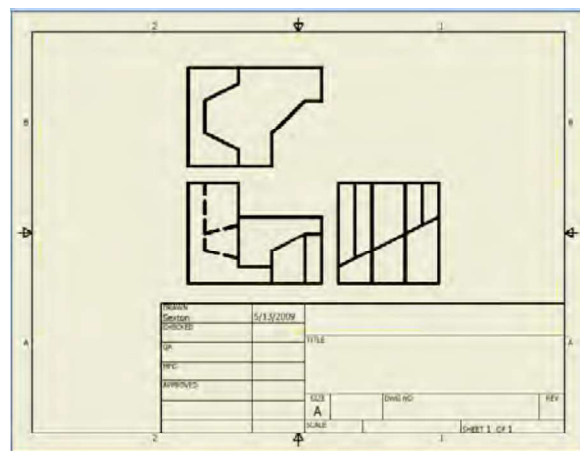
Figure 9: An AutoCAD drawing brought directly into Inventor. The drawing is an embedded figure.

VII. Importing an AutoCAD *.dwg File Directly into Inventor

While in Inventor:

1) Select **Files, Open** select an existing 2-D AutoCAD *.dwg file.

2) Select the desired portion of the drafting graphic.

3) The drawing is placed into a black background environment.

4) Use *Copy and Paste* to place the drawing into an Inventor sketch.

5) IT will not paste into a drafting sheet.

VIII. 2D Inventor Draft to a 2-D Solid Edge Sketch Plane

While in Inventor:

1) *Open* an Inventor drafting sheet (*.idw).

2) *Copy* the desired portion of the AutoCAD drawing

While in Solid Edge:

3) Select *Files, Open*

4) The *New* dialogue box appears. Select *More* and Normet.dft then *OK.*

5) *Paste* the copied drawing onto the Inventor sketch plane. An operation such as extrude or revolve can be performed.

IX. 2-D Solid Edge Draft to Inventor Sketch Plane

While in Solid Edge:

1) *Open* a 2-D Solid Edge drafting file (*.dft).

2) *Save As* an AutoCAD file (*.dwg).

While in Inventor:

3) *Open* the saved *.dwg file. It comes into a black background environment.

4) *Copy,* and *Paste* the drawing into Inventor's sketch plane.

X. 2-D Solid Edge Draft to 2-D Inventor Draft

While in Solid Edge:

1) *Open* a 2-D Solid Edge draft (*.dft) drawing.

2) *Edit,* and *Copy* the selected portion of the drafting document.

While in Inventor:

1) *File, New* set up a new Inventor Drafting file (*.idw).

2) Select *Paste Special.*

3) The **Paste Special** dialogue box appears with options.

4) Select the Solid Edge draft document.

5) Select *OK.*

The drawing comes in as an embedded drawing which is not editable in Inventor but one must go back to Solid Edge to make any edits.

XI. Conclusion

Teaching file translations makes students aware of the problems when translating between particular CAD software whether it is 2-D or 3-D. Many major manufacturers require drawings in electronic format. In addition, they may want the drawings in particular software. When a company changes their software a major problem is encountered. An old but still pertinent example of this is when Caterpillar Tractor changed from Iron CAD to Pro Engineer in 1987. There was a significant cost to setting up the server, managing the new software, and training. So if any drawings can be recovered by translation it, it would be a definite cost savings. Otherwise the models and drawings would need to be developed from scratch.

XII. Acknowledgments

For further information on 2-D file transfers and file extensions consult the following:

en.wikipedia.org   good source of definitions and history of file extensions

file-extension.org   lists extensions for an extensive list of software. In the 3-D graphics – CAD-CAM category 361 extensions are listed

okino.com	provides a table listing CAD software and cross references them to general translators in order of the preferred translator for the given software.

Web Sites for Software Used:

Autodesk.com	parent company of AutoCAD and Autodesk's Inventor
Furbix.com	home site for BetterWMF
Solidedge.com	Siemens PLM Solid Edge software