

Parametric Modeling for Lead Time Reduction in High-Mix, Low-Volume Applications

LFMcapital

BUSINESS PROBLEM

Volumetric manufactures custom filling equipment for food/ beverage production. Lead times exceed 6 months, causing customers to purchase from competitors offering shorter delivery. The core issue: engineers rebuild CAD models from scratch for each customer configuration (40 days per design), and high error rates require 30-50% of assembly time for rework. With 3000+ possible machine configurations but only ~10 units sold annually, the company needs to dramatically reduce engineering time and error rates to remain competitive and increase revenue.

DATA SOURCES

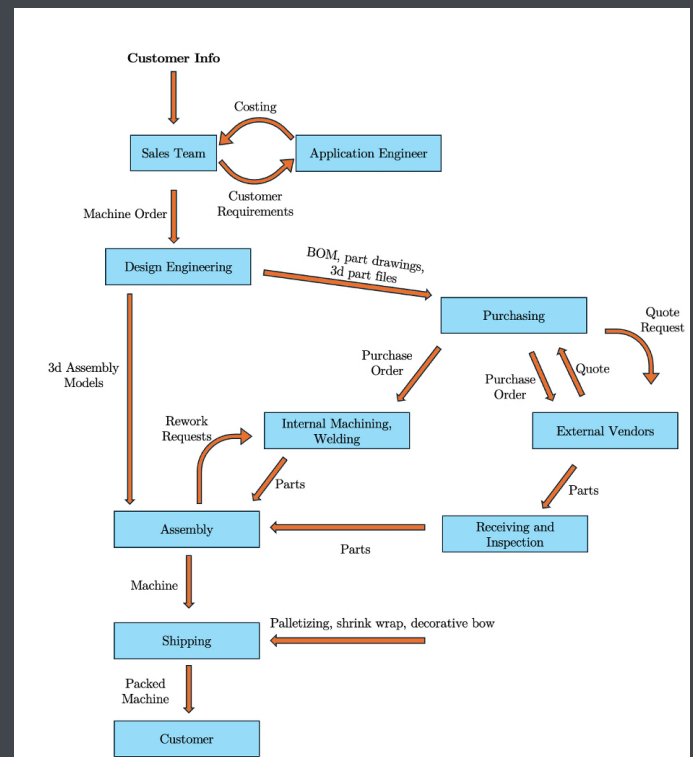
1. GEMBA walks
2. Limited time studies
3. Interviews with all areas of the company

Data Types and Format

Unstructured

APPROACH

Data was gathered through GEMBA walks and by embedding inside the engineering design and assembly groups. In this high-mix low volume shop, architecture across machines is highly similar and changes can be characterized by only 13 key variables (lane count, piston size, temperature, etc.) A production ready parametric CAD model was created in SOLIDWORKS for the highest value product family at Volumetric, complete with engineering drawings and 3d CAD files. Configurations are controlled through a shared .txt file, through part sketches, or through external software such as DriveWorks.



IMPACT

Engineering Design Time: Base filler model build time reduced from 40 days to under 2 days (95% reduction), with the actual model rebuild completing in under 20 seconds. Overall project engineering time is projected to drop from 61 days to 23 days--a 62% reduction. The broader design phase is expected to shrink from 9 weeks to 3 weeks.

Assembly Time: Assembly is projected to decrease from 9 weeks to 6 weeks (33% reduction), driven primarily by fewer design errors propagating to the shop floor. Previously, 30-50% of assembly floor time was consumed by rework traced back to CAD model defects such as interferences or mis-sized clearances. The parametric model eliminates entire categories of these errors by computing sensitive dimensions (e.g., thermal expansion clearances, port sizing) automatically rather than relying on manual entry.

Overall Lead Time: Total project timeline is expected to drop from 31 weeks to approximately 22 weeks, moving Volumetric closer to its goal of shorter, more competitive delivery windows. Sales leadership reported that customers frequently chose competitors solely based on lead time, so this reduction directly supports revenue growth.

Scalability and Standardization: A single parent model now covers 3,000+ configurations, replacing a fragmented library of one-off models. This eliminates evolutionary divergence, improves part interchangeability, simplifies spare parts inventory, and reduces costs. Design updates and defect fixes propagate uniformly across all configurations from one source, rather than requiring redundant corrections across dozens of individual models.



DRIVERS

Lead time is a driving factor for customer purchase decisions. A major root cause of long production times is inefficient engineering methods that consume weeks and introduce errors at higher than desirable rates. By parameterizing models, the key driving features for each customer can be used to automate CAD modeling and improve this process.



BARRIERS

Takes time of over 6 months alongside limited order volume constrains the ability to test and iterate with the solutions created. Simulated orders were used for testing, but none were physically built due to internship duration constraints.



ENABLERS

Team is flexible and open to innovation and progress. This allowed the easy implementation of improvements in the company.



ACTIONS

The first two months were spent learning about the company processes, previous designs, and production resources. This led to a possibility of a parametric approach to modeling, shortening lead time by reducing engineering time while still maintaining more flexibility than a stocked-model approach. A production ready working model was created to showcase this process.



INNOVATION

Unlike traditional designs where each model is built and maintained separately, this approach maintains a parent model as a single source of truth for an entire product family. This approach simplifies version control, part interchangeability, and limits evolutionary divergence with a minimum of effort. Parameters for a new version are entered, and the 3d and 2d models are created in seconds.



IMPROVEMENT

Base filler design time reduced from 40 to 2 days. Overall projected engineering time reduced from 61 to 23 days. Repeated errors fixed permanently, expect to see assembly reduction time from 61 to 40 days.



BEST PRACTICES

Parametric approaches allow for families of products to be designed with a single parent model. This controls divergence, improves handling of common parts, and supports late-stage differentiation and set-based design.



OTHER APPLICATIONS

This framework is applicable to any other high mix area where many similar models are created and where the differences between models can be easily quantified and those variables used to control the CAD.