

# Carrier Uses aPriori to Generate Should Cost Models for Components with Complex Geometries



CASE STUDY

Carrier has identified an annual savings opportunity around \$200,000 for a set of screw compressor rotors. aPriori's digital manufacturing simulation technology is used for should cost analysis on many components at Carrier. These savings stem from just one rotor set. In another case, the should cost team was able to realize over \$1 million in annual savings based on a single cost modeling iteration.

## THE CHALLENGE

### Modeling Manufacturing Costs for Complex Parts Requiring Multiple Manufacturing Processes

The should cost professionals at Carrier face the difficult task of analyzing and optimizing costs for a diverse range of products. These products require different manufacturing processes including casting, sheet metal bending, wire harnesses, PCB assembly, and additive manufacturing.

The cost engineering group's mission is to optimize product cost and value through both improved supplier negotiation and more cost-effective design. Employing subject matter experts for each category of manufacturing process listed above, Carrier's cost engineering group works directly with design engineers and supply chain representatives throughout the organization to identify cost drivers and the potential for value-driven improvements.

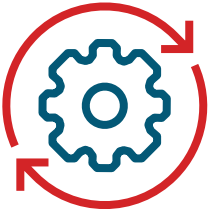
The screw rotors inside the compressors are difficult to manufacture. They feature complex geometries with extremely high tolerances. The rotors require multiple production processes including gear hobbling, grinding, stock machining for tail shafts, and a sand-casted male rotor. They must be precisely manufactured for a perfect fit that avoids binding. Surface finishes on the rotors, tail shafts, and bearings must also be manufactured to high-tolerance requirements.

Tools like Excel spreadsheets or traditional should cost software were not well-suited to generating accurate manufacturing cost models for this high-tolerance, multi-faceted production process.

**Precisely modeling manufacturing costs for this assembly without the capability to analyze an actual 3D model was simply not possible.**



Carrier manufactures products across three primary market segments: HVAC (both residential and commercial), refrigeration, and fire/security. Across these markets, Carrier generates nearly \$20 billion in sales, employing 50,000 people to support 80+ brands across its global operations.



They utilize 80+ digital factories in their aPriori implementation, taking full advantage of the capability **to generate should cost models across the full range of manufacturing processes** required by their products.

## THE SOLUTION

### Deploying aPriori's Digital Factories to Simulate Manufacturing for Carrier Designs

Carrier identified aPriori as the technology for this manufacturing cost modeling challenge. Carrier's cross-functional should cost team uses aPriori to tackle a wide range of manufacturing cost modeling projects. **They utilize 80+ digital factories in their aPriori implementation, taking full advantage of the capability to generate should cost models across the full range of manufacturing processes required by their products.**

In addition to utilizing aPriori's customizable digital factories, they have developed several in-house manufacturing cost models to reflect some of Carrier's unique designs and production requirements. aPriori's configurable digital factory approach has allowed Carrier's should cost professionals to build detailed, highly accurate models of suppliers' costs for rotor manufacturing. These manufacturing cost models are based on the precise tolerances required by Carrier for every aspect of the design.

For instance, the added manufacturing time required by cylindrical grinding and sand casting for compressor rotors is a prime cost driver for these components. Never before has Carrier been successful in generating a precise manufacturing cost model of this essential cost driver. The use of aPriori's simulated manufacturing, based directly on a 3D model of the rotor, is a game changer for Carrier's should cost team.

## THE RESULTS

### aPriori Manufacturing Cost Models Drive Substantial Savings for Parts from Third Party Suppliers

A year after the technology's initial deployment, aPriori's approach to digital manufacturing simulation has already allowed Carrier to identify substantial savings opportunities.

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aPriori also facilitates more data-rich collaboration with the product engineers who bring requests to the costing team. Cost engineers can use aPriori's digital simulated manufacturing technology to precisely illustrate how cost drivers are interacting to generate the final manufacturing cost model.

Carrier's implementation of aPriori was initially focused on bringing down supplier costs. In the near future, they plan to provide insights to engineers earlier in the design process to maximize savings.

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The substantial ROI from aPriori's enhanced manufacturing cost modeling capabilities has **illustrated the business imperative** for an expanded should costing group.

## NEXT STEPS

### Leveraging aPriori for Faster Quotes, An Organizational Component Library, and an Expanded Should Costing Unit

Carrier's should cost team is actively planning to leverage aPriori's capabilities to generate even more value across the organization. **A near-term priority is using aPriori digital factories to achieve a near-zero RFQ time with key suppliers.** Once a digital factory is specified to a particular supplier, digital manufacturing simulation can be used to achieve an extremely fast, accurate quote for new RFQs.

**The should cost group also plans to use aPriori to automate an organization-wide component library.** Carrier uses a huge array of components across its many business units. Experience has led to insight into these components' costs, but this data is currently not systematically organized and available for the broader organization. By using aPriori as a repository for these components and their manufacturing cost models, Carrier will automate crucial knowledge available for business units across the entire organization.

**Finally, the substantial ROI from aPriori's enhanced manufacturing cost modeling capabilities has illustrated the business imperative for an expanded should costing group.** Creating localized should cost teams for Carrier's many different geographic marketplaces will help generate more accurate manufacturing cost models based on more granular knowledge of supplier capabilities in specific localities.



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