RENAISSANCE SERVICES

5 Secrets for Making the Model-Based Enterprise a Reality

White Paper

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5 Secrets for Making the Model-Based Enterprise a Reality

Executive Summary

Leading aerospace and defense companies are aggressively pursuing the Model-Based Enterprise as a means to accelerate product development. The vision is relatively simple: models that fully represent the complete design are distributed electronically, where every detail of their content can be extracted and seamlessly transitioned to manufacturing.

Despite application of this vision on major commercial and military programs, there are enough prominent examples of problems to lead to the conclusion that the vision is not delivering on the promise. Nevertheless, experiences in the aerospace industry over the past few years have highlighted a common thread that reveals five insights for making MBE a reality.

Introduction

Leading aerospace and defense companies are aggressively pursuing digital product definition as the centerpiece of their Model-Based design efforts. Through the resulting approach, commonly referred to as the Model-Based Enterprise (MBE), they intend to achieve their objectives for Design for Six Sigma (DFSS), Design to Cost (DTC), and Design for Manufacturing & Assembly (DFMA). The vision for MBE is relatively simple: models that fully represent the complete design are distributed electronically throughout the supply chain, where every detail of their content can be extracted and seamlessly transitioned to manufacturing.

Despite application of this vision on major commercial and military programs, there are enough recent problems to lead to the conclusion that the vision is not delivering on the promise. At issue is how to make MBE fulfill its promise in delivering the high performance, affordable products expected of the aerospace and defense industry. As companies have begun to recognize the challenges, they realize that achieving their DFSS, DTC, or DFMA objectives in a Model-Based Enterprise depends on five key efforts:

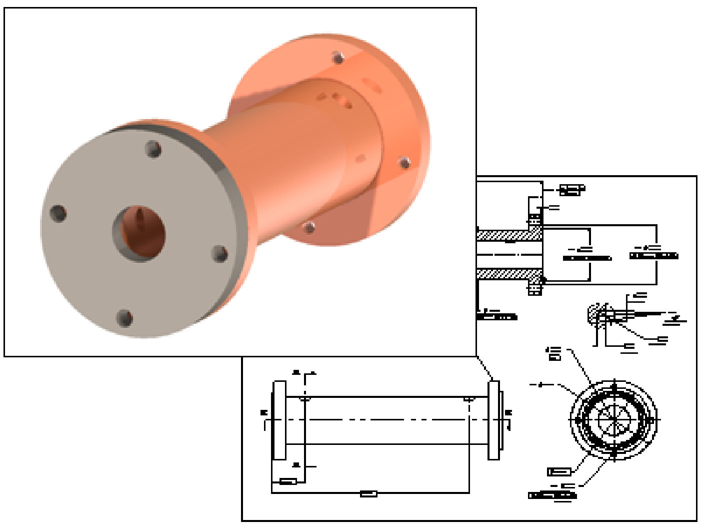
1. Use the 3D model for the majority of your annotation

For the MBE, the notion of making the model the "system of record" and the core of design would seem to be an elementary concept. However, there are many companies that use the 3D CAD model as a geometric starting point, but then maintain the majority of the configuration controlled details on the drawing. For example, it's not unusual for an aerospace engineering department to have 'engineers' that define the part and 'detailers' that create a drawing for the detailed design. The detailers have their drafting expertise in the 2D world and they still capture most of the design details on the drawing. Thus, the model may not represent the current configuration, or the "naked" model may not contain enough information to be useful for users outside of design engineering.

With the MBE, the focus has to be in using the model as a core database for collaboration. This means that the model must have more than just nominal geometric data; it must also contain 3D annotation such as GD&T, symbols, notes, etc., to help communicate design intent. As the primary source for part geometry and design intent, the model serves as the principal means for information-sharing with thermal engineers, structural engineers, manufacturing engineers, etc. These contributors to the detailed design are dependent upon understanding the nuances of the design that can only be adequately interpreted if the product manufacturing information is contained on the model.

2. Don’t plan to eliminate drawings entirely

Many aerospace companies have considered MBE based on the ostensible ability to use the model for 100% of the product definition, and the associated promise of eliminating the cost of creating drawings. The reality is that a 3D model is indeed a great way to quickly visualize the overall appearance of a part. However, there are many situations where a 2D image is a better solution for a focused need. As a consequence, many users are redundantly creating drawings from the model. In fact, suppliers that receive models from their customers usually create their own drawings for efficient internal usage.

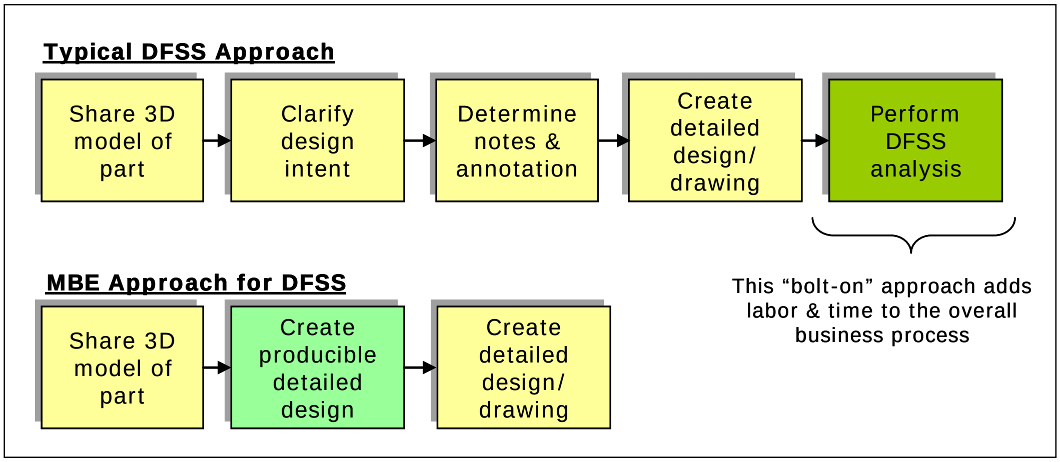


It’s best to think of the relationship between a CAD model and its drawings as analogous to the relationship between a management database and its reports. For example, by having source data in a database, you can run queries to answer questions not previously anticipated. Nevertheless, many users are most efficient by using standard reports that quickly provide them with common information. Likewise, a 2D drawing is similar to a standard report in that it enables the majority of users to quickly get to the information they need.

Companies that are succeeding in the MBE recognize that taking a practical approach and achieving results is better than following the “all model” dogma and discovering downstream holes in their products. They use “reduced detailed drawings” to complement their solid models and realize a combined richness of information that is not possible from either by itself.

3. Engage manufacturing in model-based design

One of the expected benefits from sharing a 3D representation of the part is that it accelerates understanding of design intent. More importantly, it provides the ability to have manufacturing involved earlier in the product development lifecycle. For example, Design for Six Sigma (DFSS) requires engineering to consider process capabilities in relation to design expectations. With the use of a drawing-centric approach, manufacturing engineers are typically not involved in the process until drawings are created. Thus, a producibility or cost assessment typically takes place near the end of the design process as a “bolt-on” activity during an obligatory DFSS tollgate review. In addition, since the manufacturing review often means changes to the design, this approach in effect creates “rework” late in the lifecycle for the design engineer. The bolt-on approach, while better than no manufacturing input, does not represent a truly integral collaborative exchange process.



With MBE, the 3D CAD model should act as the centerpiece for technical collaboration. This enables informed consideration of cost and producibility in an integral way during the model's formative stage. This effectively eliminates the bolt-on approach, and as importantly transitions the role of manufacturing from being "design auditors" to actually helping to complete the detailed design.

4. Connect engineering knowledge to models

The MBE vision implies engagement in the full spectrum of available engineering knowledge. That is, the manufacturing engineers, process engineers, and quality engineers all participate in bringing their experience to bear during the review of the model. Unfortunately, most companies have a tradition of "tribal knowledge", which is dependent on the accessibility and skill of selected individuals.

With MBE, it is important to both preserve the engineering knowledge in digital format and use tools to capture, apply, and share it. For example, the understanding of process capabilities and limitations, and the documentation of known design practices and constraints are essential pieces of knowledge that are seldom well documented. This captured knowledge, when coupled with a common interpretation, consistent application, and ease of access/reuse provides a common starting point during design.

The CAD model provides access to specific part characteristics that enable an unprecedented ability to apply digital engineering knowledge. By applying and integrating knowledge at the characteristic-level, the MBE – with the proper tools – becomes a critical enabler of DFSS, DTC, and DFMA.

5. Focus on the complete Technical Data Package

Even though the 3D CAD model is the core of the design, it is important to remember that it does not represent the complete definition of what is needed to deliver a producible part. A complete technical data package (TDP) consists of the model, accompanying drawing(s), and all associated narrative documents and references (e.g., material and process specifications). The expectation that a supplier can deliver a component that fully meets design intent solely from a solid model places an unwarranted burden on the supplier and introduces unnecessary risk to the product. The recently published National Aerospace Standard for TDPs defines a technical data package as:

> *"The collection of data enabling design, production, delivery, and/or maintenance that communicates a customer's product definition, performance criteria, and method of verification to the source(s) of the deliverable. It functions as the vehicle to quantify, define, and provide a deliverable; and to verify that the deliverable meets the customer's expectations."*

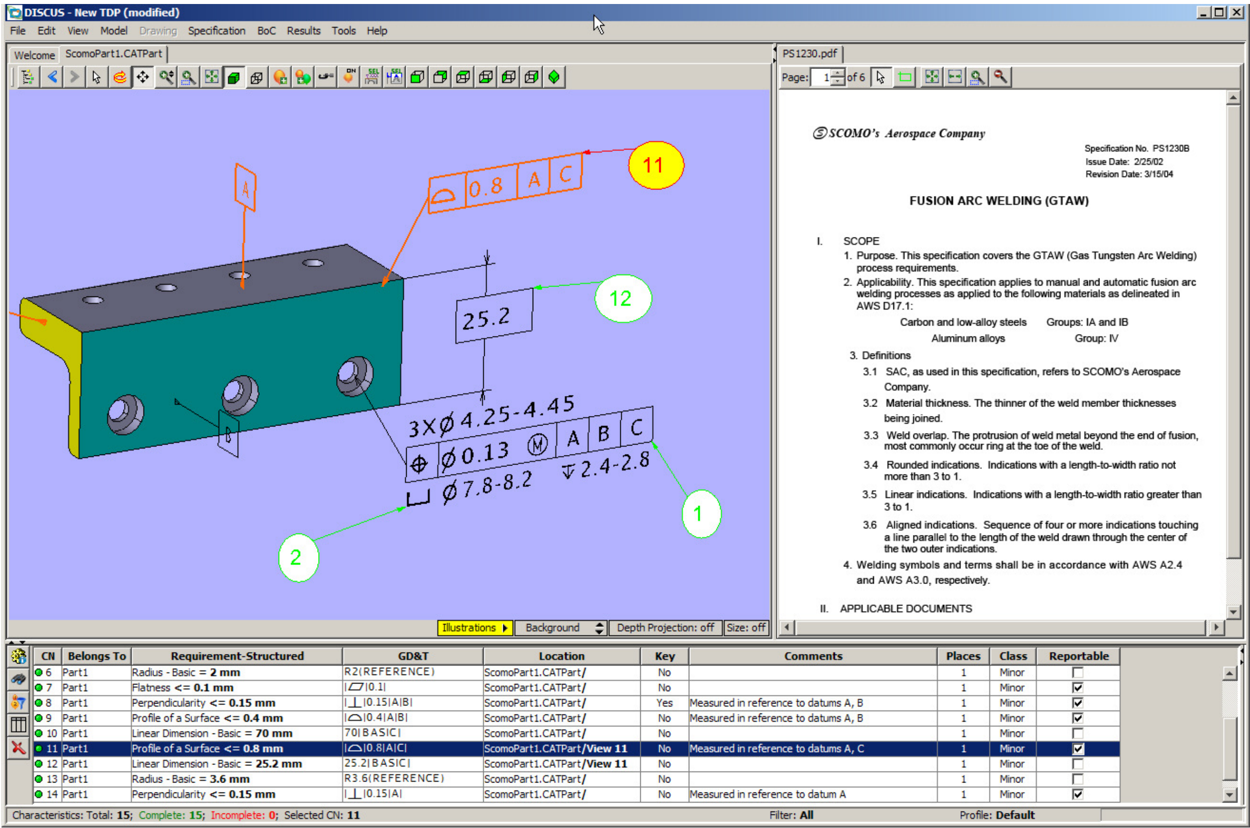
This definition is as applicable in the Model-Based Enterprise as it is for traditional legacy designs.

Applying the Five Secrets: A Case Study

A recent effort with a major aerospace and defense company applied the five secrets in conjunction with an enabling technology geared to facilitate their application. By working directly with the 3D model as the design evolved, the combined engineering/manufacturing team was able to rapidly identify design constraints as well as process capabilities and manufacturing limitations.

The enabling technology to help unlock these secrets is beginning to emerge. It serves as the technical platform for integration of process knowledge with design practices in the MBE. The system is "CAD neutral," allowing the manufacturing engineer to receive, evaluate, and annotate a solid model during that dynamic period when a part approaches detailed design.

Using the combined design and manufacturing knowledge, the system both stores and dispenses essential process insights, specification references that apply to individual processes, and design constraints. It then enables the application of this knowledge as direct characteristic-level annotations to the model. These annotations are then systematically captured in a "bill of characteristics" that allows them to be managed going forward over the product lifecycle.



The combined knowledge of the entire team was fully leveraged with a focus on the necessary documentation (i.e., the TDP) to ensure that models are adequately supported to avoid ambiguity and uncoordinated interpretation by the supply chain. The end result was the definition of very producible designs with substantially reduced product development cycle.

Conclusion

The companies that have incorporated the lessons learned from incorporating MBE are moving towards a consistent business process that enables them to realize dramatic time and labor savings. By applying software tools such as DISCUS, Renaissance Services has worked with numerous aerospace companies to help them achieve the promise of the Model-Based Enterprise. To learn more about how it can work for you, contact:

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