Summary: The pressure to develop products from multiple locations continues to grow. Computer technology isn't keeping pace with requirements. But there are techniques that managers can use to minimize problems and make the process leaner. In this final article of a three-part series, Contributing Analyst L. Stephen Wolfe, P.E. reviews the promise and possibilities of state-of-the-art collaborative product development technology, including the ideas from PLM managers at Ford and Spirit Aerosystems. (August 6, 2009)

Managing Distributed Product Development, Part 3: Realizing the Vision of Collaborative Product Development

By L. Stephen Wolfe, P.E.
Contributing Analyst

Steve Wolfe

[Editor's Note: The first two articles in this series are available online: Part 1, PDM Systems Still Don't Know How to Play Nice; Part 2, The Need for Simplified Product Model Data.]

August 6, 2009—Major OEMs of aircraft, ships, and automobiles have spent hundreds of millions on 3D CAD systems and PDM software to manage them. Yet none that I've heard about have come up with an efficient process for collaborating with the complex networks of suppliers using 3D design and system-level simulation.

A few have forced proprietary CAD and PDM on their Tier 1 suppliers, but as none of these PLM Systems are standardized, the effect has been to raise suppliers' costs while lowering their efficiency. And none of these systems is capable of managing the engineering of long-lived products.

If OEMs are to realize the benefits of what they are calling "model-based design," then they will need to take the lead in crafting practical, affordable collaborative methods. They also need to choose appropriate technology for digital prototypes.

Here are some general principles for collaborative product development that help minimize costs while assuring quality:

1. OEMs and subcontractors should provide to suppliers only information required to design the subsystems being furnished.
2. OEMs should require from suppliers only the data required to integrate the subsystems with their products including operation and maintenance procedures, if applicable.

3. Suppliers must be able to control their own internal processes and supply networks.
4. At each level in the supplier network, subcontractors must be responsible only for submitting information to their customers.
5. OEMs must have a means of monitoring suppliers' design and development progress.
6. OEMs should not require their suppliers to complete detailed designs in a particular CAD system.
7. OEMs must insist that suppliers submit models in formats that can be integrated with an overall mockup.
8. When possible, collaborative design systems should be based on open-source standards.

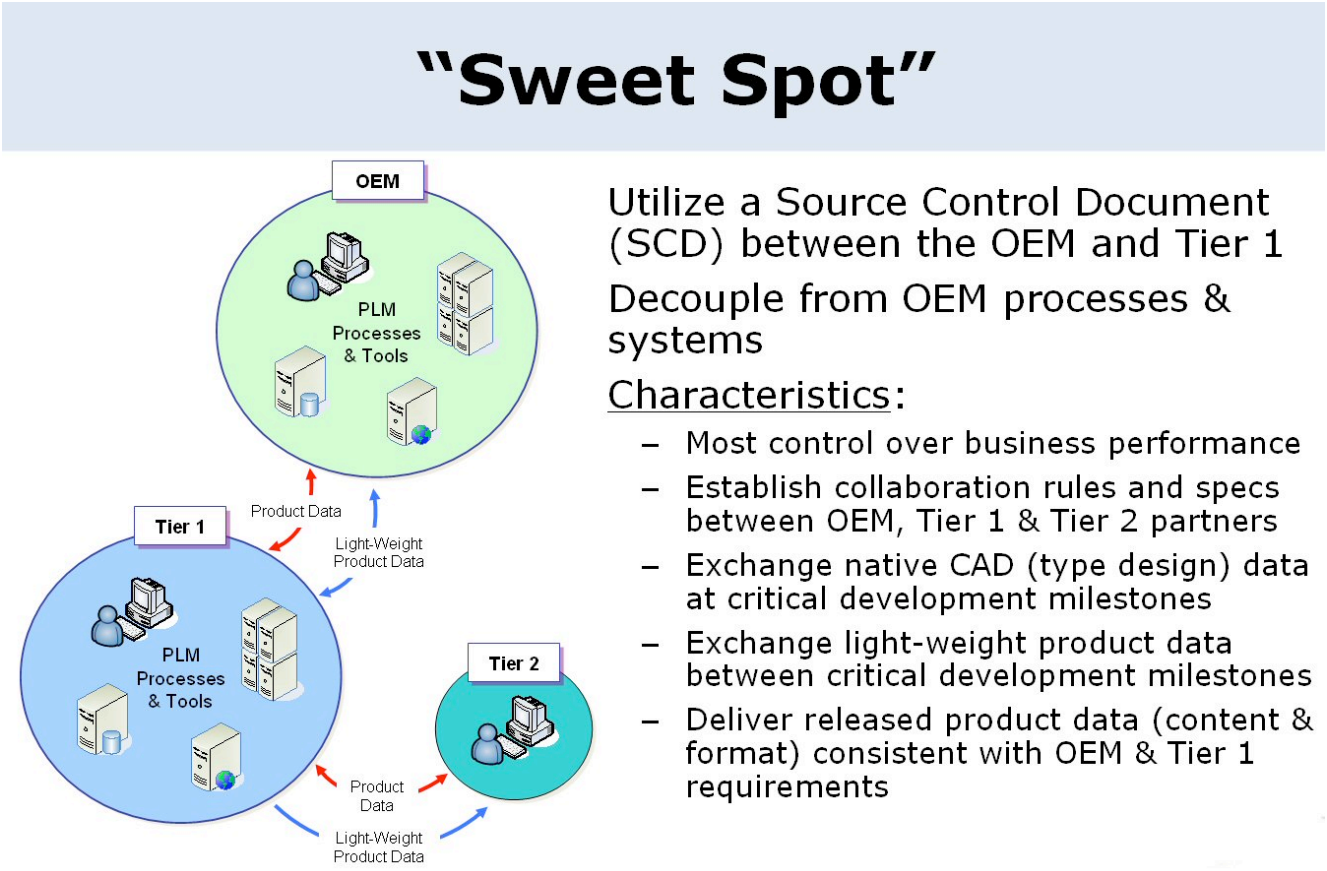

Figure 1—From a presentation by Mike Voth of Spirit Aerosystems at the Collaboration and Interoperability Conference, May 19, 2009.

At the recent Collaboration and Interoperability Conference, Spirit Aerosystems' Mike Voth outlined how such a collaborative design system might work. He envisions frequent exchanges of compact product models that are assembled by OEMs in a digital mockup distinct from the detailed CAD/CAM system. The digital mockup would

use lightweight graphic data that would take less time to transmit over wide-area networks and would protect suppliers' trade secrets by excluding internal details.

In Voth's proposal, suppliers would submit data in the OEM's native CAD format only at critical milestones (such as for final assembly checking, manufacturing release, and as-built documentation). For daily development, OEMs and suppliers would exchange what Voth calls "source control documents" including 3D models that contain only the information needed for the supplier to furnish the required parts.

Has any company built such a system? Probably not yet, but there are examples of this kind of lightweight technology in use today. Ian Weitzer of the Ford Motor Company said his firm assembles "digital bucks" (i.e. prototypes) of automobiles using lightweight JT models instead of detailed CAD models. He said Ford needs to improve the way it manages this data with its supplier community.

Realizing the Vision

If an efficient collaborative engineering environment is to be realized, OEMs and their Tier 1 suppliers must take the initiative. OEMs need to work with suppliers of software technology to develop practical and affordable systems that enable collaborative development based on open standards. Voth listed the major issues that OEMs and their supplier networks need to resolve in implementing collaborative design. These include:

- Requirements for source-control documents
- Collaboration rules and methods
- Data management, definition, exchange & distribution
- Change & configuration control
- Requirements of certification or regulatory agencies
- Program management
- Protection of confidential information

As in any engineering development, OEMs need to compromise between what they would ideally like to have and what software engineers know how to make affordably today. As they do when specifying their own products, OEMs should explain to PLM software suppliers what is important to their collaborative processes but not dictate how these requirements are implemented in software.

Emerging Technologies

Smaller, more focused software suppliers may be willing to develop products that work with other software and adhere to more open standards than the current big six: Autodesk, Dassault Systèmes, Oracle, SAP, Siemens PLM, and PTC. All the leading mechanical CAD, PDM, and ERP vendors still believe that their vested interests lie in selling proprietary systems that don't exchange data with other systems well. When they see that major manufacturers are bypassing their proprietary solutions, they may

become proactive in standardizing data exchange, but history suggests that customers can't look to these firms for leadership.

Although no OEM has yet realized a flexible, distributed collaborative environment for complex product development, a number of existing technologies could be used in such a system:

The **Right Hemisphere** 5 "platform" is a set of products including 2D and 3D viewing software, CAD systems translators, adapters for PDM systems, and a server application that enables 3D models and other product data to be displayed in a compact format to people with no CAD user experience. Right Hemisphere's faceted compact format is employed in Adobe's Acrobat 3D as well as the Universal 3D standard of Ecma International (Ecma).

Lattice Technology's XVL Studio is a set of tools designed to build 3D digital mockup systems. It employs a compact, proprietary XVL format that can represent either faceted or spline-based 3D models. Lattice claims that XVL files are about 0.5% the size of the original CAD models from which they are derived. Unlike Right Hemisphere, XVL Studio doesn't have its own server software but instead offers tools that enable XVL to be tied into other server applications, such as PDM systems.

Adobe Acrobat 3D – Adobe has been working for six years to establish itself as a purveyor of neutral-format, 3D data for engineers and manufacturers. Adobe people think of information as collections of documents, and the 3D version of the popular Acrobat format follows this model. As such, Acrobat 9 Pro Extended may not the right tool to build a collaborative digital mockup system for aircraft or ships. It is a good tool for sharing documents that contain 3D models of parts or small assemblies with suppliers. 3D PDF supports both the faceted U3D format and a compact, proprietary boundary-representation format that Adobe has proposed as an ISO standard.

Siemens JT has been around longer than most compact 3D formats used to represent manufacturing data. UGS acquired Engineering Animation in 1999 and with it the compact, faceted JT format for storing 3D models. Since then, UGS was itself bought by Siemens, although the original UGS employees continue to run the business. In recent years, JT has been fortified with b-rep solids that enable JT models to be used in manufacturing applications that require mathematical surfaces.

Siemens gives away a free JT viewer, called JT2Go, but prefers that customers employ JT as part of its Teamcenter PDM system. Siemens claims that JT is an open format and sells a "JT Open Toolkit" that enables C++ programmers to write applications that employ JT models. However, some customers take issue with Siemens' definition of "open." "It costs $100,000 to be on the [JT Open] board and get the libraries. That is not an open standard," said a Boeing representative at the CIC conference.

3D Via Composer – Dassault Systèmes bought Seemage, a young French company, and rechristened its product 3D Via Composer. Composer models are compact and take an innovative approach to assembly management. Instead of employing models that relate every part in an assembly, Composer models know only about their

immediate children. This organization enables customers to update parts in large assemblies without touching most of them. Dassault Systèmes has pigeon-holed Composer as a tool for assembly instructions and is selling it through SolidWorks' retail channel. These decisions would seem to doom Composer to lingering death. Nevertheless the software is worth studying because it embodies many clever concepts.

CATIA V6 – The next generation of Dassault Systèmes' flagship CATIA software is the alleged cure for problems of collaboration with large assemblies. (See "CATIA V6, FUD and Promise.") V6 is supposed to enable fast remote access to CATIA models that has bedeviled V5 customers. Dassault expects that small customers will be able to use it through software services offered by Dassault Systèmes or IBM. For V6 to be successful, Dassault Systèmes' CATIA group needs to demonstrate that designers and manufacturing people throughout the supply network can—without unreasonable effort—put data into CATIA V6 product models or get it out. Right now most CATIA customers I have spoken with are skeptical that V6 will solve more problems than it creates.

mental images is best known for its *mental ray* rendering engine that's built into most CAD applications including CATIA, SolidWorks, Autodesk Inventor, and, most recently, Pro/ENGINEER Wildfire 5. *mental images*' collaboration engine, called RealityServer, is less well known, but exceptionally innovative. Instead of downloading lightweight models to each user's computer, RealityServer displays images of a master model stored on a multiprocessor system in a data center. RealityServer generates views of this model and transmits them to any remote system with a Web browser. The approach enables people with computers of limited memory, disk capacity, and graphics power to look at models as large as an airplane or a commercial building.

Nobody has yet integrated RealityServer with a data-management system that enables designers to update the model with subsystems they have recently designed or modified. *mental images* is seeking partners in such development. Demonstrations of RealityServer can be viewed at the following Web site: http://www.mentalimages.com/products/realityserver/realityserver-video-demo.html.

The Missing Piece

The missing element in an affordable collaborative design system is modular, flexible, and extensible software for managing product models and related documents. PDM software products from the leading suppliers (Siemens, PTC, Dassault Systèmes Enovia, SAP, and Oracle) tend to be monolithic architectures that are costly to implement. Most PDM customers run out of money before accomplishing their goals. Moreover, PDM systems aren't easily upgraded to new software releases without extensive revision and retesting of custom scripts and/or compiled code.

Finance chiefs have become increasingly reluctant to spend millions of dollars upgrading enterprise PDM systems to new releases that do little to lower costs or provide enhanced capabilities. The problem isn't unique to PDM software. So-called enterprise resource management systems suffer similar problems. (See "The Trouble

With Enterprise Software" by Cynthia Rettig in the *MIT Sloan Management Review* October 1, 2007.)

To be effective, PDM or PLM software needs to be implemented in digestible modules that can be implemented and upgraded individually and exchange data with similar systems produced by other suppliers. A system that enables design collaboration among networks of suppliers need not have all the capabilities of a system that manages design changes after products are in production.

At this writing, computer scientists have not figured out how to design such software nor have business executives come up with plans to fund it. **Aras** is a relatively young PDM software company that employs an open-source model based on the Microsoft Public License. Customers or developers can extend the Aras Solution Suite but need not share their extensions with everyone else. Aras makes its money by providing maintenance, consulting, and training services.

An overly complex and indivisible open-source PDM application could be just as costly as the leading proprietary systems. Aras Solution Suite currently consists of eight discrete applications. Whether this granularity is sufficient to enable customers to implement it on an incremental basis isn't clear, but it appears to be a step in the right direction.

Speaking at the spring 2009 COE conference, Boeing's Kevin Fowler said his company didn't want to upgrade its current CATIA V5/Enovia LCA system for at least a decade because Boeing needed to recoup the investment it spent to implement it. Such a policy isn't necessarily a bad idea as long as Boeing's next generation of CAD and PDM software meets its business objectives of reducing implementation, product-development, and manufacturing engineering costs.

Throughout history, change has come only when people recognize the status quo as unacceptable. The largest CAD and PDM customers are beginning to recognize that current systems for collaborative design of complex systems cost too much and that projects undertaken with these systems take too long. Efforts to make the entire supply network use a common system are as futile as the Esperanto movement was to create a world language. Companies that propose solutions based on open standards may at last get a hearing.

Send comments or questions about this article to stephen.wolfe@cyonresearch.com. You may also address comments to info@cadcamnet.com.