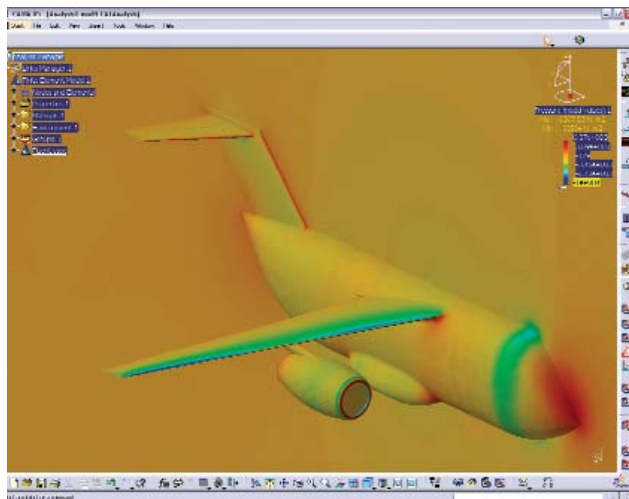


# How Rapid Flow Modeling Benefits Product Design

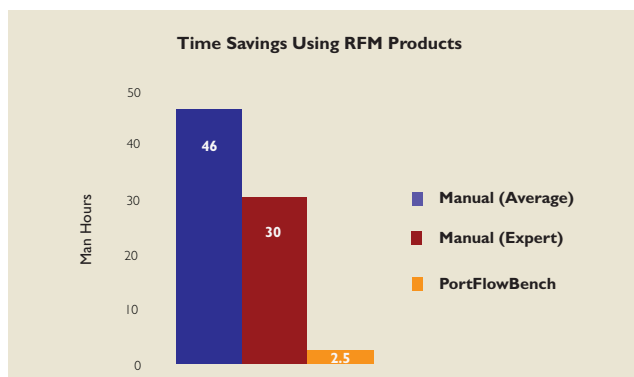
By André Bakker, Rapid Flow Modeling Manager, *Fluent Inc.* and Paul Bemis, VP of Marketing, *Fluent Inc.*

Historically, CFD has been applied as a forensic tool for resolving problems or improving existing product designs. However with ever-increasing computational speed and continued improvements in CFD modeling fidelity, the opportunity now exists for CFD to be applied early in the design cycle, quickly and efficiently. This alternative approach of using CFD analysis to lead the design process is called Rapid Flow Modeling, or RFM. It enables design engineers to optimize new product designs on their desktops far in advance of building physical prototypes.

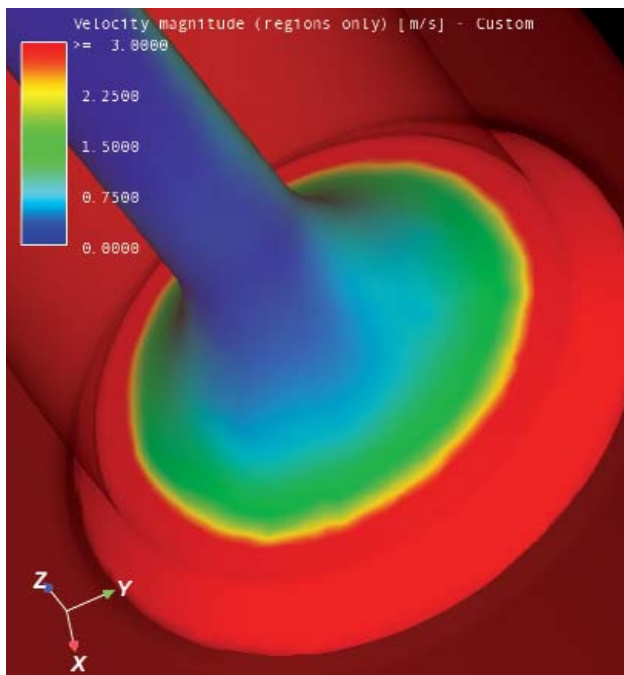


Fluent's latest Rapid Flow Modeling tool:  
FLUENT for CATIA V5

RFM is transforming the role of fluid flow analysis from a troubleshooting tool to a predictive tool, allowing for the consideration of many design alternatives in the early stages of product development. This approach allows for more innovative and imaginative designs and lowers downstream costs in both manufacturing and field warranty.



The time savings of an application specific rapid flow modeling tool are shown here. In the PortFlowBench tool, the designer can load the geometry of his newly designed cylinder air intake system. The engineer only needs to provide inputs specific to the range of operating conditions that he wants to analyze. No CFD specific inputs are needed; these are all handled automatically behind the scenes. The bar chart shows the dramatic time savings that can be achieved. Using fully manual CFD software, performing two analyses would take an average user 46 hours, and a CFD expert 30 hours. The customized rapid flow modeling tool reduces that time to less than three hours.



Velocity magnitude on the piston calculated by the custom PortFlowBench rapid flow modeling tool

It is well known that a majority of the costs of product development are committed in the early stages, when only a small percentage of project time has been expended. If poor design decisions are made at this time, the downstream costs to correct them far outweigh the costs to adjust the design early on. Rapid Flow Modeling provides the design community with an important tool that can aid the design decision-making process by allowing candidate designs to be functionally simulated prior to physical prototyping.

Companies that have adopted RFM methods exhibit a distinct competitive advantage in the market because it enables them to consider more designs, study the performance of each one without the need to create prototypes, eliminate bad designs early, and have high confidence that the final design decision will result in a successful end product.

Rapid Flow Modeling technology was developed as part of Fluent's mission to bring CFD to the broader engineering design market to compress overall engineering time and increase development efficiency. Years of deep modeling experience and well-understood techniques have been encapsulated into completely new, highly-automated analysis tools, such as FloWizard and FLUENT for CATIA V5. These tools let designers quickly and efficiently turn their CAD models into CFD analysis results.

To accomplish this, the RFM products focus on the

physics most commonly encountered in product design, such as compressible and incompressible fluid flow, laminar and turbulent conditions, heat transfer, and flows in both stationary equipment and rotating machinery, such as pumps and fans. Tasks that often require a lot of user interaction are fully automated. Not only does this save time, it also leads to a significantly reduced learning curve.

The power of the new RFM technology can be substantially increased through customized interfaces to analyze a specific company's products. For example, a manufacturer of engine parts could use an interface specific to the modeling of its most common components. An engineer would send the CAD model to the customized RFM software and specify which component is being analyzed. The software would then let the user pick other parts from the company parts database with which the new component interacts and ask which variables are to be optimized. Behind the scenes, the software automatically determines the pertinent model setup parameters and performs the analysis on the user's desktop computer. Often these computations can take time, so Fluent also offers the option of performing the calculations from anywhere in the world on its secure Remote Simulation Facility. This option speeds computations significantly by executing them on a high-performance computing (HPC) cluster while freeing the user's desktop computer for other tasks.

The increasingly intimate relationship between RFM and the CAD system opens the door to a more advanced design optimization approach. For example, if the original CAD design was created using certain parameters, the opportunity exists for those parameters to be used in an optimization study at any point in the design process.

In the early stages of product development, various design alternatives are assessed using CFD and other factors. As the design alternatives narrow, the analyses performed involve more complex physical phenomena. These simulations may include optimization to consider issues ranging from material cost to extreme use conditions. The output from the analyses can be tailored to provide the information required in the company's specific design process and can also be formatted to meet company standards. Automating many of the standard modeling procedures makes CFD analysis much easier to perform and opens the door for widespread deployment of CFD as a decision-support tool throughout the entire design process. ■