A Primer on the Use of Solid Models for Manufacturing: Buzzwords, Benefits and Potential Pitfalls

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Agenda

- Who is Delcam?
- Modeling Basics
- The Benefits of Working with Solid Models
- The data translation problem
- Why is it getting worse?
- Data Repair – Solid Doctor
- Direct Modeling
- Conclusions
Who is Delcam?

Our People
800 Staff
325 Within Overseas Subsidiaries
240 Within Joint Ventures
227 Software Development Group

What makes Us Unique
In house manufacturing facility
Nationwide/Worldwide training facilities
Local support
Delcam’s Ownership Structure
Industrial Partners

Local Events
User Groups
Software Release Meetings
Technology Seminars
Press Conference
Regional Engineer Training Events
Inward Missions

Our Success
End user revenues over $100m
30,000+ Customers
60,000+ End users
Modeling Basics
• Lines
• Arcs
• Curves
• Highly rigid and mechanical
• Basically 2D
Surfaces

- Created with longitude, laterals, and trim boundaries using wireframe and curve geometry
- Individual pieces
- Highly malleable and flexible, but have no volume
- Typical neutral formats
  - IGES
  - STP/STEP
• Groups of surfaces to create one piece
• Contains history tree in native format
• Have volume
The Benefits of Solid Modeling

- Improved Visualization
- Paperless manufacturing
- Automatic documentation
- Improved communication with customers
- And so much more....
What do solid models have to do with cars?
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Data Translation Problems Affecting Your Supply Chain

- The data translation problem
- Why is it getting worse?
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Data Translation

- Data translation is the same as translating languages
- Easy at the basic level
- Very difficult for complex or intricate details
What is football? – U.S. vs UK

• Two nations separated by a common language
• How do you spell mold (mould)?
• True Irony:
  – U.S. - Modeling
  – U.K. - Modelling
The cost of data translation

- In 1999, NIST estimated the cost of data translation to the automotive industry as over $1 billion.
- 2008 report in MoldMaking Technology claimed:
  - 90% of toolmakers receive less than half of models in their preferred format.
  - 42% of toolmaking companies use four or more CAD systems each month.
How are the costs incurred?

- Cost of data translation software
- Cost of time needed to repair models
- Cost of time to confirm repairs are correct
- Cost of maintaining multiple CAD systems
- Cost of hiring or training staff to operate multiple systems
- Cost of translating files to return to customer
Some promote the concept of a single system for the whole supply chain

This won’t work because:

- OEMs and Contract Manufacturers use different systems
- OEMs change the systems they use
- New versions of “same” system aren’t compatible
- Disappearing CAD systems, e.g. CADDS and SDRC
The “best” software

• No software is the “best” for everything
• The needs of the OEM manufacturer are not the same as those of the contract manufacturer
• Being the best at data management and product design does not make you the best at NC programming
• OEMs can afford to pay more for software than smaller contract manufacturers
The problem – Part complexity
The problem - Productivity

• All industries are looking to shorten product development times as faster new product introduction increases profitability
• Companies that are second to market want to shorten the time gap
• Time taken to solve data translation issues increases product development times
The problem – Data reuse

• Companies are looking to increase design productivity by modifying existing products
• Data translation issues are a major problem according to Longview Advisors
  – Only 14% of designers receive their data in the required format, even in the same company
  – 8% never get their data in the required format
The problem - Litigation

- Buyers are more likely to sue suppliers
- OEMs are more likely to pass the problem on to suppliers
The problem - Longevity

• Aircraft built 50 years ago are still flying
• Aircraft built today will still need replacement parts for the rest of this century
The problem - Traceability

• OEMs, especially in areas like aerospace and medical applications, need to provide complete traceability on their parts

• Data must be transferred back up the supply chain if any changes are made to the design
  – Fillets added or altered to improve flow in the mold
  – Draft angles changed to ease removal of the part from the mold
What is a dumb model?
Definition: A solid model without any “history” or perhaps one converted to a surface model such as IGES or STEP

Why should you care?
• Designers may not want to send outside manufacturers their actual native files for concern of IP piracy
• Designers don’t want to send out more information than they have to get the part made
• Designers often don’t know how a part will be made – i.e. machined, cast, molded, pressed etc.
Standard formats

• Standard formats are promoted, especially IGES, STEP and Parasolid

• IGES is like ice cream, very nice but comes in many flavors
Model Repair

- Solid Doctor
Data Repair Solution

• Software (part of CAD and reverse engineering) that can read and repair CAD models
• Converts CAD files into valid, high-precision Solid models
• Typical problems solved are:
  – Gaps/overlaps
  – Duplicated/missing surfaces
  – Poor quality trimming
• This requires solid and surface modeling options
Stage 1 – Highlight the problems

- Analyses the model and labels all the problems
Stage 2 – Automatic repair

- Automatic repair tools fix the simpler problems
- Solid modeling tools used to match edges exactly
- Labels are turned green as problems are fixed
Stage 3 – Complex problems

- Remaining problems keep red labels
- Repair methods are suggested using surface modeling tools
Stage 4 – Re-trimming

- A common problem comes when surfaces aren’t trimmed correctly
- This can be corrected by editing boundaries
Stage 5 – Replace surfaces

- For the most complex problems, surfaces must be deleted and replaced
- Surface modeling can fill the area with a surface tangent to adjoining areas
What is Direct Modeling?

- Ability to make rapid, history free edits to solids
- Surrounding faces automatically extend and re-intersect
- Maintains a closed solid
What does Direct Modelling mean to machining organizations?

- Import and Fixing
- Modeling for manufacture edits
- Export to CAM
Direct Modeling

Edit draft

Remove & Heal

Edit faces
- Move
- Rotate
- Offset
- Scale
- Copy

Edit features
- Holes
- Pockets
- Cuts & bosses
- Fillets
Conclusions

• Working with solids has many great benefits
  – Visualization
  – Collaboration
  – Communication

But...

• Lack of CAD compatibility is a major problem for manufacturing industry
• Using the same system along the supply chain is not the answer
• A combination of solid and surface modeling tools provides a quick, easy way to work with models created from any CAD system through to manufacturing