



The Multi-CAD Development Environment

With the consolidation of the Mechanical CAD market, coexistence of different CAD systems is becoming more and more a standard element of many design environments. Each of the remaining systems now has a significant market share as well as the loyalty of experienced users to keep that product in continued use for a number of years to come.

As people look at implementing an environment that can support these different systems, the general requirements of data exchange start to become a central theme of the discussion.

First, let's explore the reasons that a multi-CAD environment even exists in a corporation.

There are several business processes that drive the CAD environment

1. Interoperability
The sharing of design data between users where the original system retains the design ownership, but that data must be used as reference in other systems.
2. Collaboration
The sharing of design data where the data may be modified by any user using any CAD system as controlled by PDM or PLM practices and systems.
3. Coexistence
Data is shared by users on an ad hoc basis as required. Examples include not only design data but analysis based on design data.
4. Migration
Customers who are replacing one CAD with another will go through a period of coexistence before the original system is replaced completely.
5. Archiving
Some markets require that the design data be preserved for decades. Creating vendor neutral representations of the design may be required for compliance with these regulations.

Increasingly, the issue of data management is combined with these issues to enable the management of all of this data.

With each of these processes there are specific requirements on the data translation that must occur.

	Critical Data Requirements
Interoperability	Accurate geometry, unambiguous product structure, key annotation
Collaboration	Complete Feature information, agreed feature mapping between system users, understanding of technology of all involved systems
Coexistence	In many cases, the requirements are the same as interoperability, but some downstream applications may find feature based exchange provides added value that is worth the cost of interpretation and QA
Migration	A clear understanding of the items being translated and how that translation will affect future business is required. Requires understanding the limitations of available technologies.
Archiving	Requires the ability to see in to the future and decide the most robust format to preserve complex design data.

As you can see, the multi-CAD environment is not a simple situation and a great deal of misunderstanding and lack of knowledge is present in the user community.

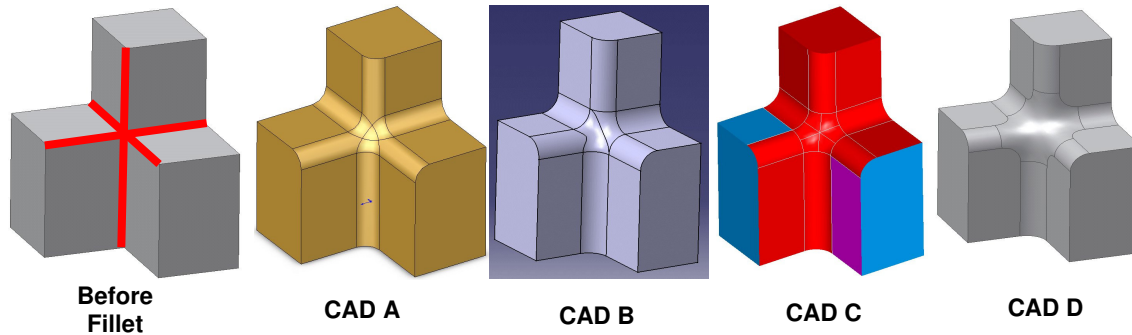
Technical foundations

Based on these business practices, there are two fundamental representations of the design geometry of each part that are available on the market:

- Boundary Representation (B-rep)
- Feature Based.

All of the notable CAD systems available today are in one way or another considered feature based modelers. While some are based on commercial kernels (e.g. Parasolid, ACIS) several of the largest in terms of market share are proprietary or add proprietary entities and construction methods to these kernels. Each of these vendors adds special features and options to features that are intended to sell that systems value compared to the competitors. These added capabilities are great for each user but make the exchange of data between different systems very complicated and in many cases not realistic.

One other aspect of Feature Based data exchange is the mathematical and topological assumptions that are present within each system. The following picture shows the differences between a simple fillet created with several different CAD systems.



As you can see, the geometry of each solution is different and this will result in different mass properties as well as potentially different clearance to adjacent parts in an assembly.

As the features get more complex, the difference between the desire and actual geometry can become significant.

However, for some classes of parts, feature based exchange can be very successful and this translation can become a normal part of the design process.

The other form of data, B-rep, is typically a solid part that is passed between the CAD systems. While this data exchange has been going on for over 20 years, it is still not perfect although successful transfer (where the geometry from a solid in one system can be translated to a solid in another system both of which have the same physical properties) rates of over 95% are not unusual. The available translators for this type of information include standard based translators (IGES, STEP) and commercially based point to point translators. As would be expected, the commercially based solutions targeted at translation usually have a higher rate of success especially in an enterprise data exchange setting as is driven by Multi-CAD requirements.

To summarize:

	Feature Based	B-rep
Accuracy	Variable. Depends on CAD systems, features used, modeling techniques	While the modeling technique can affect the result, most accurate and requires little QA to maintain.
Performance	Variable, follow-up for some parts may be significant.	Consistent, minimal follow-up once completed
Quality	Success rates of 50 to 75% are fairly common. Requires significant QA process to validate results	After initial implementation tuning, typically can run unattended and achieve over 95% success.
Content	If successful, all dimensions, design relationships, and assembly mating information can be observed in both systems with high accuracy	Geometry, key annotation, some relationship information, some feature information may be captured using groups or layers.



Multi-CAD Enablers

More and more companies are realizing that the multi-CAD development environment is a requirement for doing business with their many suppliers. As customers believe that geometry is becoming more and more of a commodity, that is the translation of the geometry is taken for granted, they are looking for additional information to be communicated between systems.

The promise at the end of the dot-com boom was that feature based data exchange would make all of the problems go away. While this level of exchange of information has not met the expectations of the market, the technology is gradually gaining some level of success in specific niches of the market.

There are three key aspects to creating a multi-CAD environment that will satisfy your requirements.

1. A clear definition of the business process that is driving your data exchange requirements
2. Understand the data exchange technology available for your CAD design tools, your supplier or vendors tools, and how complexity of the products you design will affect the translation results.
3. Consider a PDM solution to manage not only the original CAD design data but also the translated information begin receive from or sent to others.

Future Directions

The consolidation of the major players in the CAD market had lead to the current core tools being utilized by many major corporations that rely on an extensive set of tiered suppliers. These tools are now as a level of maturity that they will remain in use for many years even if they are not pro-actively marketed and sold by the vendors. Data exchange between these systems will become even more critical as electronic communication becomes faster and more expected throughout the entire supplier chain.

Data exchange will become more and more seamless as PDM systems control the automatic generation of alternate representations that are created to serve a wide variety of customers. While the core design information may reside in one system, these alternate representations will service all of the others in the supplier chain. These alternate representations will have various levels of intelligence and will be certified for specific tasks. Some will be for visualization only, others for inspection, some for manufacturing and design. While a single representation might be desirable, the proliferation of systems that provide added value to design geometry have made that impractical.



Data management is the next area where that will really enable multi-CAD data exchange to gain greater acceptance as these systems can enable background creation of additional representations of the master parts. Many companies are now recognizing the value of communicating the geometry and key annotation between systems while maintaining design ownership within the original authoring system. For example, a company designing telephones might use CAD system A for the handset and CAD system B for the recharging assembly. By insuring that all of the data was available for at least reference in both systems the designers can access any information they need. The only location where changes can be made is the original authoring system. Another enabler for this technology is a back office system that can automatically process the translations based on data management directions.

The multi-CAD data environment will be present for many years and can either be a drag on the business or a differentiator in your processes. Take the time to understand the real requirements of data exchange and understand the capabilities of the technology.