



# *Accelerating the Integration of CAD Equipment Models into Plant Designs*

*An ITI Technical Brief*  
by James Flerlage & Andy Chinn

## **Abstract**

By automating the model simplification process, companies can accelerate the integration of mechanical equipment models and assemblies into plant design systems.

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# Introduction

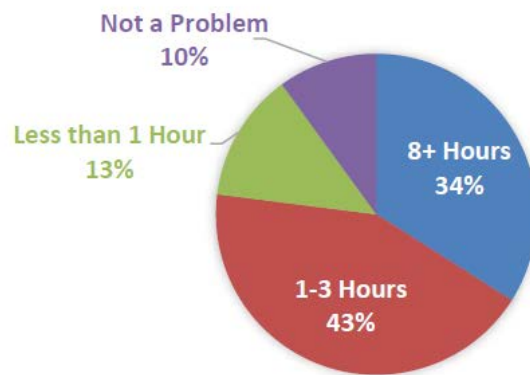
**“There is wide recognition in the industry that step-change improvement in efficiency and productivity is possible by advancing interoperable practices and tools.”**

- Advancing Interoperability for the Capital Projects Industry: A Vision Paper  
Fiatech, August 2012

Our clients have clearly identified equipment model/assembly integration into plant/factory/BIM design applications as a major interoperability obstacle to accelerating project schedules.

For the past three years, ITI has polled over two-hundred (200) EPCs, Owner-Operators and OEMs to determine the average amount of time designers and engineers spend simplifying an average equipment assembly for integration into plant design layouts. The numbers are staggering, with 43% respondents claiming 1-3 hours and another 34% stating “more than a day.” A proportionate number of those polled have also indicated that as much as 85% of a plant design model is made up of equipment assemblies.

## TIME SPENT SIMPLIFYING MCAD EQUIPMENT MODELS



ITI's contribution to the capital projects industry's need for “step-change improvement in efficiency and productivity” is to help design/layout stakeholders reduce the time it takes to integrate mechanical CAD (MCAD) assemblies into plant designs.

ITI's approach is to automate the manual process of MCAD simplification using a vendor-neutral software solution that supports a myriad of native and neutral mechanical CAD formats for a variety of import/export paths. As industry leaders we also provide an ROI calculator that can be adapted by executives to formulate business cases for our solutions.

The following paper will define the problem, technical challenges, approach and solution, as well as insight and tools for measuring return-on-investment.

# Situation Summary

Manufacturers of industrial machinery and equipment supply 3D CAD models of their products to Engineering, Procurement and Construction (EPC) companies and/or Owner-Operators for integration within the plant design. These models may include the full mechanical CAD (MCAD) details required for manufacture, and the resulting assemblies can be several hundred Megabytes (MB) or Gigabytes (GB) in size when exported to neutral formats such as STEP, Parasolid, SAT or DWG for delivery.

Plant and mechanical design engineers need to integrate the MCAD models to perform operations such as clash detection and pipe network routing. Plant design systems often struggle with importing large, detailed MCAD models, which leads to excessive load times, import failures, crashes and compromised system response. In business terms, these scenarios force EPCs and Owners to look for manual work-arounds that result in potential project delays and additional labor costs.

Companies operating in the plant and process, offshore and shipbuilding industries, across multiple verticals (oil & gas, power generation, chemical, pharmaceuticals, food & beverage) have engaged ITI to help resolve mission critical issues associated with the integration of MCAD models into plant designs. This paper summarizes how design/engineering teams can accelerate this process and save both time and costs by automating the MCAD geometry simplification.

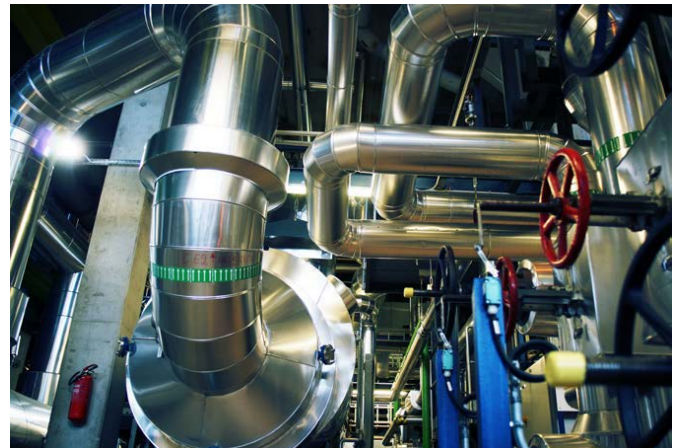
## Industry Experience

Power Generation  
Marine and Offshore  
Oil and Gas  
Chemical  
Mining  
Pharmaceutical  
Food and Beverage

## Three Technical Challenges

A complete plant model is comprised of superstructure, buildings, pipework, generators, filtration systems, fire safety systems, coolant and lubrication systems, heating, ventilation and air conditioning systems, and a variety of specialist equipment. Details in fully featured mechanical CAD models like nuts, bolts, and screw threads add unnecessary complexity when viewed in the context of a complete plant layout, offshore installation or marine structure.

Design systems used in the plant and process sector tend to define the components using primitive simplified definitions to cope with the data volume. Struts, beams, pipes, elbows, connectors, vessels etc., are often basic solid shape definitions with associated metadata to describe properties such as pipe inner and outer diameters, material, and other necessary engineering standards and plant-specific data.



### Challenge #1

Large plant layout models containing a significant number of machines and equipment installations are often so massive that they simply cannot be modeled with the level of detail that we see in traditional MCAD manufacturing models due to the sheer volume of data.

### Challenge #2

Even if the MCAD assemblies import OK, the level of detail in the equipment model result is a mass of unintelligible lines in a small area of the overall plant model (designers often refer to these as “squashed bug” images).

### Challenge #3

Service and construction engineers in the field often need to view plant design data on portable devices and they cannot accept hundreds of MBs of equipment models being downloaded over slow and expensive cellular connections.



# One Automation Solution

To accelerate the integration of MCAD models into plant design applications, it is important to recognize that orders of magnitude in file size reduction are required to render the MCAD equipment models usable in the plant design system while still maintaining the required information for plant integration.

For over two decades, ITI's CADfix™ geometry transformation technology has helped CAD, CAM, and CAE teams transform multi-format 3D CAD models into usable geometry for diverse downstream applications, formats, and processes.

In response to growing demands from the industry sector, ITI created the CADfix™ PPS (Plant and Process Simplification) solution to help EPCs, Owners, and OEMs integrate MCAD models into plant and factory designs. The objective of the software was to achieve as much model simplification and data reduction as possible, while retaining the outer envelope of the MCAD model for clash detection and pipe routing, with the important features, key locating points and interfaces to the rest of the plant.

## **CADfix PPS offers a user-friendly Wizard interface.** CADfix PPS

Today, CADfix PPS features a new, advanced automatic simplification Wizard supported by dedicated manual simplification tools, targeted at data reduction. CADfix PPS allows the plant designer to quickly and easily:

- > Remove unwanted small parts such as nuts, bolts, washers and other small components
- > Remove detailed CAD features such as holes, protrusions, fillets, logos, lettering and ribs
- > Remove invisible internal parts from complex assemblies
- > Simplify complex parts to basic shapes such as cylinders and bounding boxes

### **Simplified MCAD files exported from CADfix PPS can be read into plant design systems from vendors including:**

- Autodesk
- AVEVA
- Bentley Systems
- Bricsys
- CADISON
- ESAin
- Hexagon PPM (Intergraph)
- ITandFactory



The CADfix PPS automatic simplification Wizard takes fully featured MCAD models and automatically removes details and simplifies parts to basic geometric forms.

#### **CADfix PPS Import Formats**

- CADD5 5i
- CATIA
- Creo
- DXF / DWG
- Inventor
- JT Open
- NX
- Parasolid
- SAT
- SOLIDWORKS
- STEP

#### **CADfix PPS Export Formats**

- DXF / DWG
- JT Open
- Parasolid
- SAT
- STEP

CADfix PPS removes the barriers that prevent the reuse of solid models. It is packaged as a desktop or server solution, with extensible modular functionality dependent upon the end user's source and target systems. It may be integrated into workflow automation tools.

# Proven Results

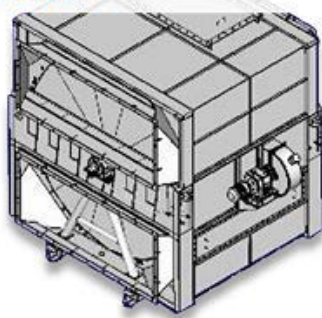
By applying the CADfix PPS technology for MCAD model simplification, orders of magnitude in file size reduction can be achieved ahead of integration of the equipment models into 3D plant and process design systems. This saves days of non-productive geometry handling and increases design efficiency.

The removal or simplification of geometry and small parts across hundreds or thousands of plant equipment installations will facilitate the removal of megabytes-to-gigabytes of data across the plant model. MCAD equipment model integration times can be measured in hours rather than days or weeks.

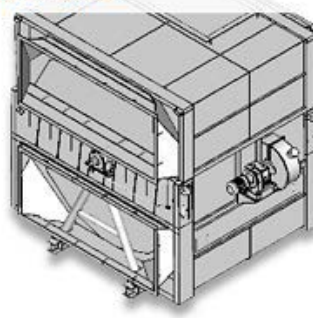
CADfix PPS achieves these results by automatically removing unwanted detail that is effectively hidden within a container or building and invisible to the rest of the plant. The image below demonstrates possible data reduction for complex MCAD equipment models, where an original 40MB DWG MCAD model with 73K CAD faces is reduced to a 1MB DWG model with only 2K CAD faces. This 97% data reduction was achieved in just 15 minutes.

## Equipment assembly: 97% reduction in 15 minutes

40MB DWG file  
73,000 faces



1MB DWG file  
2,000 faces

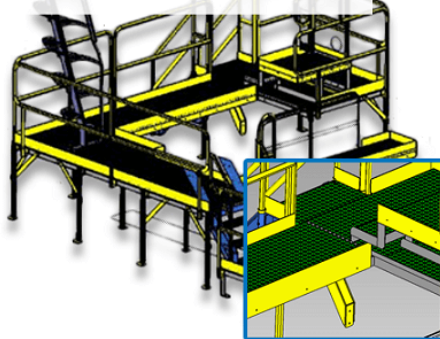


Further examples include:

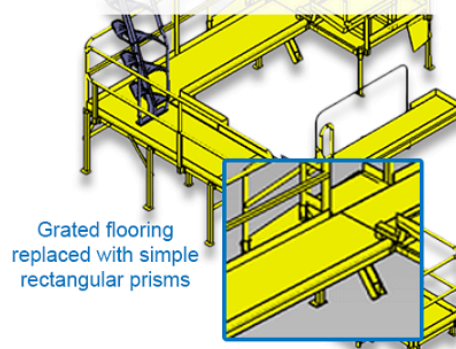
Stairway and platform assembly: reduced from a 72MB DWG file to 4MB in 20 minutes

## Stair & floor assembly: 93% reduction in 20 minutes

72MB DWG file  
26,000 faces



4MB DWG file  
4,750 faces

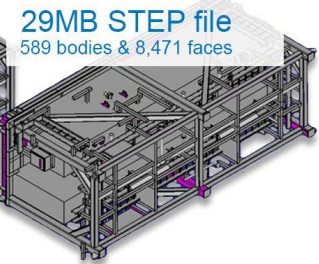
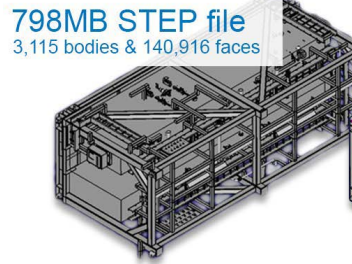
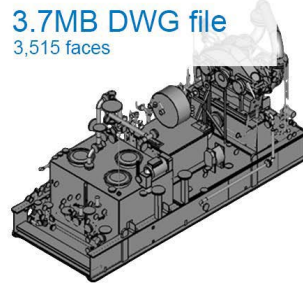
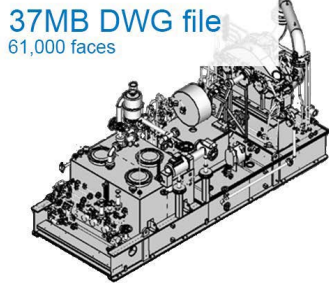


Large equipment assembly: reduced from a 37MB DWG file to 3.7MB in 25 minutes

Large skid assembly: reduced from a 798MB STEP file to 29MB in 20 minutes

Equipment assembly: 90% reduction in 25 minutes

Skid assembly: 96% reduction in 20 minutes




## Qualitative benefit

By using automated MCAD model simplification, engineering can receive equipment and structure designs from multiple vendors and/or CAD systems. They can quickly simplify the models, save them in a neutral format, and then reuse the simplified models across multiple projects and plant design systems - without having to repeat manual rework processes.

## Quantifiable ROI

Over the past three years, ITI polled EPCs and Owner-Operators about the time spent on MCAD model reduction and simplification for a single project. Out of two hundred (200) respondents, 34% said they spend more than eight (8) hours per week manually simplifying MCAD models. Another 43% said they spend one-to-three (1-3) hours per week. This data, in combination with lessons learned from various CADfix PPS deployment projects, gives us a starting point for measuring ROI.

The calculation in the figure above quantifies the labor costs for a single project with a burdened per-hour labor cost of \$105. In this example, the ROI for a single-site software solution is estimated to be 323%. Even if the proposed solution cost were higher, the software will likely be floated between local, regional, or global users across multiple projects, resulting in higher first-year ROI.

| First-Year Return on Investment Calculator                     |           |  |  |
|--|-----------|---|--|
| Number of designers on a project                               | 7         |   |  |
| Average number of hours spent manually simplifying MCAD models | 4         |   |  |
| Total hours spent per week manually simplifying MCAD models    | 28        |   |  |
| Average project contract period (in weeks)                     | 72        |   |  |
| Number of non-value-added hours spent on simplification        | 2,016     |   |  |
| Average burdened labor cost per hour                           | 105       |   |  |
| Lost revenue due to non-value-added labor                      | \$211,680 |   |  |
| Proposed solution cost   | \$50,000  |   |  |
| <b>First-Year Return on Investment Calculation</b>             |           |   |  |
| (Investment Gain – Investment Cost) / Investment Cost          | \$211,680 | Projected Labor Savings   |  |
|  | \$50,000  | First-Year Solution Cost  |  |
|  | 323%      | First-Year ROI  |  |

As the use of mobile solutions increases for work package automation, construction, shipbuilding, and plant/factory layouts, so will the broadband costs for uploading and downloading large files to mobile devices.

When applying simplification technologies across all MCAD models, the overall data reduction may result in an exponential decrease in mobile broadband costs for virtual design construction applications.



# Summary

Pressure remains throughout the plant and process industry for ever shorter commissioning times. With this comes a demand for more effective MCAD model reuse across the supply chain, which places the focus on MCAD model simplification as a critical issue to address.

The power of CADfix PPS is in the simplification of large MCAD assemblies and equipment models for rapid integration into plant and process design systems, where productivity improvements make a real difference.



## About the Authors



### James Flerlage

Jamie's twenty-plus years of experience spans Fortune 500 sales and marketing responsibilities for PLM and plant engineering technologies. His credentials include an MBA from DeVry University. He currently serves as ITI's Executive Vice President, Global Business Development.



### Andy Chinn

Andy possesses over thirty years' experience architecting and deploying 3D CAD transformation solutions. His credentials include a Bachelor of Technology from Loughborough University of Technology, England. He currently serves as Managing Director with ITI UK.

## About ITI, a Wipro company

ITI is the global leader providing reliable interoperability, validation, and migration solutions for product data and related systems. ITI solves complex product data interoperability problems so the world's leading manufacturers can focus on making great products. ITI is a wholly owned US-based subsidiary of Wipro, Ltd, and exists within the Wipro Engineering business. Wipro Engineering provides customers with a platform to innovate and engineer the next generation of products and platforms at scale.

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