Dresser-Rand: Impeller Stress Reduction

Overview
Impellers are common tools used in various applications including vacuums, pumps, and compressors. Dresser-Rand is a global technology corporation with an emphasis on energy conversion equipment such as compressors and other equipment with rotational elements. Dresser-Rand is interested in decreasing the stress that is experienced by the impeller in the company’s popular centrifugal compressor through geometry changes to the impeller cover and surrounding disk while maintaining the blade shape and performance.

Objectives
The team will generate concepts to modify the geometry and model those changes using Computer-Aided Design (CAD) software. The effect of these changes will be gauged by the percentage change in the von Mises stress as compared to the reference case, using Finite Element Analysis.

Approach
- Initially, the original impeller was modelled and analysed to establish the baseline case.
- Consumers of the compressor were interviewed to determine important design specifications.
- Using that information, key areas of concern were identified with the Analytical Hierarchy Process.
- An external search was completed that evaluated existing products and literature, combined with a sponsor visit to understand the manufacturing process.
- An iterative concept generation process was used to design new ideas and test the effectiveness of each individual concept.
- An analysis was done on each design using FEA and these results were compared to the baseline case and the other concepts.
- With all of this information, the concepts were scored and the top concepts were selected.
- A final design was modelled in SolidWorks and analysed using FEA. The results were validated through hand calculations.

Outcomes
- The final design is a combination of the top concepts.
- The design maintained material usage and manufacturability to be approximately consistent with the baseline model.
- The resultant stresses were reduced by as much as 10% in identified problem areas.
- Performance is unaffected due to the unchanged blade shape and the symmetry of the modifications.