

Simulation-Based Innovation as a Competitive Advantage

Predictive analysis tools save time and money at Xerox and, more important, enable top-line revenue growth and the competitive advantage that comes from developing winning products.

By Korhan Sevenler, Director Product Lifecycle Management, Xerox Corporation, New York, U.S.A.
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Korhan Sevenler

Xerox Corporation was built on innovation, defining an industry with the introduction of the first plain paper photocopier using a new electrographic process it called xerography. Innovation remains at the foundation of the \$17 billion company as the world leader in document duplication and management. In the face of fierce global competition, Xerox provides the industry's broadest portfolio of offerings. Digital systems include color and black-and-white printing and publishing systems, digital presses and "book factories," multifunction devices, laser and solid ink network printers, copiers, and fax machines.

Engineering simulation is vital in developing this expanding range of products. Predictive tools ensure that high quality standards are met and reduce the number of prototype testing iterations, each costing tens of thousands of dollars and weeks of time. More profoundly, simulation enables top-line revenue growth and the competitive advantage that comes from developing innovative, winning new products.

Design for Lean Six Sigma

One of the latest and most far-reaching engineering initiatives is the Xerox Design for Lean Six Sigma (DFLSS) strategy. The program was instituted in 2005 following the start of

the company's Lean Six Sigma in manufacturing 18 months earlier. At the heart of DFLSS is the capability to perform numerous design of experiments (DOEs) to study the sensitivity of changes in key product variables such as part manufacturing tolerances, operating temperatures of the machines or differences in print media. The idea is to arrive at a robust design — one that delivers defect-free performance in spite of these variations by taking the guesswork out of design and shifting the focus to optimization up front in development.

ANSYS DesignXplorer technology holds great potential in the Xerox DFLSS efforts by enabling engineers to readily set up these DOE studies, assess design sensitivities through response surfaces and quickly develop robust designs. The speed and ease of use of the software fits right in with the program of instilling DFLSS throughout the company's engineering ranks and increasing overall efficiency of engineering operations.

Simulation-Based Product Development

All Xerox products are developed using leading-edge analysis tools. ANSYS Mechanical software is one of the primary analysis tools for advanced simulation, particularly in multiphysics applications in which multiple physical factors must be evaluated. ANSYS CFX



Structural analysis of interconnected parts and assemblies was of critical value in developing the iGen3 digital printing system — one of the most complex systems ever developed by Xerox.

and FLUENT products, likewise, are used for computational fluid dynamics studies, and ANSYS DesignSpace technology is an ideal tool in early product development for simulation-based design to assess alternative concepts and to optimize designs up front in the cycle. Xerox is moving toward greater use of the ANSYS Workbench interface, which is consistent with the approach of engineers performing their own analysis, rather than having a central group for that function.

Software from ANSYS was instrumental in developing the iGen3 digital printing system, enabling Xerox to penetrate the commercial printing market with image quality “look and feel” comparable to offset presses — yet with a faster speed, greater economy for short-run press jobs and the ability to customize each page. More than \$1 billion was poured into the R&D project, which resulted in greater than 400 patents on a product that was the most complex system ever developed by Xerox and that pushed the limits of speed and performance.

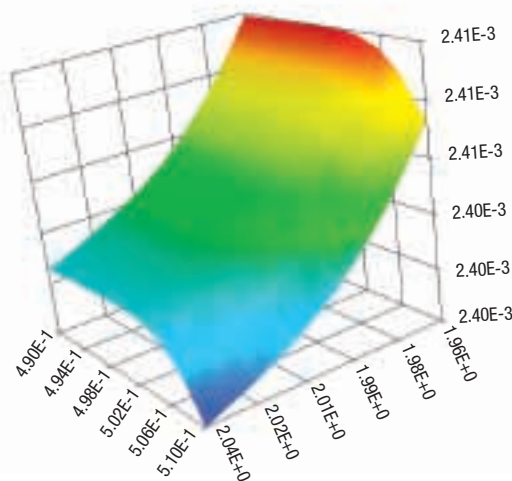
Structural analysis of numerous interconnected parts and assemblies was of critical value during the design of the iGen3. By shifting engineering efforts up front as much as possible, engineers could more readily study product performance, spot potential problems, evaluate alternatives and refine the design to avoid problems later. Using engineering analysis and DFLSS methods, Xerox brought the iGen3 to market on time while keeping

costs in line and maintaining quality and reliability. The machine is now regarded as one of the company’s premier flagship products and a major source of revenue.

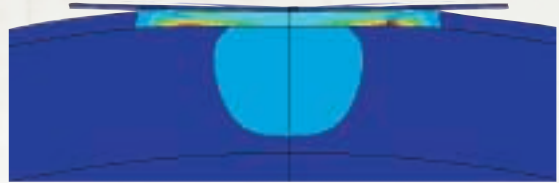
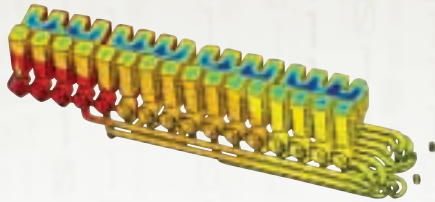
Overcoming Organizational Obstacles

In many respects, implementing the tools and technologies for simulation-based product development is easier than overcoming organizational obstacles across a large, distributed enterprise. One of the challenges is in securing funding and time in the development cycle for up-front simulation. Traditionally, engineering groups have been set up to complete designs as fast as possible, with incentives based on productivity and speed in performing these tasks.

In contrast, the simulation-based design process focuses on spending more time early in the cycle to analyze and refine designs, thus saving time and expense downstream through reduced reliance on



ANSYS DesignXplorer study of a deformation of a polygon mirror used in a complex digital printer



Xerox engineers use ANSYS Mechanical software in a wide range of analysis applications such as these studies of heat transfer (left) and contact analysis (right).

prototype testing cycles and less last-minute troubleshooting. Over recent years, Xerox has made great progress in moving to up-front modeling and simulation in order to reduce physical prototypes. Training for DFLSS has been especially effective, beginning first with the enthusiasts and then extending to those who recognized the value of DFLSS in their professional development.

Communities of Practice

One of the challenges for a large organization is that professionals generally have only limited opportunities to exchange ideas and share their knowledge. Xerox addressed this issue with Communities of Practice: knowledge networks through which people with common specialties (engineers, sales, marketing, equipment repair, etc.) can discuss best practices, experiences, tips and solutions to problems.

As part of this effort, Xerox holds an annual company-wide two-day forum for engineers on modeling, simulation and DFLSS. Speakers from within the company, as well as outside experts, are invited, and ample free time and break-out are provided for informal networking and information exchange. The company also hosts monthly “Lunch and Learn” sessions, in which engineers meet to hear about and discuss the latest simulation approaches and methods.

Driving Innovation with Simulation-Based Processes

One of the greatest values of Communities of Practice for Xerox is that

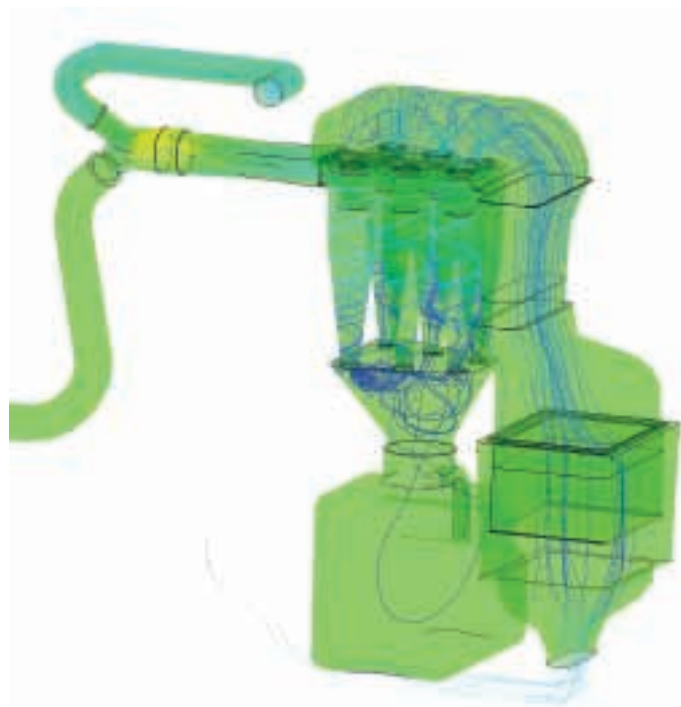
engineers can discover how to best utilize simulation tools and techniques such as DFLSS and DOE in the product development process — not solely to save time and money but also to explore alternatives, try out different ideas and run through numerous what-if scenarios.

From that type of environment comes the stimulus for innovation needed to maintain a competitive edge. In this respect, simulation-based approaches today are analogous to what happened in Thomas Edison’s lab in New Jersey, United States. Considered one of the most prolific inventors in history, Edison didn’t just sit around

dreaming up innovations, such as the incandescent electric light bulb; instead, he had a process of experimentation in place and workers to carry out his directions.

Likewise, simulation technology today enables engineers to be their own innovator, trying out different ideas efficiently to see what works and what doesn’t. By zeroing in on the good ideas and iteratively refining concepts with multiple experiments, engineers today can leverage the speed and accuracy of simulation in driving product design innovations, which are the foundation of industry-leading companies. ■

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Particle trajectories in a printer emissions control subsystem were simulated by Xerox engineers with ANSYS fluid analysis software.