CAD Selection Considerations: Design Changes

Dealing with Rapid Changes to Models

June 2012

CIMdata, Inc.
3909 Research Park Drive
Ann Arbor, MI 48108
+1 (734) 668-9922
www.CIMdata.com

CAD Selection Considerations: Design Changes

Innovation in product development relies heavily on the fundamental engineering cycle of modify and improve. Most new products are built from changes made to existing products. The modeling tools most beneficial to product designers must align to that cycle and should contain a wealth of rapid and flexible editing methods. When selecting a modeling suite, prospective users must assess their past New Product Introduction experiences and compile a list of their most important and impactful needs.

In a series of brief papers, CIMdata identifies and discusses a number of functional capabilities within CAD solutions that have proven to be of critical use for leading-edge users. Research for this paper was partially supported by PTC.

Introduction

"…engineering is practicing the art of the organized forcing of technological change..."

—Dean Gordon Brown; Massachusetts Institute of Technology

Change drives innovation. In today's fast-moving, technology-driven marketplace, uniquely new products are rare. Most products are based on designs that have grown out of an engineering cycle of modify and improve. In order to facilitate that reality, designers need flexible tools that allow them to be responsive when making design changes at any time throughout the product development process. That is especially true for last-minute design changes required to expeditiously deliver the product on time and on budget.

Most products are based on designs that have grown out of an engineering cycle of modify and improve.

Product engineers must deal with the fact that with ever-increasing product complexity, design modifications can often result in a substantial amount of time and effort, even full or partial model re-creation. The demands in each of their competitive market segments require them to make adjustments to any model quickly and easily. Change not only drives innovation, it drives marketshare and bottom-line profits.

Users of the design industry's most popular parametric modeling technologies especially need a set of easy-to-use geometry editing tools that allow them to make model changes with the same speed and flexibility associated with dedicated direct modeling approaches. Yet those changes must be made while avoiding the concerns of damaging built-in design intent. This paper cites a number of functional capabilities and some of the significant reasons design engineers should look for flexibility in the design editing functions of their

Users need a set of easy-to-use geometry editing tools that allow them to make model changes with speed and flexibility.

modeling tools. The paper also highlights a number of key technology considerations that potential buyers should require from the tools they select.

The Need for Flexibility

Product design companies face increasing pressure from both business and process demands that challenge them to be highly responsive in their product development workflow. Be it last-minute changes to product requirements from a volatile market, changes in a supplier network and the manufacturing tooling differences that presents, or simply the need to make and evaluate a product change at the suggestion of a colleague, product model edits must happen. Key product stakeholders should be able to make those changes intuitively, easily, and rapidly.

In an accelerated workflow, companies are often confronted with the demand to proactively conduct product design reviews where alternatives and variations of the product design are proposed and assessed. Make a change, validate its impact; then make more changes. Decisions must be made, and made quickly. A cumbersome modeling tool that necessitates careful methodical planning before any change is made will fail in this environment.

Yet another frequently deployed process step found during product development is virtual simulation and analysis. Designers must be able to predict how the product will react to varied real-world conditions due to structural mechanics, heat transfer, fluid flow, electromagnetics, and other factors. One useful approach is to use finite element modeling. In order to better prepare geometric models for analyses that simulate the product's behavior, it must first be geometrically simplified by removing extraneous design detail. Recent research has identified that over fifty percent of models have required model clean-up (or de-featuring) prior to finite element meshing for analysis.

The model preparation edits can be basic removal or suppression of features, such as small holes and fillets, or actual movement of the faces and edges of the solid model. In either case, the edits must be captured as features and must not propagate a ripple change effect to other parts of the model. The same demands hold true further downstream in the product development process. Often companies build rapid digital prototypes of the product for final evaluation prior to release into manufacturing. The digital prototyping solutions also require model clean up and simplification operations to help speed up their execution.

Throughout the design process numerous other opportunities arise for rapid model edits. Many companies report difficulty—often failure—in having a designer modify models created by another. The adverse impacts of an unanticipated change late in the product development cycle can prevent release to manufacturing while the engineer now put in charge struggles to understand the intricacies of embedded model constraints and parametric relationships imposed by the original designer.

Many companies report difficulty in having a designer modify models created by another.

In addition, design change flexibility provides benefits on the opposite end of the spectrum—the front end of product development—in conceptualizing product variations. In the concept phase, ideas need to be realized quickly—often adapted from existing parametric models. Designers must be able to rapidly modify the existing design without losing design intelligence, so they can spend time exploring concept options, rather than recreating models.

Modeling tools must deliver flexible, agile model editing capabilities to allow users to deal with these CAD model changes. While CAD tools that only support direct editing provide operations for rapid editing, they lack the important ability to add and maintain design constraints and relationships to the model. A suite of unintelligent direct editing operations within a parametric CAD tool serves no better. The direct editing operations must be implemented to protect the knowledge of constraints and geometric relationships while still allowing direct editing flexibility.

Selection Criteria

Potential buyers of CAD design tools face a formidable challenge in their selection due in large part to the overwhelming flood of fancy labels the solution providers will use to describe their applications. Terminology glut can blind. The buyer must keep a keen eye on the goal—observing whether the CAD modeling suite offers intuitive, easy, and flexible change capability for its users.

Regardless of the sophistication of the parametric design model the user can build, the user must also have the ability to move, remove, attach, change size, and make other similar edits without the burden of understanding embedded design intent and with the security that there will be no surprise ripple effects in the model.

Each of these model change operations should be accomplished without needing to understand or rework design intent. The edits should be recorded as features that can be modified later in the design workflow.

Model change operations should be accomplished without the need to understand or rework design intent.

The best design tools are those that accommodate and facilitate the workflow showcased by industry-leading product developers. Central and key to their leadership status is an effective engineering cycle of modify and improve. They demand CAD tools that allow flexible model edits.

When conducting due diligence on the selection of CAD, prospective buyers must ask:

- Does the CAD suite offer change operations to move, rotate, remove, and attach basic solid edges, faces, and form features?
- Does the suite allow the user to simplify the model by removing or changing the sizes of rounds and chamfers, as well as to transform a round into a chamfer?
- Does the CAD suite provide edit operations without requiring the user to understand design intent and delve into pre-existing constraints?

- Does the CAD suite also provide edit operations that can modify the geometry without breaking and removing existing design intent within the model?
- Will the CAD suite allow the user to capture a geometry change as a parametric feature to edit or undo later?
- When making a model edit, does the tool allow the user to control and prevent a ripple effect of model changes elsewhere in the design?

Of course CAD design change flexibility is only one of many considerations a buyer should regard in determining their selection of a CAD application. It is, however, critically important.

Conclusion

Modeling tools must deliver flexible, agile design editing capabilities to allow users to deal with CAD model changes. It is one of the more decisive factors in the selection of a tool that will help drive profitability.

Modeling tools must deliver flexible, agile edit capabilities.

Overall, an effective CAD application must support the entire design cycle from concept through detailed design, simulation, validation, manufacturing planning, and tooling. The design suite must unite best-in-class point solutions in a framework that supports multi-CAD interoperability and collaboration across the full design chain, including suppliers and customers. In addition, the design application should contain all the necessary factors that would allow it to reside comfortably within a larger context of a product development workflow that interfaces with non-engineering domains, such as procurement, marketing, sales, manufacturing, and services. Finally, the stability and solvency of the vendor, and their responsiveness to issues, are also considerations, as are the alignment of the client's and vendor's long term visions.

About CIMdata

CIMdata, a leading independent worldwide firm, provides strategic management consulting to maximize an enterprise's ability to design and deliver innovative products and services through the application of Product Lifecycle Management (PLM) solutions. Since its founding nearly thirty years ago, CIMdata has delivered world-class knowledge, expertise, and best-practice methods on PLM solutions. These solutions incorporate both business processes and a wide-ranging set of PLM-enabling technologies.

CIMdata works with both industrial organizations and providers of technologies and services seeking competitive advantage in the global economy. CIMdata helps industrial organizations establish effective PLM strategies, assists in the identification of requirements and selection of PLM technologies, helps organizations optimize their operational structure and processes to implement solutions, and assists in the deployment of these solutions. For PLM solution providers, CIMdata helps define business and market strategies, delivers worldwide market information and analyses, provides education and support for internal sales and marketing teams, as well as overall support at all stages of

business and product programs to make them optimally effective in their markets.

In addition to consulting, CIMdata conducts research, provides PLM-focused subscription services, and produces several commercial publications. The company also provides industry education through PLM certification programs, seminars, and conferences worldwide. CIMdata serves clients around the world from offices in North America, Europe, and Asia-Pacific.

To learn more about CIMdata's services, visit our website at www.CIMdata.com or contact CIMdata at: 3909 Research Park Drive, Ann Arbor, MI 48108, USA. Tel: +1 734.668.9922. Fax: +1 734.668.1957; or at Oogststraat 20, 6004 CV Weert, The Netherlands. Tel: +31 (0) 495.533.666.