Modular Architecture is Gaining Focus among CAD and PLM Tools

Modular Management’s PALMA™ software provides key functionality for implementing Modular Architecture in CAD and PLM

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There is a market pull on CAD and PLM systems to add functionality for Modular Architecture

With a rise in the number of companies developing and implementing Modular Architectures for their product families, CAD and PLM system suppliers have been paying more attention to how their tools are being used for these purposes. Modular Management, for example, has been helping companies to move from 2D to 3D CAD to improve the efficiency of designing a module system. Using 3D early in the development of interfaces leads to higher quality connections because the interface is visualized upfront of the component design.

Modular Architectures generate a lot of data, and Modular Management has worked with some larger companies to implement that data within their PLM systems. They are hoping to improve the organization of the data and make it easier to locate and retrieve. They are also looking for ways to display the data to make it easier to understand. PLM is not yet widely used in small and mid-size companies, but these companies have many of the same needs when it comes to Modular Architecture.

As with any information management system, the system is only as good at the information that is entered into it. As with the case of PLM systems, companies are very excited about having access to all of their product data through a freshly implemented PLM system. Senior management is convinced that they will soon be making better, informed decisions. After moving forward at full speed to implement the system, many find out that they have little of the right data to populate it.

Features that existed in CAD for years are being repackaged to address Modular Architecture

CAD is used extensively to develop module concepts and to create detailed module variant designs. It starts with the sketching of concepts and evolves toward the definition of the 3D space that envelops the range of module variants. Along with detailed design comes the need to swap-out the various module variants to evaluate the final product configurations. The CAD data should also contain documentation for modules and interfaces that preserve the integrity of the architecture.
**Interface Management**

Most of the CAD functionality for interface definition comes from the area of product assembly. Tools have been available for many years allowing a designer to interchange components and to visualize product assembly in the manufacturing process. For defining the interfaces in a Modular Architecture, PTC’s Pro/ENGINEER® has a special interface feature that controls mating constraints, and there are several means of controlling geometry including Copy Geometry and Publish Geometry. Siemens NX™ allows for control of mating references through Product Interface, and the geometry can be managed with the Wave function. Both these tools support the management of interfaces but lack the ability to manage the spatial envelopes of all of the module variants.

SolidWorks® from Dassault Systems has quite recently added support for coordinate systems so that they can be used to define interfaces locations. The Mate Reference feature can be used to preset mating conditions, and derived part (part-in-part) functionality is used to control geometry. The Envelope feature can be used as a Zone to verify that modules fit within a given envelope.

**Variant Management**

All of the major CAD systems have the capability to manage interchangeable module variants. This includes Interchange Assemblies in Pro/ENGINEER, Wave Links in NX and named Mate References in SolidWorks. Pro/ENGINEER recently added the Option Modeler that allows the exchange of data with the Windchill® PLM system. It has only been implemented for a couple of large companies because of the large effort to setup and maintain the links.

None of the CAD systems have an integrated solution to managing complex configuration rules. Pro/ENGINEER and NX can allow the selection of module variants based on specific properties, but these are made hierarchal and will not consider interdependencies or consequences. SolidWorks has chosen to integrate with third-party vendors, including TactonWorks™ and DriveWorks™, which provide sophisticated configuration support. These tools are not, however, tightly integrated with any PLM solution.

**Modular Architectures are being implemented in PLM with limited sophistication and integration**

There is a variety of information that must be monitored and manipulated in order to effectively deploy Modular Architecture for a product family. The range of the product family is described in terms of the configurations of specific module variants. This can be a static definition or one that is created dynamically at the point of sale. Similarly, the product forecasts and actual demand need to be translated into a supply plan for the modules. As a product family is launched to the market in waves, the development of modules variants needs to be closely coordinated to match the schedule.

PTC Windchill and Siemens PLM software have the ability to define products from a selection of components within a master bill-of-materials. The selections are based upon the desired properties of the product, and all properties need to be selected at the same time. There is logic missing that allows the most desired properties to be selected first narrowing the remaining combination of components and arriving at the best solution. Without this kind of logic, the definition of products is static and, therefore, not useful during the sales process. In fact, no current PLM system allows storage of the complex relationships within a Modular Architecture. Another challenge is the lack of integration between PLM module data and the information about the modules that is captured in CAD.
There are many challenges that remain to effectively implement Modular Architecture in today’s CAD and PLM systems

Most company’s product data is incomplete, unclean and inaccessible. They can build existing products, but it’s hard to make changes or develop synergies across products. CAD and PLM are tools that automate the management of product data to make better use of the parts. CAD documents and shares the specific details of individual parts. PLM identifies and collects the parts from bill-of-materials to form individual products.

For both CAD and PLM, the automation of the data comes from a set of rules. For existing product families, these rules are embedded in the designs and structure and can be inferred or extracted, but it is very difficult to modify or recreate the rules. These rules are used to populate the data in CAD and PLM, but they are not contained within these tools. When a product family is based on Modular Architecture, these rules are created and documented ahead of time.

Modular Management has worked with many companies to optimize their IT-infrastructures for Modular Product Architecture including streamlining and eliminating information bottlenecks. Through the development of Modular Design methodology, the company has worked on implementation and operation of all major CAD, PDM, PLM and configuration tools. Modular Modelling and Design-for-Configuration are sophisticated methods to efficiently work within these systems.

A separate tool is needed to manage the rationale behind the rules that can also be used to create, preserve and update the rules. Updating often comes with the need to reanalyze the structure and compare with past analysis. CAD may evolve to include more about module definitions and specifications, but the interplay between modules will never reside within it. PLM may evolve to include the configuration logic of a Modular Architecture, but it will never be the tool to create and/or modify the logic of how and why the parts are put together to form modules.

PALMA software provides the relational tools and analysis for creating and supporting a Modular Architecture

PALMA is a software tool used to manage the creation of a Modular Architecture and it contains the data that describes the parts of product family and how they fit together. It integrates with CAD through the delivery of module and interface specifications that are used to develop the detailed designs. It provides the rules for populating the product data within a PLM system.

The documentation starts at the level of company and product strategy. PALMA captures the decisions about customer targets and the types and levels of value to be delivered by the products. As these values are transformed into specific product performance characteristics, the software captures the collaboration of the market, technical, financial and operational teams. PALMA is supported by Modular Management’s Modular Functional Deployment® process that leads to the identification of interfaces and modules for the entire product family.

When the market, technology or operational conditions change, the Modular Architecture can be re-evaluated. The multiple levels of data and relationships can be displayed and scrutinized to determine if and where changes need to be made. If necessary, the entire process of the creation of the data can be revisited and modified to adjust how the parts come together. The documented rationale can be updated and repopulated into CAD and PLM.
The recent advances in CAD and PLM are making it easier for the growing concern of companies who are implementing Modular Architectures for their products families. It is likely that the complexity of data and configuration rules will remain out of scope for general purpose tools continuing the need for specialty tools like PALMA that support both the creation and development of Modular Architecture.

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Since 1996, Modular Management has worked with companies across the globe to create and apply market driven, strategic Modular Product Architectures in industries as varied as home appliances, industrial products, telecommunications and construction equipment.

By partnering with Modular Management to implement this approach, companies have achieved dramatic improvements in business performance through increased speed and efficiency while simultaneously expanding the breadth of product offered to the market.

Using a proven methodology, experienced Modular Management consultants partner with companies to deploy a set of innovative tools and structured processes. Together, they uncover and exploit the economic potential of a Modular Product Architecture that lies within the markets, products, technologies and operations.