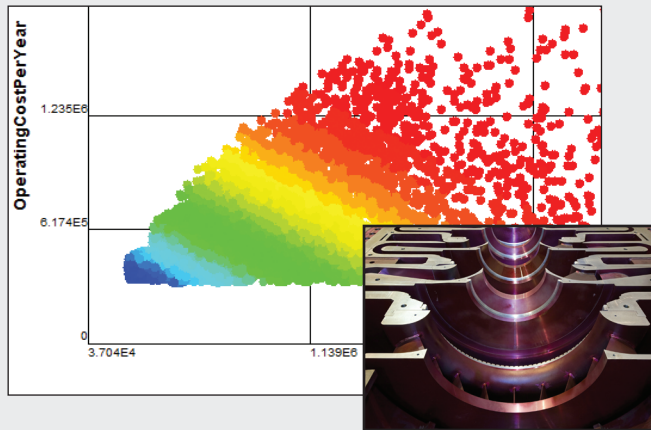


Analysis of Alternatives in PHX ModelCenter Enables Rapid Selection of Optimal Centrifugal Compressor Configuration

Challenge: Identify Best Design Alternative to Meet Customer Demands



A manufacturer must respond to a customer's demand for an industrial centrifugal compressor factoring a set of inlet conditions—flow rate, gas composition, pressure, temperature—and desired outlet conditions. Highly-engineered turbomachines, industrial centrifugal compressors vary greatly in configuration from order to order. The manufacturer must size the machine according to diameter of each stage, number of stages, and shaft speed before parts can be made or, if needed, further detailed design. Many basic configurations will fit the requirements. The challenge is to quickly identify the best alternatives when many variables can be changed across a very wide design space. All alternatives must be assessed to arrive at the optimal machine configuration while achieving the best performance with minimized risk, equipment cost, and annual operating cost.

Solution: PHX ModelCenter Integration for Analysis of Alternatives to Optimize Selection Process

PHX ModelCenter was used to provide the integration and trade-study environment necessary to create a useful system model. Once a combination of file-wrapped components, custom scripts, and Excel plug-in components was integrated in PHX ModelCenter, various Analysis of Alternatives (AoA) trade studies were performed to optimize the selection process. A Design of Experiments (DOE) study was first performed using a relatively wide design space. The DOE produced a table of results, which could then be analyzed using several visualization tools available in PHX ModelCenter, including Data Visualizer. With Data Visualizer, a manual optimization problem was created to calculate constraints and a weighted sum of objectives: risk and cost. Though thousands of alternatives were considered, Data Visualizer color-coded the best and worst designs making it easier to quickly pinpoint the best design alternative. Once the best design was established, further optimization was performed using PHX ModelCenter's Design Explorer, a surrogate-based

optimization tool, to find an even more efficient distribution of diameters and speed. As a result, the optimum configuration was found quickly despite the initially wide design space.

Benefit: Easily Reduce Thousands of Design Choices to the Best Alternative

PHX ModelCenter is a decision support environment for performance, cost, and operational assessments, offering unique trade study, visualization, and optimization tools specifically designed for AoA and used frequently by engineers and analysts who are evaluating multiple design concepts. By enabling AoA for sizing and cost analysis, thousands of design choices were quickly and easily reduced to the best few alternatives. In addition to time savings, the economic implications of pinpointing viable design options at the conceptual stage are significant. By conducting AoA in the conceptual phases of design, time is not wasted on infeasible or weak design possibilities. Instead the optimal machine configuration, factoring all requirements and desired outcomes, can be determined efficiently and effectively.