SUSTAINED CAD INTEGRATION

A PROPOSED METHOD TO RESOLVE DEFICIENCIES RELATED TO DATA EXPORT/IMPORT

Robert Kirkwood, PE
Prof. James Sherwood, PE

Drawbacks to Homogeneous Integration where export/import is unnecessary

- 4+ distinct formats
- Version upgrades (sometimes)
- Acquisitions
- Subcontractors
- Software innovations

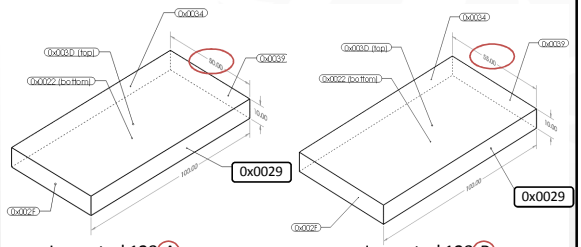
This is a very expensive issue!

The most notable case:

An aerospace company had to report to their board of directors that they **lost 2 billion $** and 2 years on a major project, due to a CAD migration failure.

Why is this so difficult?

These are imports of successive versions from another format



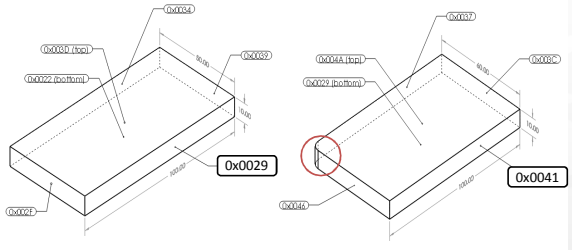
Imported 123-A Imported 123-B

It isn't

… in this special case

Forcing the issue to appear

These are imports of successive versions from another format

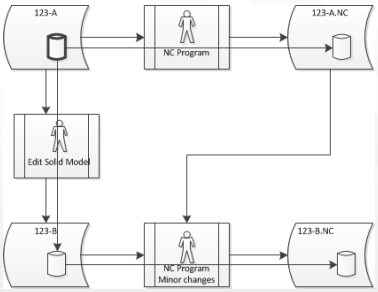


Imported 123-A Imported 123-C

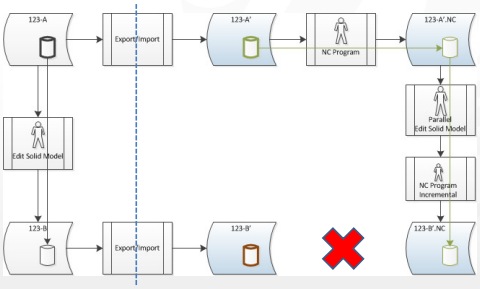
The real problem

- Not precision
- Not flavoring
- Not incompatible geometric entities
- **Entity ID's**
  they often resequence
  ..but not always

Homogenous Integration

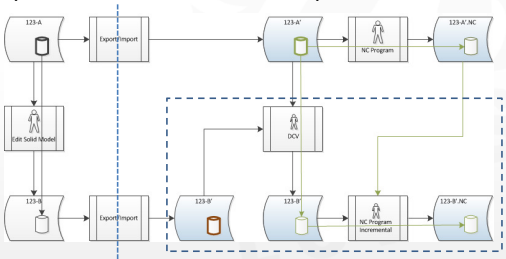


Heterogeneous Integration



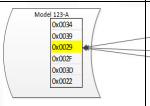
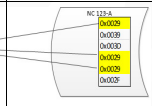
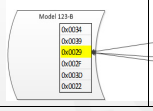
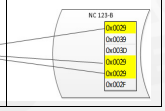
DCV Integration

Implements the idea of virtual persistent identifiers



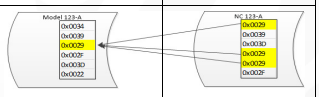
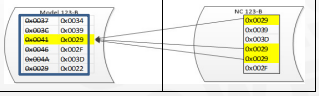
The receiving application can solve the problem accepting imported data as-is (123-B')

Native - Homogeneous

Part-Version	Solid model	Downstream
123-A		
123-B		

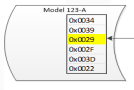
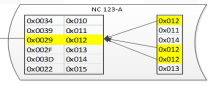
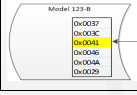
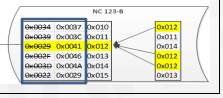
No problem to solve here

Remap (Rename)

Part-Version	Solid model	Downstream
123-A		
123-B		

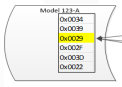
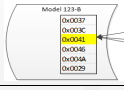
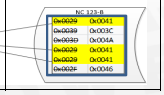
Least difficult

Indirection

Part-Version	Solid model	Downstream
123-A		
123-B		

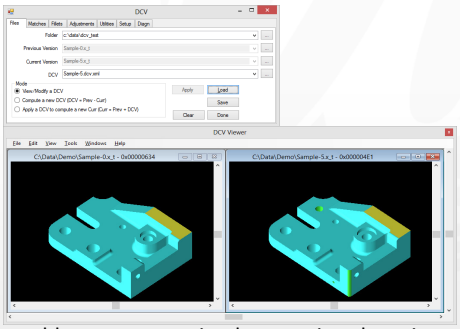
Medium difficult

Redirection

Part-Version	Solid model	Downstream
123-A		
123-B		

More difficult

The Hard Part



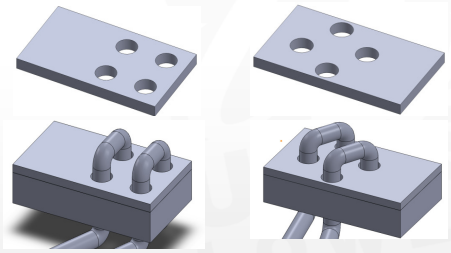
The table necessary to implement virtual persistent identifiers (VPI-Table) is a solvable software problem.

Scorecard

Integration Target	Working	How
Solidworks Assembly	Yes	Indirection
Solidworks Parts	Not yet	
Solidworks Features	Yes	Redirection
FEMAP (finite element)	Yes	Remap
NX/CAM (NC)	Pending	
Wiring application	Not yet	
Excel	Yes	Indirection

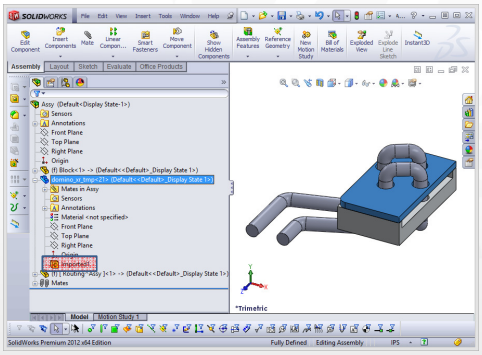
Applications that support associativity and a reasonable API can support sustained integration across successive versions.

A simple experiment



Download from: http://m-5.eng.uml.edu/DCV/

You saw it here first!



Future Research

1. **Test DCV software**
   for scalability & entity coverage
2. **Case-studies**
   migrations, rescues, or extended-enterprise
3. **Reconcile this approach with STEP.**
4. **Design Change Vectors (DCV)**
   A different way to understand this same process
5. **Feature and PMI data**
   Take advantage of synergies here

You can help

- **Send files**, 2 or more versions
  Format: STEP, IGES, Parasolid, ACIS (most other formats are okay as well)
  If there is an related integration problem, please describe it.
- Looking for **case studies**
  Case studies will determine priorities for integration targets
- Send files or case-study opportunities to DCV@k6mfg.com.

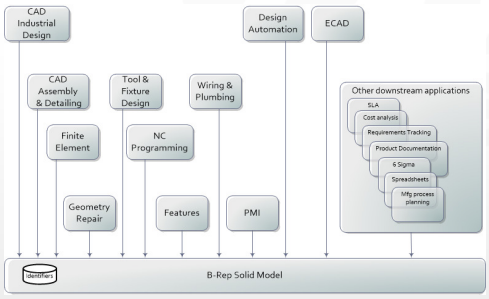
Conclusions

1. Expect more from your export/import integration. It can deliver sustained integration regardless of format or version.
2. Broken integration can be repaired.
3. CAD migrations can be gradual.
4. Beware of phantom success.
5. Standards should not be an excuse for further delays.

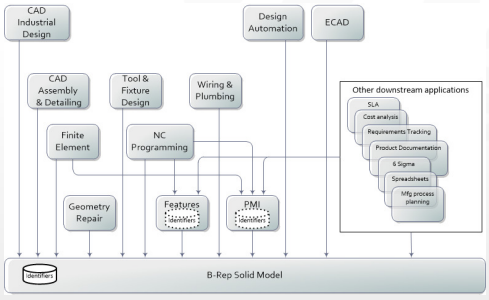
Questions

Slides and files may be downloaded from :
http://m-5.eng.uml.edu/DCV/

BREP as the CAD/CAM/CAE Backplane



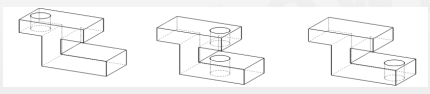
BREP as the CAD/CAM/CAE Quasi-Backplane



Why would a standard for Persistent Identifiers be difficult?

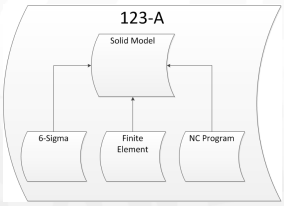
..after all, it's just an integer

- Persistent Identifiers in the STEP standard would allow one to bypass any or all application protocols (other than AP-203 defining the solid model)
- Persistent Identifiers are very entwined with design-intent.



Application protocols

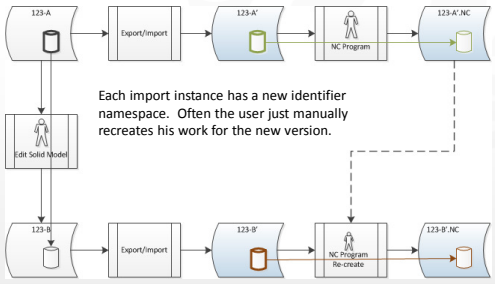
- All the applications are in the same file as the solid model.
- All the ID's and ID references resequence together.
- File contention
- ..or SDAI
  (STEP part 22, aka Database)
  demands a solution to ID resequence issue.



The 'D' word

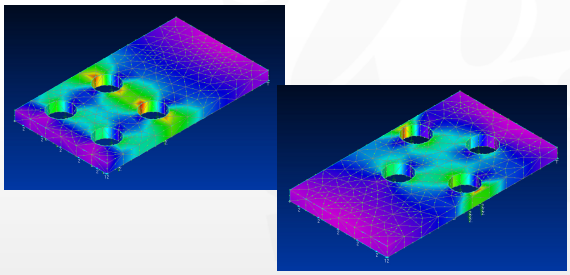
- Database instance vs database format
- The truth: It's a file/format (STEP part 21)
- STEP was intended to support a more proper database (SDAI, STEP part 22), but this presenter is aware of no active implementations

Heterogeneous Integration - 2



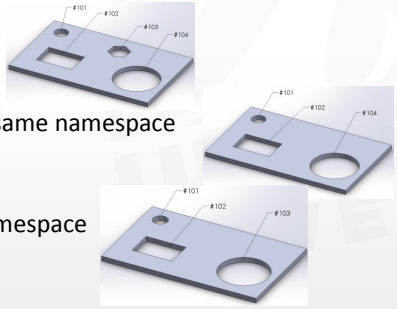
Each import instance has a new identifier namespace. Often the user just manually recreates his work for the new version.

FEMAP Integration



Identifiers and Namespaces

- Original
- Edited, same namespace
- New namespace



*not purely correct for brep

Persistent Identifiers vs Virtual Persistent Identifiers

Persistent Identifiers: A persistent identifier uniquely defines some geometric element in authoritative source solid model. It must remain unchanged across subsequent versions of the design for the entire life-cycle of the product.

Virtual Persistent Identifiers: A virtual persistent identifier is one that from the perspective of a downstream application behaves as if it were a persistent identifier.

Sustained Integration vs Associativity

- **Associativity:** A behavior of an application in relation to a re-loaded solid model such that the application accommodates reasonable changes in the solid model.
- **Sustained CAD Integration:** A property of a design process such that the changes to the authoritative solid model propagate easily to each downstream application. Such integration remains intact through the entire life cycle of the product.
  Restating: Changes to the authoritative solid model should integrate as well as changes to the solid model that is native to the downstream application.