"Using HEEDS, we are able to discover much better designs than we could when we used a manual FEA approach. Also, we are able to rule out concepts that are not feasible, because we are confident that HEEDS has thoroughly explored the design space for each concept."

Arun Nair
Project Engineer
Corporate CAE Group

Adoption of HEEDS improves BD's design process, increases customer satisfaction and inspires innovative technologies

BD is a leading global medical technology company that develops, manufactures and sells medical supplies, devices, laboratory instruments, antibodies, reagents and diagnostic products. The company is focused on products and technologies that improve people's health throughout the world. BD is a Fortune 500 company that employs approximately 29,000 people in more than 50 countries throughout the world.

To date, the use of HEEDS at BD has enabled the identification of product designs that have resulted in significant cost savings, superior acceptance in customer user studies, and identification of innovative technologies.

BD's Design Process before HEEDS

Before HEEDS was adopted as the in-house optimization tool, the Corporate CAE group at BD performed discrete analyses to evaluate new design concepts or variations of existing concepts to ensure the desired part functionality. Each discrete study required the design engineer to provide the CAD geometry for the iteration and the CAE analyst to manually set up each simulation.

This iterative process significantly limited the number of designs the group could evaluate before the best design had to be selected to meet the product development timeline. More importantly, the product development space was not explored in the most effective fashion to determine the optimal design that would meet the product requirements in a robust manner.

How HEEDS Has Changed the Design Process at BD

"Since the adoption of HEEDS as the optimization code by Corporate CAE, we have had several successes in identifying design solutions using HEEDS in combination with Finite Element Analysis (FEA). These design solutions were sought out but at times not found when using traditional methods like prototyping in combination with discrete FEA studies," says Arun Nair, Project Engineer.

"HEEDS has provided a significant benefit in helping us to better understand the guiding principles behind the product functionality, as well as understand how to optimize these parameters."

Arun Nair
Project Engineer
Corporate CAE Group

The Corporate CAE group began using HEEDS with finite element analyses (FEA) in 2008. Since that time, the group has taken a more active role in the product development process, using HEEDS with FEA models early in the process to evaluate and optimize potential design concepts.

"Using HEEDS, we are able to discover much better designs than we could when we used a manual FEA approach. Also, we are able to rule out concepts that are not feasible, because we are confident that HEEDS has thoroughly explored the design space for each concept," says Nair. Once a few optimal design concepts have been identified from rigorous HEEDS studies, physical prototypes are built to confirm the product performance.

How HEEDS Contributes to BD's Success

The Corporate CAE group finds HEEDS easy to use, because SHERPA, the powerful optimization algorithm within HEEDS, does not require expertise in optimization to establish parameters for the optimization studies. All of the engineers on the team are comfortable using HEEDS.

"SHERPA is so flexible that we can focus on solving the design problem at hand without worrying about adapting the problem definition to match the optimization method. Also, SHERPA's efficiency allows us to quickly explore different design concepts without having to build expensive design prototypes at the initial phase of the project. We tried using response surface methods from other tools, but these did not work well on the kinds of problems we regularly encounter. However, SHERPA has performed very well for BD's applications," says Nair.

Corporate CAE Group Manager, Anita Bestelmeyer, agrees that SHERPA has been a key technology for solving unique design problems: "The HEEDS optimization algorithm has proven to be successful in solving technically challenging problems in a robust and efficient fashion. The ability to combine this powerful optimization code with our simulation codes to smartly and comprehensively explore highly non-linear design spaces is extremely powerful."

Finally, HEEDS provides an environment where optimization, DOE, and robustness studies can easily be performed on the same problem. It requires minimal effort from the CAE analyst's side to switch among the Optimization, DOE and Robustness assessment modules.

"HEEDS has provided a significant benefit in helping us to better understand the guiding principles behind the product functionality, as well as understand how to optimize these parameters. We also use HEEDS to identify critical

"Since our group adopted the practice of combining HEEDS optimization software with simulation two years ago, the strategic value that we can provide to the BD product development community has accelerated dramatically."

Anita Bestelmeyer
Manager
Corporate CAE Group

drivers and to determine design sensitivity and robustness," says Nair. This innovative process has significantly reduced the time and cost for new product development at BD, especially by identifying unique solutions through hundreds of virtual iterations instead of relying on costly and lengthy trial-and-error methods.

"In my 20 years with BD, I have directly observed how simulation can play a role in delivering high-quality and robust products to market faster. Since our group adopted the practice of combining the HEEDS optimization software with simulation two years ago, the strategic value that we can provide to the BD product development community has accelerated dramatically," says Bestelmeyer.

Specific Problems BD Has Solved with HEEDS

Next-generation Syringe

For one of its next-generation syringe concepts, BD used HEEDS to identify a design that would result in a minimum assembly force and a maximum disassembly force. The Corporate CAE group used HEEDS in combination with FEA to drive the dimensions of the component feature to best meet the product requirements. Prototype testing confirmed that the performance of the selected design was in agreement with the FEA predictions.

The selected concept was unanimously chosen in a user study over the competitor's design based on the superior product performance, giving BD a significant competitive advantage. Due to the success of this effort, the product development team decided to use simulation-based Optimization, DOE and Robustness assessment studies to determine optimal and critical-to-quality dimensions for different sizes of this next generation syringe.

Two-component engagement mechanism

BD also used HEEDS to identify a design for a two-component engagement mechanism with a consistent range of forces and an audible click to indicate proper insertion. The project also involved switching an existing metal component to a plastic component to reduce cost. Several months of efforts employing traditional design/FEA approaches had not identified a plastic design concept that met all of the requirements.

BD's Corporate CAE and product development R&D groups worked with Red Cedar Technology on this effort. HEEDS identified several feasible plastic designs. The final prototype design was further evaluated through DOE studies to establish critical dimensions and robustness assessment studies, to ensure that the identified design would result in a consistent performance for the expected dimensional tolerances.

"I believe that we have only begun to realize the potential of using simulation-based optimization techniques in achieving BD's growth and innovation objectives. We look forward to exploring new ways to leverage this novel technology to drive innovation and impact BD."

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Extensive prototype testing revealed that the identified design would meet all of the product requirements. BD launched the new product in 2010 with an estimated cost savings in the millions of dollars.

"I believe that we have only begun to realize the potential of using simulation-based optimization techniques in achieving BD's growth and innovation objectives. We look forward to exploring new ways to leverage this novel technology to drive innovation and impact BD," says Bestelmeyer.

BD's Corporate CAE Group. Back row (left to right): Gayle Rose, Arun Nair, Siva Balasubramaniam, Patrick Downie. Front row (left to right): Ingrid Bowman, Anita Bestelmeyer, Beth Israelnaim.